KG
11365
429

Preliminary Investigation of
Ruling Machine Screw

Discussion of Asteroid No. 112 (Iphigenia)
Elements + Ephemeris 1873 1874
ane of (Felicitas) No 109 Ephemeris 1875–4

KG 11365.429

Preliminary investigation of Ruling Machine Screw.

E.P. micrometer divisions. 1 Div. = about $\frac{1}{2285}$ in.

In $\frac{1}{2}$ revolution
of a

	div. I.	II
1st rev.	47.9	47.4
2nd	47.9	47.6
3rd.	48.0	47.4
4th.	48.0	47.3
5th.	48.0	47.5
	47.98	47.44
	47.44	
	95.42	

In $\frac{1}{4}$ revolutions
of a

I	II	III	IV	V	
23.8	.9	.9	.9	.9	23.88
23.8	9	8	.9	.9	23.86
23.6	.6	.6	.7	.7	23.64
23.8	.7	.7	.7	.8	23.62
					300
					23.750
					95.000

95.42
95.00
95.20
62

95.21 rev = $\frac{1}{2400}$ in.

1

In $\frac{1}{5}$ revolution

19.1	.2	.2	.2	19.18	−.14
19.2	.1	.2	.1	19.15	−.11
19.0	.0	.0	.0	19.00	+04
18.9	.9	.9	.9	18.90	+.14
19.0	.9	.0	.0	18.97	+.07
				45.20	
				19.040	
				95.20	

−.15 sin x	−.04 cos x	Sum	°
−.09	−.03	−.12.	36
−14	+.01	−.13	108°
−00	+04	+04	180°
+14	−01	+.13	252°
+.09	−03	+.06	324°

z = sin x a + cos x b

$-.14 = +.59\,a + .81\,b$

$-.11 = +.95\,a - .31\,b$

$+.04 = +.00\,a - 1.00\,b$

$+.14 = -.95\,a - .31\,b$

$+.07 = -.59\,a + .81\,b$

$\sin^2 x$	$\cos^2 x$	sin x cos x	z sin x	z cos x
+.35	+.66	+.48	−.08	−.11
+.90	+10	−29	−10	+03
+00	+100	−00	+00	−04
+90	+10	+29	−13	−04
+35	+66	−48	−04	+.06
+250	+2.52	~~−106~~ ~~+48~~ ~~−.58~~ .00	−.35	+.13 −.19 −.10

$-.35 = +2.50\,a - .08\,b$
$-.10 = -.08\,a + 2.52\,b$

$-.14 = a - ~~.23\,b~~$ $\quad -.14 = a - .03\,b$
$-.03 = -a + 4.34\,b$ $\quad .00 = -a + 1.07$

$-.17 = +4.14\,b$

$b = -.04$
$a = -.15$

$z = -.15\sin x - .04\cos x.$

Div	x°	sin x	cos x	−.15 sin x	−.04 cos x	Sum	Recips	Div.
0	0°	+.00	+100	−00	−04	−.04	−57100	−.42
10	36	+59	+81	−.08	−03	−11	−20670	−1.15
20	72	+95	+31	−13	−01	−14	−16.320	−1.48
30	108	+95	−31	−13	+01	−12	−19040	−1.26
40	144	+59	−81	−08	+03	−05	−45.680	−0.53
50	180	+00	−100	−00	+04	+04	+57.100	+0.42
60	216	−59	−81	+08	+03	+11	+20.670	+1.15
70	252	−95	−31	+13	+01	+14	+16.320	+1.48
80	288	−95	+31	+13	−01	+.12	+19.040	+1.26
90	324	−59	+81	+08	−03	+.05	+45680	+0.53
100	360	−00	+100	+00	−04	−04	−57100	−0.42

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Discussion of (112)

Assumed Elements. B.M.T.

Epoch Feb. 11.5 1872. Mean. Eq. 1870.0

$M = 156° 13' 42.8''$
$\pi = 337\ 54\ 32.8$
$\Omega = 324\ 02\ 11.6$
$\omega = 13\ 52\ 21.2$
$i = 2\ 36\ 44.0$
$\varphi = 7\ 15\ 26.6$
$\mu = 934.37484''$ 2.9705211
$\log a = .3863237$

156 13 42.80
− 132 06 36.79
24 7 6.01
+ 1 2 17.50
25 9 23.51

M for Sept. 24.5 1870 = 25 9 23.51

156 13 42.8
2 20 9.37
158 33 52.17

$d\Omega = l + \cot i\, \pi \sin(\Omega - \Pi)$
$d\pi = l - \tan \tfrac{1}{2} i\, \pi \sin(\Omega - \Pi)$
$di = -\pi \cos(\Omega - \Pi)$

For 1870

$\Pi = 173° 12' 15''$
$l = 50.''240$
$\pi = .4795''$
$\Omega - \Pi = 150° 49' 57''$

log cot i	1.3406	− log tan ½ i	8.3579n
log π	9.6808	log π	9.6808
log sin(Ω − Π)	9.6878	log sin(Ω − Π)	9.6878
log I	0.7092	log I	7.7265
I	5.119		− .005
l	50.240	l	50.240
dΩ	55.359		

− log π 9.6808n
log cot(Ω − Π) 9.9411n
9.6219
+0.42

$d\Omega = +55.36''$
$d\pi = 50.24$
$di = +0.42$
$d\omega = -5.12$

For 1872 Feb. 20.5

	π			Ω			i			φ			μ	log a	M		
(dt) p	337°	54'	32.8''	324	02	11.6	2°	36	44.0	7	15	26.60	934.37484	.3863237	158°	33'	52.17''
		1	40.48	+	1	50.75	+		0.84						−	21	17.14
	337	56	13.28	324	04	2.35	2	36	44.84						158	12	35.03
Perturbations	+	23	7.83	−		20.08	+		7.10	+ 3		24.25	− .60303		3	37	52.81
				324	03	42.27	2	36	51.94	7	18	50.85	933.77181	.3865706			
													2.9702407	M for Mar. 5	161	50	27.84
													3.5500066				
													5797659				
													1932553				

π 338 19 21.11
Ω 324 03 42.27
14 15 38.84

For 1873 May 28.5

	π			Ω			i			φ			μ	log a	M
Precession	337	54	32.80	324	02	11.60	2	36	44.00	7	15	26.60	934.37484	.3863237 ~~3.5500066~~	158 33 52.17
	+	2	30.72	+	2	46.08		+	1.26						
	337	57	3.52	324	04	57.68	2	36	45.26						
Perturbations	+	24	8.79		−	20.29		+	7.70	+ 6		0.10	+ .20380	.3862604	− 2306.47
	338	21	12.31	324	04	37.39	2	36	52.96	7	21	26.70	934.57864		158 10 45.70
													2.9706159		
													3.5500066		
													5793907		
													1931302		

Constants.

	1870	1872	1873
Ω	324 02 11.60	324 03 42.27	
$\Omega - n$	144 02 11.60		
$\tfrac{1}{2}(\Omega - n)$	72 01 5.80	72 01 57.13	
i'	2 36 44.00	2 36 51.94	
ε	23 27 22.30	23 27 21.86	
$i+\varepsilon$	26 04 06.30	26 04 13.30	
$i-\varepsilon$	20 50 38.30	−20 50 29.42	
$\tfrac{1}{2}(i+\varepsilon)$	13 02 3.15	13 02 6.65	
$\tfrac{1}{2}(i-\varepsilon)$ −	10 25 19.15	−10 25 14.71	

	1870	1872	1873
$\sin \Omega'$	8.7917861	8.7918767	
$\cos i'$	9.9550754	9.9550676	
$\cos \Omega'$	9.9991660n	9.9991657n	
$\sin i'$	9.6357895	9.6358238	
$-\cos \Omega'$	9.9991660	9.9991657	
$\cos i' \sin \Omega'$	8.7468615	8.7469443	
$\tan A$	1.2523046	1.2522214	
A	86 47 54.28	86 44 52.08	
$\log a$	9.9998445	9.9998443	
$-\sin \Omega'$	8.7917861n	8.7918767n	
$-\cos i' \cos \Omega'$	9.9542414	9.9542333	
$\tan B$	8.8375447	8.8376434	
B	−3 56 7.27	−3 56 10.48	
B	356 03 52.73	356 03 49.52	
$\log b$	9.9552666	9.9552590	
$A+\omega'$	67 56 14.70	68 21 3.24	
$B+\omega'$	337 12 13.16	337 37 0.68	
ω'	341 08 20.43	341 33 11.16	
$\log a$	9.9998445	9.9998443	
$\log b$	9.9552666	9.9552590	
$\log c$	9.6357895	9.6358238	
$\log e = \sin\varphi$	9.1014958	9.1048597	
e	.1263269	.1273099	
$1+e$			
$1-\varepsilon$	.8736731	.87269081	
$\log(1+e)$	.0516645	.0520427	
$\log(1-e)$	9.9413489	9.9408604	
$\log\sqrt{1+e}$	.0258322	.0260213	
$\log\sqrt{a}$	.1931618	9.9704302	
$\log\sqrt{1-\varepsilon}$	9.9706744		
$\log\sqrt{a(1+\varepsilon)}$	.2189940	.2192766	
$\log\sqrt{a(1-\varepsilon)}$	.1638362	.1636854	
φ	7 15 26.6	7 18 50.85	
$\tfrac{1}{2}\varphi$	3 37 43.30	3 39 25.43	
$45-\tfrac{1}{2}\varphi$	41 22 16.70	41 20 34.57	
$\log\tan(45-\tfrac{1}{2}\varphi)$	9.9448422	9.944408	
$\log e$	9.1014958	9.1048597	
$\log$ Const	5.3144251	5.3144251	
$\log e''$	4.4159209	4.4192848	

	1870	1872	1873
$\sin\tfrac{1}{2}(\Omega-n)$	9.9782514	9.9782823	
$\sin\tfrac{1}{2}(i+\varepsilon)$	9.3532097	9.3532414	
$\sin\tfrac{1}{2}i' \sin\tfrac{1}{2}(\Omega'+\Delta)$	9.3314611	9.3315237	
$\sin\tfrac{1}{2}i' \cos\tfrac{1}{2}(\Omega'+\Delta)$	8.7469860	8.7466409	
$\tan\tfrac{1}{2}(\Omega'+\Delta)$	75242900	0.5848828	
$\tfrac{1}{2}(\Omega'+\Delta)$	104 35 31.00	−75 25 16.88	
$\tfrac{1}{2}(\Omega'+\Delta)$	71 51 30.23	104 34 43.12	
$\tfrac{1}{2}(\Omega'-\Delta)$		71 52 15.44	
Ω'	176 27 1.23	176 26 58.56	
Δ	32 44 6.77	32 42 27.68	
ω	13 52 21.20	14 15 38.84	
ω'	341 08 20.43	341 33 11.16	
$\cos\tfrac{1}{2}(\Omega'-n)$	9.4895557	9.4892616	
$\sin\tfrac{1}{2}(i'-\varepsilon)$	9.2574303	9.2573793	
	8.7469860	8.7466409n	
$\sin\tfrac{1}{2}(\Omega-n)$	9.9782514	9.9782823	
$\cos\tfrac{1}{2}(i+\varepsilon)$	9.9886640	9.9886623	
$\cos\tfrac{1}{2}i' \sin\tfrac{1}{2}(\Omega'-\Delta)$	9.9669154	9.9669446	
$\cos\tfrac{1}{2}i' \cos\tfrac{1}{2}(\Omega'-\Delta)$	9.4823311	9.4820386	
$\tan\tfrac{1}{2}(\Omega'-\Delta)$	.4845843	.4849060	
$\tfrac{1}{2}(\Omega'-\Delta)$			
$\cos\tfrac{1}{2}(\Omega-n)$	9.4895557	9.4892616	
$\cos\tfrac{1}{2}(i-\varepsilon)$	9.9927754	9.9927770	
	.4823311	9.4820386	
$\sin\tfrac{1}{2}i'$	9.3457003	9.3457366	
$\tfrac{1}{2}i'$	12 48 24.99	12 48 28.90	
i'	25 36 49.98	25 36 57.80	

	1870 Sept. 24.5	1870 Oct. 14.5	1872 Mar. 5.5	1873 May 25.5
	° ′ ″	° ′ ″		
M	25 09 23.51	31 23 8.51	161 50 27.84	
E	28 37 26.28	35 35 56.30	163 52 4.10	
sin E	9.6803890	9.7650031	9.4438134	
log e″	4.4159209	4.4159209	4.4192848	
log e sin E″	4.0963100	4.1809240	3.8631022	
e sin E″	3 28 2.74	4 12 47.84	2 1 36.30	
E′	28 37 26.25	35 35 56.35	163 52 4.14	
½E′	14 18 43.12	17 47 58.17	81 56 2.07	
sin ½E′	9.3930513	9.4852768	9.9956821	
cos ½E′	9.9863076	9.9786972	9.1471051	
√r sin ½v	9.6120453	9.7042708	~~.8485770~~ .2145587	
√r cos ½v	.1501438	.1425334	9.3107905	
log tan ½v	9.4619015	9.5617374	.9041682	
½v	16 09 16.77	20 01 42.57	82 53 82.89	
v	32 18 33.42	40 03 25.14	165 47 5.78	
log r	0.8852802	.3392524	.4366146	
	° ′ ″			
(λ+Ω+ω)	100 14 48.12	107 59 39.84	234 08 9.02	
B+v+ω′	89 30 46.58	17 15 38.30	143 24 6.46	
v+ω′	93 26 53.85	21 11 45.57	147 20 16.94	
sin(A+v+ω′)	9.9930176	9.9782201		
log r a	.3351247	.3390967		
sin(B+v+ω′)	9.2181949	9.4723452		
log r b	.2905468	.2945190		
sin(v+ω′)	9.3665495	9.5581796		
log r c	9.9710697	9.9750419		
x	+2128.8361	+2.0764289		
X	−1.0019707	−.8994892		
x′		1.1769357		
y	+.3226544	+.5846077		
Y	−.0268533	−.3913523		
y′		+.1932554		
z	+.2175801	+.3413671		
Z	−.0116479	−.1698052		
z′		+.1715619		
log cos δ sin α	.0518720	.0707543		
log cos δ cos α	9.4710042	9.2861317		
log tan α	9.4191322	9.2156774		
α	14 42 30.23	9 19 29.45		
Δα	18.82	20.75		
C α	14 42 49.05	9 19 50.20		
O α	14 42 51.4	9 19 55.00		
Δα(C−O)	−2.4″	9 19 ~~38.64~~ −4.8″		
log cos δ	9.3137243	9.2344210		
log sin δ	.0663420	.0765315		
log tan δ	9.2473823	9.1578895		
δ	+10 01 26.48	8 17 07.68		
Δδ	+7.21	8.44		
C δ	10 1 33.7	8 17 16.12		
O δ	10 1 33.5	8 11 16.0		
δ(C−O)	+0.2″	+0.1″		

Elements first assumed.

Epoch Berl. M. Z. 1870 0 B. M. T.

M 25° 12′ 0″.32

ω 13 51 34.1

Ω 323 58 54.1 +55″.36

i 2 36 34.4 + 0.42

φ 7 16 6.1

μ 934.3770 log μ 2.9705221

log a 3863230

π 337 50 28.2 +50.24

For 1873 May 25.5

M	π	Ω	i	φ	μ	log a
25 12 0.32	337 50 28.2	323 58 54.1	2 36 34.4	7 16 6.1	934.37700	3863230
− 23 6.47	+ 24 8.79	− 20.29	+ 7.70	+ 6 0.1	+ 20380	
24 48 53.85	338 14 36.99	323 58 33.81	2 36 42.10	7 22 6.20	934.58080	
Precession	+ 2.30.72	+ 2.46.08	+ 1.25			
252 48 3.20						
277 36 57.05	338 17 7.71	324 01 19.88	2 36 43.35	7 22 6.20	934.5808 2.9706168	3862558

Ω 324 01 19.88
$\Omega - n$ 144 01 19.88
$\frac{1}{2}(\Omega - n)$ 72 00 39.94
i 2 36 43.35
ε 23 27 20.88
$i+\varepsilon$ 26 04 4.23
$i-\varepsilon$ 20 50 37.58
$\frac{1}{2}(i+\varepsilon)$ 13 02 2.11
$\frac{1}{2}(i-\varepsilon)$ −10 25 18.46

$\sin\frac{1}{2}(\Omega - n)$ 9.9782336
$\sin\frac{1}{2}(i+\varepsilon)$ 9.3532001
$\sin\frac{1}{2}i'\sin\frac{1}{2}(\Omega'+a)$ 9.3314337
$\sin\frac{1}{2}i'\cos\frac{1}{2}(\Omega'+a)$ 8.7471493n
$\tan\frac{1}{2}(\Omega'+a)$ .5842844
$\frac{1}{2}(\Omega'+a)$ −75 24 06.77
$\frac{1}{2}(\Omega'+a)$ 104 35 53.23
$\frac{1}{2}(\Omega'-a)$ 71 51 4.22
Ω' 176 26 57.45
a 32 44 49.01
ω 19 15 47.83
ω' 341 30 58.82

$\cos\frac{1}{2}(\Omega - n)$ 9.4897234
$\sin\frac{1}{2}(i-\varepsilon)$ 9.2574259n
8.7471493n
$\sin\frac{1}{2}i'$ 9.3456851
$\cos\frac{1}{2}i'$ 9.9890600
$\frac{1}{2}i'$ 12 48 23.84
i' 25 36 46.68

$\sin\frac{1}{2}(\Omega - n)$ 9.9782336
$\cos\frac{1}{2}(i+\varepsilon)$ 9.9886645
$\cos\frac{1}{2}i'\sin\frac{1}{2}(\Omega'-a)$ 9.9668981
$\cos\frac{1}{2}i'\cos\frac{1}{2}(\Omega'-a)$ 9.4824989
$\tan\frac{1}{2}(\Omega'-a)$ .4843992
$\frac{1}{2}(\Omega'-a)$ 71 51 04.22

$\cos\frac{1}{2}(\Omega - n)$ 9.4897234
$\cos\frac{1}{2}(i-\varepsilon)$ 9.9927755
9.4824989

$\sin\Omega'$ 8.7919143 − $\cos\Omega'$ 9.9991656 − $\sin\Omega'$ 8.7919143 − $A+\omega'$ 68 18 49.62 log a 9.9958444
$\cos i'$ 9.9550788 $\cos i'\sin\Omega'$ 8.7469931 − $\cos i'\cos\Omega'$ 9.9542444 $B+\omega'$ 337 34 47.48 log b 9.9552703
$\cos\Omega'$ 9.9991656n $\tan A$ 1.2521725 $\tan B$ 8.8376695 ω' 341 30 58.82 log c 9.6357750
$\sin i'$ 9.6357750 A 86 47 50.80 B −3 56 11.34
log a 9.9958444 B 356 03 48.66
log b 9.9552703

φ 7 22 6.20
log e 9.1080522
e .1282485
$1+e$
$1-\varepsilon$ .8717515
log $(1+e)$ .0524048
log $(1-\varepsilon)$ 9.9403927
log $\sqrt{1+\varepsilon}$ .0262024
log $\sqrt{a}$ .1931299
log $\sqrt{1-\varepsilon}$ 9.9701963

log e 9.1080522
log 5.3144251
log e'' 4.4224773

φ
$\frac{1}{2}\varphi$ 3 41 3.10
$45 - \frac{1}{2}\varphi$ 41 18 56.90
log $(45-\frac{1}{2}\varphi)$ 9.9439940

log $\sqrt{a(1+\varepsilon)}$ .2193323
log $\sqrt{a(1-\varepsilon)}$ .1633262

B. M. T.

May 25

M 277 36 57.05 2
E 270 15 44.18
a E 9.9999955
4.4224773
4.4224428
e sin E -7 20 52.47
E 270 16 04.18
8 209 ½E 135 08 52.09
9484676 sin ½E 9848487
8504977 cos ½E 9850476
.0677999 .0678210
.0138239 .0138029
.0539760 .0540181
33 489 ½v 48 33 1469
26 55.11 ½ 131 26 4521
53 50.22 v 262 53 3042
log √r 193 0024
386 0022 log r 386 0048

12 3984 v+A+ω' 331 12 2004
28 0770 v+B+ω' 240 28 17.90
244.04 v+ω' 244 24 29.24

26724 S-(v+A+ω') 9.6827483n
58466 log a 3858492
95781 sin(v+B+ω') 9939575 n
12725 log b 3412757
51753 sin(v+ω') 9.9551554n
17772 log c .0217798
-11708980 x -11711095
.4325916 + .4325916
-19052861 y -19091948
8408186 + .8408186
-9483150 z -.9482771
3648259 +.3648259

8652365 log a cos δ cos α 9.8683610n
0287618 log a cos δ sin α 0.0287242n
1605263 tan α 0.1603632
55 21 20.74 α -55 20 44.62
6.1 α 235 20 ~~13.38~~ 44.62
2352126.8 Δα 6.14
g 293 11
α 235 21
H 283 41
G+α 168 33
H+α
2 21 268 C α 235 20 50.76
6 55.0 O α 235 6 55
14 32 Δα(C-O) + 13' 56"
872" = 836"

113521 log Δ cos δ 1135365
77660333 Δ sin δ 94660044n
96525117 tan δ 965246779
-11354 δ -24 11 27.80
- 55 Δδ - 5.44
11409 C δ -24 11 33.28
8 45 O δ -24 8 45
2 56 Δδ(C-O) = - 2 48"
176" = -168"
log g sin 7483
log sin(G+α) 9.2978
δ log r .0461
+5.03
+ 1.11
d' α +6.14
log g 7483
log sec(G+α) 9.9972n
.7395
- 5.49

For May 25 1873 the error of the Ephemeris in the B. J. will be taken as follows.

Δα(C-O) = + ~~10~~ 9" Δδ(C-O) = - 4"
α 235 7 3 δ -24 8 49
α(O) 235 6 55 δ(O) -24 8 45

S | n | a | b | c | d | e | f

-.1413 0 = -0.9 + d Ω' + ∂ di" + 2.2595 dL - 2313 d log a + 2.2818 dq - 4451 dχ
-.0045 - 2.3 + 2.2387 - .1729 + 2.2928 - 4.3681
+1.2484 + 599.5 + 1.1496 - 3.8284 + 0.9231 + 3.0041
~~15.5094~~ -12.5416 + ~~776.6~~ 818.5 + 1.6839 - 11.0546 - 3.3770 + .2061

-.3155 0 = + 0.7 - .4689 + .4254 - .0101 - .0428 + .0346 + .0468
-.0337 - 1.7 - .7300 + .6550 + .0024 + .0119 + .0410 + .0388
+1.3558 - 5.2 + .5380 + .7995 - .0017 + .0193 + .0700 - .0093
~~1.0960~~ 1.0307 + ~~31.4~~ 8.3 - 1.5385 + .3185 - .0095 + .1174 - ~~.0504~~ + .0119 + .0695

Cherm 1873

log n 9.~~5542425~~ ~~2.8901974~~ 2.9130187 ~~1.49693~~ 0.91908
a 0.18710n
b 9.50311
c 0.2263163n 7.97772n
d 1.0435432n 9.06967n
e 0.5285311n ~~8.72754~~ 8.07555 8
f 9.3140780 8.84198
8 ~~1.2916588~~ 1.0983530n ~~0.03981~~ 0.01313n

nn ne nd ne nf n8 nf nn nb
603106 - 130772 - 858500 - 262258 + 16005 - 1235525

~~aa ab ae ad ae af a8~~

bb. be bd be bf b8

~~ee ed ee ef~~ e8

dd de df d8

~~ee ef~~ e8

~~ff~~ f8

aa ab ac ad ae af a8

bb bc bd be bf b8

ce cd ce cf c8

dd de df d8

ee ef e8

ff f8.

nn	na	nb	nc	nd	ne	nf	ns
603106	—	—	−1307.72	−8585.00	−2622.58	+160.05	−12355.25
9.86	+48.31	+10.00	−.30	+3.69	−1.67	+2.18	−34.41
604092	−48.31	+10.00	−1308.02	−8581.31	−2624.25	+162.23	−12389.66
359437	−2.09	−4.97	+682.00	−2294.15	~~+5454.4~~ +545.94	+1815.01	+741.34
763529	−50.40	+5.03	−626.02	−10875.46	−2078.31	+1977.24	−11648.32

aa	ab	ac	ad	ae	af	as
+2.3670	−.4900	+.0146	−.1806	+.0822	−.1069	+1.6862
+1.4135	−.3452	+.0052	+.0870	−.0639	−.0701	+.9965
+3.7805	−.8652	+.0198	−.0936	+.0183	−.1770	+2.6828

bb	bc	bd	be	bf	bs
+.1014	−.0030	+.0374	−.0170	+.0222	−.3491
+1.2492	−.0041	−.0420	+.0611	+.0386	+.9276
+1.3506	−.0071	−.0046	+.0441	+.0608	+.5786

cc	cd	ce	cf	cs
~~2.8855~~ +3.4884	+18.6149	+5.6865	−.3470	+26.7889
.0001	−.0011	+.0005	−.0006	+.0104
+3.4885	+18.6138	+5.6870	−.3476	+26.8003
+2.8356	−5.3107	+11.3506	−16.3753	+1.1063
+11.4405	+13.3031	+17.0376	−16.7229	+27.9066
+14.7261				

dd	de	df	ds
122.2042	+37.3314	−2.2784	+175.8722
+.0139	−.0063	+.0081	−.1286
+122.2181	+37.3251	−2.2703	+175.7436
+14.7458	−4.4630	−9.7214	−4.7043
+136.9639	+32.8621	−11.9917	+171.0392

ee	ef	es
+11.4042	−.6960	+53.7261
+.0028	−.0037	+.0585
+11.4070	−.6997	+53.7846
+11.3204	−17.3846	+.8207
+22.7274	−18.0843	+54.6052

ff	fs
.0425	−3.2789
+.0048	−.0762
+.0473	−3.3551
+47.8827	+4.3699
+47.9300	~~7.7250~~
	+1.0149

log cos i′ 9.95508
cos i′ .9017
1 − cos i′ .0983
log (1 − cos i′) 8.99255
log dΩ′ 1.00417
log dΩ′(1 − cos i′) 9.99672
dχ, −11 51.25
dπ′ −11 50.26
dΩ′ + 10.10
dϖ′ −12 00.36

dψ, −8 0.79
(1 − cos i′)dΩ′ + 0.99
dχ, −7 59.80
dπ′ −11 50.26
dM +3 50.46

log b 0.17609n
~~log d log a~~
log μ 2.97052
log sin 1″ 4.68557
log cos φ 9.83218n
log d log a 1.58369
log dμ 9.41587
dμ −.26054
μ₀ 934.57700
μ 934.11646
log μ 2.9704010
log b 3.5500066
log a .3864038

log cos i′ 9.95508
− log dΩ′ 1.00417n
log cos i′ dΩ′ 0.95926n
cos i′ dΩ′ −9.10
dχ −11 51.25
dϖ′ −12 0.35

log M 4.32335
log d log a 1.58369
log d log a 5.90704
d log a +0000807
a₀ 3863230
3864037
a =

log fm₅ 2.31182
− log ffb₅ .45980n
log dχ 1.85202n
dχ/10 −71.125
dχ −1′ 51″.25

dχ/10 efy −98.417
eny +72.760
Sum −25.657
log D 1.40921n
log ee 8.87795n
log dψ 2.53126n
dψ 339.83
dψ +5′ 39″.83

dχ/10 df₃ −25514
dφde₃ +577262
dn₃ −1029370
Sum −477622
log D 3.67908n
− log dd₃ 2.09539n
log d log a 1.58369
d log a +38.84

dχ/10 ef₂ +1189.35
dφ ce₂ +578995
d log a cd₂ + 510.11
cn₂ − 625.77
Sum +686364
log D 3.83656
− log cc 1.15461n
log dψ 2.68195
dψ′ −480.79
−8′ 0″.79

dχ bf −1.44
dφ bc′ +16.41
d log a bd, −1.00
dψ be, +1.25
bn, −6.50
Sum +8.72
log D 0.94052
− log bb, .06168n
log di′ .87884n
di′ −7.57

dχ/10 af +12.57
dφ ae +6.22
d log a ad −3.59
dψ ae −9.52
di ab +6.55
an −50.40
Sum −38.17
log Sum 1.58172n
− log aa .57755n
log dΩ′ 1.00417
dΩ′ +10.10

	a	b	c	d	e	f	s	n
(aa)	+3.7805	−.8652	+.0198	−.0936	+.0183	−.1770	+2.6828	~~−[illegible]~~ −50.40
lg(aa)	0.5775492	9.9371165n	8.2966[illegible]	8.97128	8.26245	9.24797n	0.42859	1.70243n
bb		+1.3506	−.0041	−.0046	+.0441	+.0608	+.5786	+5.03
ab ab/aa		+.1980	−.0045	+.0214	−.0042	+.0405	−.6140	+11.58
bb1		+1.1526	+.0026	−.0260	+.0483	+.0203	+1.1926	−6.50
lg bb1		.06168	7.41497n	8.41497n	8.68395	8.30750	0.07649	0.81291n
cc			+14.2761	+13.3031	+17.0376	−16.7229	+27.9066	−626.02
ac ac/aa			+.0001	−.0005	+.0009	−.0009	+.0141	−26
cc1			+14.2760	+13.3036	+17.0366	−16.7230	+27.8925	−625.76
bc1 bc1/bb1			+.0000	+.0001	−.0002	−.0000	−.0027	+.01
cc2			+14.2760	+13.3035	+17.0368	−16.7220	+27.8951	−625.77
lg cc2			1.1546065	1.1239659	1.2314085	1.2232882n	1.4455279	2.7964147n
dd				+136.9639	+32.8621	−11.9917	+171.0392	−10875.76
ad ad/aa				+.0023	−.0004	+.0044	−.0664	+1.25
dd1				+136.9616	+32.8625	−11.9961	+171.1056	−10877.01
bd1 bd1/bb1				+.0005	−.0011	−.0005	−.0269	+.15
dd2				+136.9611	+32.8636	−11.9956	+171.1325	−10876.86
cd2 cd2/cc2				+12.3972	+15.8770	−15.5828	+25.9948	−582.14
dd3				+124.5639	+16.9866	+3.5872	+145.1377	−10293.72
lg dd3				2.0953923	1.2301064	0.5547556	2.1617803	4.0125726n
ee					+22.7274	−18.0843	+54.6052	−2078.31
ea ea/aa					+.0001	−.0009	+.0130	−24
ee1					+22.7273	−18.0834	+54.5922	−2078.07
be1 be1/bb1					+.0020	+.0008	+.0500	−27
ee2					+22.7253	−18.0842	+54.5422	−2077.80
ce2 ce2/cc2					+20.3334	−15.9568	+33.2912	−746.82
ee3					+2.3919	+1.8726	+21.2510	−1330.98
de3 de3/dd3					+2.3164	+.4892	+19.7922	−1403.74
ee4					+.0755	+1.3834	+1.4589	+72.76
lg ee4					+8.8779470	0.1409478	+0.1640255	+1.861892
ff						+47.9300	+1.0149	+1977.24
af af/aa						+.0083	−.1258	+2.36
ff1						+47.9217	+1.1408	+1974.88
bf1 bf1/bb1						+.0003	+.0216	±.11
ff2						+47.9214	+1.1192	+1974.77
cf2 cf2/cc2						+19.5822	−32.6745	+432.98
ff3						+28.3392	+33.7938	+1241.78
df3 df3/dd3						+.1033	+4.1796	−296.44
ff4						+28.2310	+29.6141	+1538.22
ef4 ef4/ee4						+25.3483	+26.7317	+1333.19
ff5						+2.8827	+2.8824	+205.03
lg ff5						0.45980		2.31182

	ns	nn				
	−1164832	+963579			−1164832	+963529
an as/aa	−3660	+672			−35.76	190
ns1 nn1	−1161172	+962857			−1161256	+963339
bn1 bs1/bb1	−673	+37			−6.73	+37
ns2 nn2	−1160499	+962820			−11605.83	+963302
cn2 cs2/cc2	−122274.6	+27420			−122275	+27430
ns3 nn3	+62247	+935390	+62247	+935390	−10383.08	+935872
dn3 ds3/dd3	+140595	+70119	−11993.9	850654	−11993.70	850655
ns4 nn4	−78348	+865271	+1821.86	84736	+1610.62	85217
en4 es4/ee4			140595		+1405.96	70119
ns5 nn5			415.91		+204.86	15098
						14583
						515

0 = −0.9 − 1086.5 − 8.9 + 775.4 + 316.6 = −4.3″
= −1.8 − 1076.3 − 6.6 + 775.2 + 310.4 = +4.4
= +599.5 − 552.7 − 146.8 − 213.7 + 312.7 = +0.011
= +476.0 + 809.6 − 423.9 − 1147.6 − 18.7 = +2.9

0 = +31.4 + 4.6 + 4.5 − 15.5 − 2.4 − 18.2 − 4.5 = −0.5″ lod:
= +0.7 − 7.7 − 3.2 + 4.9 − 1.6 + 11.6 − 3.3 = +1.4
= −1.7 − 7.4 − 5.0 − 1.2 − 2.3 + 20.0 − 2.8 = −0.4
= −5.2 + 5.4 − 6.0 + 0.8 + 3.7 + 3.4 + 0.6 = −0.3

New Elements.

Epoch Sept. 24.5 1873 B.M.T.

At

	M	Ω'	ω'	π'	i'	φ	μ	log a
♃	25° 12' 0.32"	176 26 5.81	341° ~~30~~ 04' ~~58.82~~ 21.03"		25° 36' 36.76"	7° 16' 6.1"	934.37700	9.863230
4f	+ 3 50.46	+ 10.10	– 12 0.36		– 7.57	+ 5 3.98	– 26.054	
	25 15 50.78	176 27 2.55	341 ~~18 58.46~~		25 36 39.11	7 21 4.59	934.1164	9.864038
			340 52 20.67					

M Sept. 24.5   31° 25' 45.37"
4 M   + 3 50.46
M ~~Sept~~ 24.85   31 29 35.83
4 f   – 6.25
M   31 29 29.58

M Mars 1873   161° 53' 5.79"
+ 3 50.46
161 56 56.25
– 2 17.56
161 54 38.69

May 25.5 1873   277° 36' 37.05"
+ 3 50.46
277 40 27.51
– 4 13.77
277 36 13.74

Tab. 20.5 ~~158 33 52.17~~
– ~~21 17.14~~
Tab. 20.5 ~~158 12 35.03~~ 158 15 12.91
+ 3 50.46   3 50.46
158 16 25.49   158 19 03.41
+ 3 37 49.19   3 37 49.19
Mars 161 54 14.68   161 56 52.60
– 2 17.56
161 54 35.04

Tab. 20.5 M   158° 15' 12.95"
4 M   3 50.46
158 19 03.41
– 2 13.92
New M Tab. 20.5   158 16 49.49
+ 3 37 49.19
M   161 54 38.68

	1870	1872	1873
sin Ω'	8.7916272	8.7916974	8.7915715
cos i'	9.9550964	9.9550882	9.9550864
cos Ω'	9.9991666	9.9991664	9.9991669
sin i'	9.6356982	9.6357344	9.6357418
	9.9991666	9.9991664	9.9991669
~~log Ω'~~	~~8.7916272~~	~~8.7916974~~	~~8.7915715~~
cot i' sin Ω'	8.7467236	8.7467856	8.7466579
log A	1.2524430	1.2523808	1.2525090
A	86 47 57.94	86 47 56.29	86 47 59.69
log a	9.9958445	9.9958445	9.9958446
– sin Ω'	8.7916272	8.7916974	8.7915715
– cos i' cos Ω'	9.9542630	9.9542546	9.9542533
log tan β	8.8373642	8.8374428	8.8373182
β	– 3 56 01.40	– 3 56 03.95	– 3 55 59.91
β	356 03 58.60	356 03 56.05	356 04 0.09
log b	9.9552874	9.9552792	9.9552775
A + ω'	67 40 18.61	68 03 26.45	68 06 58.15
B + ω'	336 56 19.27	337 19 26.21	337 22 58.55
ω'	340 52 20.67	341 15 30.16	341 18 58.46
log a	9.9958445	9.9958445	9.9958446
log b	9.9552874	9.9552792	9.9552775
log c	9.6356982	9.6357344	9.6357418
φ	7 21 45.90	7 25 10.15	7 27 46.00
½ φ	3 40 52.95	3 42 35.08	3 43 53.00
45 – ½ φ	41 19 07.05	41 17 24.93	41 16 7.00
log tan ½ω	9.9440371	9.9436035	9.9432725
log e	9.1077215	9.1110367	9.1135492
1 + e	.1281509	.1291328	.1298821
1 – e	.8718491	.8708672	.8701179
log (1 + e)	.0523672	.0527450	.0530334
log (1 – e)	9.9404414	9.9399519	9.9395782
log √(1+e)	0261836	0263725	0265167
log √a	1932019	1932954	1931703
log √(1–e)	9.9702207	9.9699760	9.9697891
log √((1+e)a)	.2193855	.2196679	.2196870
log √((1–e)a)	.1634226	.1632714	.1629594
log e	9.1077215	9.1110367	9.1135492
log C	5.3144251	5.3144251	5.3144257
log e''	4.4221466	4.4254618	4.4279743

	M	Ω	ω	i	φ	μ	log a		M
1870. Oct. 4.6	25° 12′ 0.32″	176° 26′ 55.81″	341° 04′ 21.03″	25° 36′ 36.76″	7 16 6.1	934.37700	.3863230		31 25 45.37
	+ 3 50.46	+10.10	−12 0.36	− 7.57	+5 39.8	−26054	+ 808		+3 50.46
									− 6.25
	25 15 50.78	176 27 05.91	340 52 20.67	25 36 29.19	7 21 45.0	934.11646	.3864038	oct 18.5	31 29 29.58
1872 Mar 1.5	161 53 5.79	176 26 53.74	341 27 30.52	25 36 45.00	7 19 30.35	933.77397	.3865100		
	+ 3 50.46	+10.10	−12 0.36	−7.57	5 39.80	−26054	808		
	161 56 56.25	176 27 03.84	341 15 30.16	25 36 37.43	7 25 10.15	933.51343	.3865908		
	− 2 17.56					2.9701206			
	161 54 38.69								
1873 May 25.5	277° 36′ 57.05″	~~341 01 18.8~~ 176 26 57.46	341 30 58.2	25 36 46.8	7 22 6.20	934.58080	.3862598		
	+ 3 50.46	+10.10	− 12 0.36	− 7.57	+5 39.80	− 26054	+ 808		
	277 40 47.51	176 27 07.65	341 18 58.46	25 36 39.11	7 27 46.00	934.32026	.3863406		
	− 4 13.77					2.9704957			
	277 36 33.74								

Wrong.

M	1870 Sep. 24.5	1870 Oct 18.5	1872 Mar 1.5	1873 May 25.5
M				277 36 33.74
E				270 10 3.76
sin E′				9.9995981
log C				4.4279743
C″ sin E′				4.4279724
C″ sin E				7 26 29.98
E′				270 10 3.76
½E′				135 05 1.88
sin ½E′				9.8488484
cos ½E′				9.8496153
√r sin ½v				.0685354
√r cos ½v				.0128747
log tan ½v				.0559607
½v				44 40 52.43
½v				131 19 7.57
v				262 38 15.14
log r				.3857356
u+Ω+ω′				330 45 13.29
u+B+ω′				240 1 13.69
u+ω′				243 54 13.60
sin(u+Ω+ω′)				9.6889224 n
log r a				.3855802
sin(u+B+ω′)				9.9376202 n
log r b				.3410131
sin(u+ω′)				9.9484401 n
log r c				.0214774
x				−.1187144
X				+.4325916
x′				−.1899473 5
y				+.8408188
Y				
y′				−.9331418
z				+.3648289
Z				
z′				

wrong

log Δ cos δ cos α	9.5688231 | 5.5776724
log Δ cos δ sin α	.0275793 | .0247546
log tan α	0.1887562 | 1470821
α	55 | 14 47 54 31 18
α	235 14 47

log Δ cos δ	~~9.7568750~~ 9.7545898
log Δ sin δ	

nn	na	nb	nc	nd	ne	nf	ns
6.9942	~~+1378.28~~	~~-9048.19~~	~~-2764.08~~				
			+1378.28	-9048.19	-2764.08	+168.69	-10265.37
69	-12.77	+2.64	-.08	+.97	+.10	+.58	-8.55
7.0011	-12.77	+2.64	+1378.20	-9047.22	-2763.98	+169.27	-10273.92
5.9437	-2.09	-4.97	+682.00	-2294.55	+545.94	~~++~~815.01	+741.34
8							
1029448	-14.86	-2.33	+2060.20	-11341.77	-2218.04	+1984.28	-9532.58

aa	ab	ac	ad	ae	af	as.
+23670	-4900	+0146	-1806	-0183	-1069	+1.5857
+1.4131	-3752	+0052	+0870	-0639	-701	+.9965
+3.7801	-8652	+.0198	-0936	-.0822	-1770	+2.5823

bb	bc	bd	be	bf	bs.
+1014	-0030	+0374	+0038	+0222	-3283
+1.2492	-0041	-0420	+0611	+0386	+.9276
+1.3506	-0071	-.0046	+0649	+0608	+5994

cc	cd	ce	cf	cs	cs
+2.8355	-18.6[illegible]	-5.6865	+3470	-26.7899	21.1188
+ 0001	- [illegible]11	- 1	- 0006	+.0098	+.0098
+2.8356	-18.6160	-5.6866	+3464	-26.7801	-21.1090
+11.4405	-5.3107	+11.3506	-16.3753	+1.1063	+1.1063
+14.2761	-23.9267	+5.6640	-16.0289	-25.6738	-20.0028

dd	de	df	ds	ds
+122.2042	+37.3314	-22.784	+175.2722	+138.6425
+ .0139	+ 14	+ 81	- .1210	- 1210
+122.2181	+37.3328	-22.703	+175.1512	+138.5215
+ 14.7458	- 4.4630	-9.7214	~~+4~~.7043	- 4.7043
+13				
+126.9639	+32.8698	-11.9917	+171.0469	+133.8171

ee	ef	es	es
+11.4042	-.6960	+53.7261	+42.3530
+ 0001	+.0008		- .0123
11.4043	-.6952		+42.3407
+11.3204	-17.3846	+.8207	+ .8207
+22.7247	-18.0798		+43.1614

ff	fs.
+0425	~~-2.2279~~
+0048	-2.5848
+0473	- .0716
+47.8827	+4.3699
+47.9300	~~-7.63~~
	+1.7134

-21.792
1.33826n

-4162
+4.987
-9.149
0.96137n

1.11491n 0.97086n
8.82282n 8.82282n
2.29209 2.148042
.19593 .14062
+3 15.93 2 20.62

+103255 +74108
-45559 -42559
+57696 +31549
2.76115 2.49899
.28919n .28919n
2.47196n 2.20980n
-296.46 -162.11

-76133
-125886
+112524
+63071 -89095
3.79983 3.95034
1.98615n 1.98615n
1.81368 1.96419
-65.11 +92.08

-5464.2
-6867.3
+11247.6
-10839
3.03499n
1.98615n
1.04884
+11.19

log fn₅ 0.99869
-log bb₅ 8.82282n
log dψ 2.17587n
dψ×10/10 -149925
dψ -24′ 59.25″

dψ/10 ef₄ -79012
en₄ +41442
sum -37570
log sum 2.57484n
-log ee₄ .28919n
log dφ 2.28565
dφ 193.04″
= +3′ 13.04

dψ/10 df₃ +5825.7
dφ de₃ +8177.7
dn₃ -7888.5
sum +6114.9
log sum 3.78639
-log dd₃ 1.98615n
log da 1.80024n
da -68.13″
= -1′ 8.13″

dψ/10 cf₂ +1510.5
dφ ce₂ +1093.5
dlog a cd₂ +2403.0
cn₂ +2060.3
sum +7067.3
log sum 3.84925
-log cc₂ 1.15461n
log dφ′ 2.69464n
dφ′ -495.04
dφ -8′ 15.04

-22588
-9183
-2677
-28554.1
-62933.9
3.79892n
1.15461n
2.64431
+440.87

+3140.3
-1679.3
+1588.0
-2872.3
-6133.9
3.78774n
1.15461n
2.63313
4296.7

-3140.3
-1679.3
-2203.3
-2872.3
-9895.2
3.99543n
1.15461n
2.84082
+693.14

dψ bb₁ -304
dφ be₁ +8.80
dlog a bd₁ +1.64
dL be₁ +1.29
bn₁ -5.73
sum +3.06
log so .48572
-log bb₁ .06168n
log di′ .42404n
di″ -2.65

+3.97
-13.67
+1.69
-1.12
-9.13
-14.26
1.26150
.06168n
1.19982
+15.84

+3.58
-13.67
-2.39
-1.80
-9.12
-23.01
1.36182n
.06168n
1.30024
+19.96

+2.85
-7.47
-.29
-1.15
-9.15
-15.21
1.18213n
.06168n
1.12045
+13.20

dψ af +2653
dφ ae -15.87
dlog a ad -5.91
dL ac -9.80
di′ ab +2.29
an -14.86
sum -41.62
log sum 1.24601n
-log aa .57755n
log da″ .66846
+4.66

-34.68
+24.37
+6.08
+8.51
-13.71
+3.80
-5.40
0.73640n
.57755n
.15885
+1.44

-34.68 +24.37
-8.62 +13.72
-17.27 3.89
-60.57 41.98
41.98
-18.59
1.26928
.57755n
0.69173
+4.92

-24.54 +13.33
-1.05 +8.73
-11.42
-21.79
-59.15 +22.06
+22.06
-37.09
1.56926n
.59715n
.99171
+9.81

a b c d e f S v

79 ? -.051 (aa) 13889 +3.7805, -.8602, +.0198, -.0936, -.0822, -.1470, +2.5822 -14.66

826 -.286447 lg aa 0.58444 0.57755 9.93712 8.29667 8.97128 8.91487ₙ 9.24797ₙ 0.41201 1.17202ₙ

62 1605.989 bb -10.024 +1.3506ₙ -.0071 -.0046ₙ +.0649 +.0608 +.5994 -2.33

87 ab ab -.890 +.1980 -.0045 +.0214 +.0188 +.0405 +.5910 +3.40

49 ab bb₁ -.9134 +1.1526 -.0026 -.0260 +.0461 +.0203 +1.1904 -5.73

37ₙ lg bb₁ 0.96066ₙ 0.06168 9.41497ₙ 8.41497ₙ 8.66370 8.30750 0.07569 0.75815ₙ

-2854.211 cc -2872.28 +14.2761 -23.9267 +5.6640 -16.0289 -20.0028 +2060.20

-114 ac ac + .02 + .0001 - .0005 - .0004 - .0009 + .0135 - .09

-2854.097 ac c₁ -2872.30 +14.2760 -23.9262 +5.6644 -16.0280 -20.0168 +2060.29

+.020 bc₁ bc₁ + .02 .0000 + .0001 - .0001 - .0000 - .0027 + .07

-2854.117 bb₁ cc₂ -2872.32 +14.2760 -23.9263 +5.6645 -16.0280 -20.0136 +2060.30

3.4554717ₙ lg cc₂ 3.4582328ₙ 1.1546065 1.3788758ₙ 0.7531616 1.2048793ₙ 1.3013296ₙ 3.3139305

+16031.755 dd +16066.50 +136.9639 +32.8698 -11.9917 +133.8171 -1134.17

+.539 ad ad - .09 + .0023 + .0020 + .0044 + .0639 - .37

+16031.216 ad d₁ +16066.59 +136.9616 +32.8678 -11.9961 +133.8830 -1134.40

+.206 bd₁ bd₁ + .21 + .0005 - .0010 - .0004 - .0268 + .10

+16031.010 bb₁ +16066.38 +136.9611 +32.8688 -11.9957 +133.9098 -1134.50

+4783.448 dd₂ +4813.95 + 40.1049 - .94936 +26.5626 + 33.5428 - 345.303

11247.562 cd₂ cd₂

4.0510584 cc₂ dd₂ +11252.43 + 96.8610 +42.3624 -38.8583 +100.~~2372~~ 3650 - 789.47

lg dd₃ 4.0512463 1.9861489 1.6269805 1.5894837ₙ 2.0015824 3.8969927ₙ

+3361.200 ee +3325.55 +22.4247 -18.0798 + 43.1614 - 2218.04

+474 ae ae - .09 + .0018 + .0038 - .0562 + .32

+3360.726 ae e₁ +3325.64 +22.7229 -18.0836 + 43.2176 - 2218.36

-366 be₁ be₁ - .36 + .0018 + .0008 + .0476 - .23

+3361.092 bb₁ ee₂ +3326.00 +22.7211 -18.0844 + 43.1700 - 2218.13

+1132.470 ce₂ ce₂ - 1139.69 + ~~2.24459~~ - 6.3597 - 7.9412 + 814.49

+4493.562 cc₂ ee₃ + 4465.69 + 2.2476 -11.7247 + 51.1112 - 303.562

+4919.150 de₃ de₃ + 4921.28 + 20.4733 -16.9948 + 43.8949 - 345.009

-425.588 dd₃ ee₄ +4.41 + 18.5273

2.6289894ₙ lg ee₄ - 455.59 2.6588744ₙ + 1.9462 + 5.2701 + 7.2163 + 414.87

+ 14043.984 + 13977.52 1994071 0.2891875 0.7218189 0.8583146 2.6194407

-2468.808 ff -2536.12 - 14.884 2.65 4 +47.9300 +1.7134 +1584.71 +1584.70

+1.020 af af - .18 +14058.868 +13974.87 1994067 + .0083 - .1209 + .70 + .70

-2469.828 af f₁ -2535.94 - 9.449 - 9.43 72 +47.9217 +1.8343 +1583.58 +1814.31

-161 bf₁ bf₁ + - .16 +14068.317 +13984.30 1993975 + .0003 + .0210 - .10 - .10

-2469.667 bb₁ ff₂ -2535.78 + 4001.241 + 4026.76 577908 +47.9214 +1.8133 +1583.68 +1814.41

+3204.383 cf₂ cf₂ + 3224.82 +10067.076 + 9957.54 1416067 +17.9950 +22.4697 -231315 - 2313.15

-5674.050 cc₂ ff₃ - 5759.04 +11654.453 11659.50 1307205 +29.9264 -20.6564 +229683 + 4127.56

-4512.251 df₃ df₃ - 4514.20 - 1587.377 - 1701.96 108862 +15.5890 -40.2640 +316466 + 3164.66

-1161.799 dd₃ ff₄ - 1244.84 - 1578.031 - 1689.28 106650 +14.3374 +19.6076 113217 + 962.90

-1152.448 ef₄ ef₄ - 1233.69 - 9.346 - 12.68 2212 +14.2709 19.5410 112220 + 1122.20

-9.351 ee₄ ff₅ - 13.03 ns 2553ₙ + .0665 + .0666 + .99 - 157.20

0.97086ₙ lg ff₅ 1.11494ₙ

-953252 1029448 + 168.27

aw as aw - 10.16 58 + 10.07

aw w₁ - 9522.86 1029390 8.82282 0.99863

bw₁ bs₁ bw₁ - 5.92 28

bs₁ s₂ w₂ - 9516.94 1029362

cw₂ cs₂ cw₂ - 2888.37 297341

cs₂ s₃ w₃ - 6628.07 732021

dw₃ ds₃ dw₃ - 8173.84 642446

dd₃ s₄ w₄ +1545.77 89575

ew₄ es₄ ew₄ +1536.47 88228

ee₄ s₅ w₅ + 9.30 1347

bw₅ bs₅

bb₅ w₆

log(1-cos i′) 8.99255

log dΩ′ 66846

lg(1-cos i′)dΩ′ 9.66101

(1-cos i′)dΩ′ + 0.46

dχ′ - 24′ 59.25

dπ′ - 24 58.79

dΩ′ + 4.66

dω′ - 25 3.45

log cos i′ 9.95508

log dΩ′ 66846

lg cos i′ dΩ′ .62354

-cos i′ dΩ′ - 4.20

dχ′ - 24 59.25

dω - 25 3.45

dφ = -8′ 15.04

(1-cos i′)dΩ′ + .58

dφ - 8 14.46

dπ′ - 24 58.79

dM + 16 44.33

log b 0.17609ₙ

log μ 2.97052

lg ″ 4.68557

lg dμ 7.83218ₙ

log d log μ 1.00024ₙ

log dμ 9.63242

dμ 7.42898

μ 934.37700

μ₀ 934.80598

log μ 2.9707214

log b 3.5500066

.5792852

lg a 1.930951

lg a .3861902

log M 4.32335

log d log μ 1.80024ₙ

6.12359ₙ

d log a -.0001329

log a .3863230

.3861901

0 = + 8185 + 6579 - 5336 - 6519 - 30.5 = 0.0

- 0.9 - 11187 + 146 + 440.5 + 6674 = + 2.9

- 2.3 - 11083 + 10.9 + 442.6 + 6541 = - 3.0

+ 5795 - ~~5060~~ 5699 + 2417 + ~~1782~~ + 4504 = + 0.9

0 = + 8.3 + 4.7 + 2.3 - 7.2 - 0.9 - 7 - 10.4 ~~[illegible]~~ - 10.6

- 5.2 + 2.5 - 2.1 + 0.9 - 1.2 + 1.9 + 1.4 = - 1.8

+ 0.7 - 3.6 - 1.1 + 5.0 + 2.7 + 6.6 - 7.0 = + 3.3

- 1.7 - 3.4 - 1.7 - 1.2 + 3.8 + 11.4 + 6.0 = + 0.2

	M	Ω'	ω'	i'	φ	μ	log a
1870	25° 12' 03.2"	176 26 55.81	341° 04' 21.03"	25° 36' 36.76"	7 16 6.10	934.37700	3863230
Sept. 24.5	+ 16 44.33	+ 4.66	− 25 3.45	− 2.65	+ 3 13.04	+ 42898	− 1329
	25 28 44.65	176 27 00.47	340 39 17.58	25 36 34.11	7 19 19.14	934.80598	3861961
1872	161 53 5.79	176 26 53.74	341 27 30.52	25 36 45.00	7 19 30.35	933.77397	3865100
Mar 5.5	+16 44.33	+ 4.66	−25 3.45	− 2.65	+3 13.04	+ 42898	− 1329
	162 09 50.12	176 26 58.40	341 02 27.07	25 36 42.35	7 22 43.39	934.20295	3863771
	+3 46.50						
	162 13 36.62						
1873	277 36 57.05	176 26 57.45	341 30 58.82	25 36 46.68	7 22 6.20	934.58080	3862598
May 25.5	+16 44.33	+ 4.66	−25 3.45	− 2.65	+ 3 13.04	+ 42898	− 1329
	277 53 41.38	176 27 2.11	341 05 55.37	25 36 44.03	7 25 19.24	935.00978	3861269
	+ 6 57.84						
	278 00 39.22						

1870 Oct. 18.5 M = 31° 25' 45.37"
+ 16 44.33
31 42 29.70
+ 10.30
31 42 40.00

	1870	1872	1873	
sin Ω'	8.7918118	8.7918821	8.7917562	
cos i'	9.9550915	9.9550831	9.9550815	
cos Ω'	9.9991659n	~~9.9991656~~n	9.9991661n	
sin φ'	9.6357198	9.6357560	9.6357634	
− cos Ω'	9.9991659	9.9991656	9.9991661 ~~8.7917562~~	
cos i' sin Ω'	8.7469033	8.7469652	8.7468377	
tan A	1.2522626	1.2522004	1.2523284	
A	86 47 53.17	86 47 51.52	86 47 54.91	
log a	9.9998445	9.9998444	9.9998446	
− sin Ω'	8.7918118	8.7918821	8.7917562	
cos i' cos Ω'	9.9542574n	9.9542487n	9.9542476n	
tan B	8.8375544n	8.8376334n	8.8375086n	
B	−3 56 07.58	−3 56 10.15	− 3 56 06.09	
log b	9.9552827	9.9552743	9.9552726	
B	356 03 52.42	356 03 49.85	356 03 53.91	
A+ω'	67 27 10.75	67 50 18.59	67 53 50.28	
B+ω'	336 43 10.00	337 06 16.92	337 09 49.28	
ω'	340 39 17.58	341 02 27.07	341 05 55.37	
log a	9.9998445	9.9998444	9.9998446	
log b	9.9552827	9.9552743	9.9552726	
log e	9.6357198	9.6357560	9.6357634	
φ	7° 19' 19.14"	7 22 43.39	7 25 19.24	
½φ	3 39 39.57	3 41 21.70	3 42 39.62	
45°−½φ	41 20 20.43	41 18 38.30	41 17 20.38	
log tan(45°−½φ)	9.9443486	9.9439150	9.9435841	
log e	9.1053234	9.1086573	~~9.1148377~~	9.1111837
e	.1274452	.1284273	.1302680	.1291766
1+e				
1−e	.8725548	.8715727	.8697320	.8708234
log(1+e)	.0520954	.0524736	.0531814	.0527617
log(1−e)	9.9407927	9.9403036	9.9393855	9.9399304
log √(1+e)	.0260477	.0262368	.0265907	.0263808
log √a	.1930950	.1931885	0	.1930634
log √(1−e)	9.9703963	9.9701518	9.9696927	9.9699650
log √a(1+e)	.2191427	.2194253		.2194442
log √a(1−e)	.1634913	.1633403		.1630284
log e	9.1053234	9.1086573		9.1111837
log k	5.3144251	5.3144251		5.3144251
log e''	4.4197485	4.4230824		4.4256088

$\Delta i' = \cos\psi\, di' - \sin\psi \sin i' d\Omega''$

$d\Omega = \frac{\sin i' \cos\psi\, d\Omega' + \sin\psi\, di''}{\sin i}$

$d\pi = d\chi + (1-\cos i)\, d\Omega$

ψ = 32° 46'
i' = 2 37

log cos ψ 9.92474
log di'' 42404
log I .34878n
I − 2.23n
II −11.09
di' − 3.32

− log sin ψ 9.73337n
sin i' 9.63578
log dΩ' .66846
log II 0.03761n

log sin i' 9.63578
cos ψ 9.92474
log dΩ' .66846
log I 0.22898
I + 1.654
II − 1.437
dΩ +0.257

log sin ψ 9.73337
log di' .42404
log II .15741n

log(I+II)'' 9.40993
sin i' 8.65900
0.75093
dΩ +5.63

log(1−cos i') 7.01284
log dΩ .66846
log dΩ(1−cos i') 7.68130
dΩ(1−cos i') +.05
dχ −24 59.25
dπ −24 59.20
Ω + 5.63

π₀ 337° 50' 28.2"
− 24 59.2
π 337 25 29.0

dω −25 4.83
ω₀ 13 46 38.14
ω 13 21 33.31

− 25 4.83
13 51 34.10
13 26 29.27

Ω₀ ~~323 58 59.81~~
+ 5.63
Ω 324 00 5.44

323 58 54.1
+ 5.63
323 58 59.73

i' ~~2 36 48.2~~
Δi' − 3.32
i' ~~2 36 44.96~~

2 36 34.4
− 3.32
2 36 31.08

	1870 Sept. 24.5	1870 Oct. 18.5	1872 Mar. 5.5	1873 May 25.5	DM 24.0	
M	25 28 44.65	31 42 40.00	162 13 36.62	278 00 39.22	25 06 38.49	25 12 39.32
	28 55 48.40	36 00 12.65	164 13 87.31	270 36 36.29	28 33 46.53	28 41 44.10
E	9.6846141	9.7692554	9.4342914	9.9988753	9.6795403	9.6813823
	9.4197485	9.4197485	9.4230824	9.4256088	9.4148628	9.4170838
	9.1043626	4.1890039	8.8573738	9.4255841	9.0944031	4.0984661 3
	-12 716.35					
	+3 36 56.36	+4 17 32.68	+2 0 0.69	-7 24 03.06	3 27 8.05	3 29 4.87
E	29 01 17.73	36 00 12.68	164 13 37.31	270 36 36.16	28 33 46.54	28 41 44.20
½E	14 30 38.86	18 00 6.34	82 06 48.65	135 18 18.08	14 16 53.27	14 20 52.10
sin ½E	9.3989169	9.4900234	9.9958727	9.8471606	9.3921486	9.3941143
cos ½E	9.9859204	9.9782020	9.1373887	9.8517848	9.9863666	9.9862383
	9.6180586	9.7091661	.2152980	.0666048	9.6111086	9.6131186
	.1494117	.1416933	9.3007290	.0148132	.1503095	.1499354
tan ½v	9.4686469	9.5674728	0.9145690	.0517916	9.4607991	9.4631832
½v	16 23 38.53	20 16 23.50	83 03 32.415	48 24 29.95 131 35 30.05	16 06 56.95	16 11 59.62
v	32 47 17.06	40 32 47.00	166 07 04.83	263 11 00.10	32 13 53.90	32 23 59.24
log r	.3348752	.3389336	.4369852	.3855286	.3354412	.3350622
A+B+ω'	100 14 27.81	107 59 57.75	233 57 23.42	331 04 50.38	100 13 44.49	100 14 36.55
B+v+ω'	9 30 27.06	17 55 57.00	143 13 21.75	240 20 49.38	9 29 43.55	9 30 37.03
v+ω'	13 26 34.64	21 12 4.58	147 09 31.90	244 16 55.47	13 25 46.35	13 26 34.18
sin(A+v+ω')	9.9930253	9.9782079	9.9077179	9.6844664n	9.9930418	9.9930220
log r a	.3347197	.3387781	.4368296	.3853732	.3352856	8349068
sin(B+v+ω')	9.2179496	9.4724719	9.7772138	9.9390388n	9.2174022	9.2180749
log r b	.2901579	.2942163	.3922595	.3408012	2807037	2903313
sin(v+ω')	9.3663801	9.5582827	9.7342489	9.9546965n	9.3659547	9.3663762
log r c	9.9705950	9.9746534	.0727412	.0212920	9.9712461	9.9708400
x	+.21268892	+.20748467	.2107898	-.11744639	+.21297439	+.21277802
X	-1.0019707	-.8994842	+.9620910	+.4325916	-1.0019707	-1.0019707
x'	+1.1249185	+1.1753625	-1.2486988	-.7418723	1.1277732	+1.1258195
y	+.3221866	+.5843703	+1.4773156	-1.9047599	+.3221854	+.3224083
Y	-.0268533	-.3913523	-.2244328	+.8408186	-.0268533	-.0268533
y'	+.2953333	+.1930180	+1.2528833	-1.0639413	+.2953321	+.2955550
z	+.2172576	+.3411429	+.6411950	-.9462122	+.2173716	+.2173783
Z	-.0116479	-.1698059	-.0973822	+.3648259	-.0116479	-.0116479
z'	+.2056097	+.1713370	+.5438128	-.5813863	+.2057237	+.2057304
log sec δ cos α	.0511467	.0701718	.0964577	9.8703292n	.0522217	.0514687
log cos δ sin α	9.4703125	9.2855978	.0979123n	0.0269177n	.4703107	.4706383
log tan α	9.4191658	9.2154260	.0014546	0.1565885	9.4180890	9.4191696
α	14 42 34.15	9 19 33.14	-45 05 45.43	55 06 44.80		14 42 34.58
Δα			134 54 14.57	235 06 44.80		18.82
Δα	18.82	+20.75	-6.52	+6.14		
C α	14 42 52.97	9 19 53.89	134 54 8.05	235 06 50.94		14 42 53.40
O α	14 42 51.40	19 55.00	134 54 11.0	235 6 55.0		14 42 51.40
Δα(C-O)	+1.57	-1.1	-2.9	-4.1		+2.0"
log sec δ	0.0656189	.0759504	.2477012	.1129576		.0659411
log sin δ	9.3130436	9.2338512	9.7854494	9.7644648n		9.3132984
log tan δ	9.2474247	9.1579008	9.4877482	9.6515072n		9.2473573
δ	+10 01 29.93	8 11 8.46	~~17 50 39.88~~	-24 08 37.20		+10 01 24.45
	+7.21	+8.44	~~+3.82~~	-5.49		+7.21
C δ	+10 01 37.14	8 11 16.9	~~+17 50 43.7~~	-24 08 42.69		+10 01 31.66
O δ	+10 01 33.5	8 11 16.0	+17 05 20.65	-24 8 45.0		+10 01 33.5
Δδ(C-O)	+3.6	+0.9	+ +3.82	+2.3		-1.8
			+17 05 24.47			
			5 24.40			
			+0.1			
log a	.07230	.08040	~~.75995~~ .26731	.15272		

New Elements, Epoch Sept. 24.5 1870

M	π	Ω	i	φ	μ	log a
25 28 44.65	~~13 21 33.31~~ 13 26 29.27	~~324 00 05.44~~ 323 58 59.73	~~2 36 44.86~~ 2 36 31.08	7 19 19.14	984.8098	.8861901

Recomputation of Perturbations.

Jupiter

° ′ ″
Ω' 99 04 48 i' 1 18 39
Ω 323 59 00 2 36 31

i	2 36 31	Ω'	99 04 48
i'	1 18 39	Ω	323 59 00
$i'+i$	3 55 10	$\Omega'-\Omega$	135 05 48
$i'-i$	−1 17 52	$\frac12(\Omega'-\Omega)$	67 32 54
$\frac12(i'+i)$	1 57 35		
$\frac12(i'-i)$	−0 38 56		

$\sin\frac12(\Omega'-\Omega)$ 9.96577 $\cos\frac12(\Omega'-\Omega)$ 9.58196
$\sin\frac12(i'+i)$ 8.53399 $\sin\frac12(i'-i)$ 8.05404
$\sin\frac12 I \sin\frac12(N+N')$ 8.49976 7.63600n
$\sin\frac12 I \cos\frac12(N+N')$ 7.63600n
$\tan\frac12(N+N')$ 0.86376
$\frac12(N+N')$ −82 12 27
97 47 33
$\sin\frac12 I$ 8.50379
$\frac12 I$ 1 49 41

~~$\cos\frac12 I$~~ $\sin\frac12(\Omega'-\Omega)$ 9.96577 $\cos\frac12(\Omega'-\Omega)$ 9.58196
$\cos\frac12(i'+i)$ 9.99975 $\cos\frac12(i'-i)$ 9.99997
$\cos\frac12 I \sin\frac12(N-N')$ 9.96552 9.58193
$\cos\frac12 I \cos\frac12(N-N')$ 9.58193
$\tan\frac12(N-N')$ 0.38359
67 32 1+
$\frac12(N-N')$ 67 32 17 $\cos\frac12 I$ 9.99979
$\frac12(N+N')$ 97 47 33
N 165 19 50
ω 13 26 29
$\omega' = \omega-N$ 208 06 39

Tr. 1874

log 120k 0.31476
log 40m′k 2.13176

log $a\cos\varphi$ 9.99644
log $\cos^2\varphi$ 9.99288
log a 0.38619
log p 0.37907
p 2.3937 3
log m′
log e 9.10532
log sin i' 8.65814
φ × 7 19 19
$\frac12\varphi$ 3 39 39
log tan $\frac12\varphi$ 8.80605
$\frac12 i'$ 1 18 15
log e″ 4.41975
log $\sqrt{a}(1+e)$ 0.21914
log $\sqrt{a}(1-e)$ 0.16349
log p = 0.37852

log(1) $\frac{40m'k}{\sqrt p}$ ~~1.75233~~ 1.94223
log(2) $\frac{1}{\sin i'}$ 1.34186
log(3) $a\cos\varphi$ 0.38263
log(4) $\frac{p}{e}$ 1.27375
log(5) $\frac1e$ 0.89468
log(6) $\tan\frac12 i'$ 8.35729
log(7) $\frac{120ke}{\sqrt a}$ 9.22699
log(8) $\frac{120k}{\sqrt a}p$ 0.50074
log(9) $p\tan\frac12\varphi$ ~~8.42658~~ 9.18512
log(10) $2\cos\varphi$ 0.29747
log(11) $\tan\frac12\varphi$ 8.80605
$p\cot\varphi$ log(12) 1.27019
$\cot\varphi$ log(13) 0.89112

~~N'~~
N' 30 15 46 30 15 19
Ω' 323 59 00 99 4 48
$N'+\Omega'$ 354 14 16 129 20 07
I 3 39 22 3 39 22

♃
Ω' 99 04 48 i' 1 18 39
Ω 324 02 52 i 2 36 40
$\Omega'-\Omega$ 135 01 56 $i'+i$ 3 55 19
$\frac12(\Omega'-\Omega)$ 67 30 58 $i'-i$ −1 18 01
$\frac12(i'+i)$ 1 57 40
$\frac12(i'-i)$ −0 39 00

♄
112 32 00 2 29 30
324 2 52 2 36 40
148 29 08 5 06 10
$\frac12(\Omega'-\Omega)$ 74 14 34 − 07 10
$\frac12(i'+i)$ +2 33 05
$\frac12(i'-i)$ −0 03 35

Tr. ♃

9.96566
8.58429
8.49995n
7.63732n
0.86263n
−82 11 15
97 48 45

9.96566
9.99975
9.96541
9.58251
0.38290
67 30 21
97 48 45
N 165 19 06
ω 13 46 01
$\omega-N$ 208 26 55
N' 30 18 24
Ω' 99 4 48
$N'+\Omega'$ 129 23 12

9.58254
8.05478
7.63732

9.58254
9.99997
9.58251

$\sin\frac12 I$ 8.50400
$\frac12 I$ 1 49 44
I 3 39 28

9.98336
8.64857
8.63187
6.45188n
2.17999
89 37 17n
90 22 43

9.98336
9.99957
9.98293
9.43387
0.54906
74 13 40
90 22 43
N 1[illegible] 36 23
ω 13 46 01
$\omega-N$ ~~150 50 22~~
$\omega-N$ 209 09 38
N' 16 09 03
Ω' 112 32 00
$N'+\Omega'$ 128 41 03

9.43387
7.01801n
6.45188n

9.43387
10.

8.63187
$\frac12 I$ 2 27 20
I 4 54 40

	1870 Sept. 18	Oct 28	Dec 7	1871 Jan 16	Feb. 25	Apr 6	May 16	Jun 25	Aug 4	Sept. 13	Oct 23
M	23 47 29	34 10 41	44 33 53	54 57 06	65 20 18	75 43 30	86 06 42	96 29 54	106 53 32	117 0 10	127 22 48
E	27 07 12	38 44 55	50 10 24	61 21 37	72 17 39	82 58 20	93 24 44	103 35 45	113 20 42	123 07 53	132 45 14
sin E	9.65883	9.79607	9.88535	9.94332	9.97812	9.99672	9.99923	9.98766	9.96291	9.92294	9.86586
log e''	4.41975	4.41975	4.41975	4.41975	4.41975	4.41975	4.41975	4.41975	4.38364	4.34367	4.28659
log e'' sin E	4.07858	4.21498	4.30510	4.36307	4.39867	4.41647	4.41898	4.40741			
e'' sin E	+3 19 43	4 38 14	5 36 28	6 24 31	6 57 22	7 14 50	7 17 21	7 05 51	6 43 10	6 7 43	5 22 26
E_1	27 07 12	38 44 55	50 10 21	61 21 37	72 17 40	82 58 20	93 24 03	103 35 45	113 20 42	123 07 53	132 45 14
$\frac{1}{2}E_1$	13 33 36	19 22 27	25 05 10	30 40 48	36 08 50	41 29 10	46 42 02	51 47 52	56 40 21	61 33 56	66 22 37
sin ½ E_1	9.37008	9.52079	9.62734	9.70778	9.77075	9.82115	9.86200	9.89533	9.92197	9.94417	9.96199
cos ½ E_1	9.98772	9.97468	9.95697	9.93452	9.90714	9.87455	9.83620	9.79130	9.73991	9.67775	9.60284
log √ sin ½ E_1	9.58922	9.73993	9.84698	9.92692	9.98989	.04029	.08114	.11447	.14130	.16350	.18132
log √ cos ½ E_1	.15721	.13817	.12046	.09801	.07063	.03804	9.99969	9.95479	9.90346	9.84130	9.76639
log tan ½ v	9.43801	9.60176	9.72602	9.82891	9.91926	.00225	.08145	.15968	.23784	.32220	.41493
½ v	15 19 54	21 47 16.5	28 01 09	33 59 44	39 42 17	45 08 55	50 20 31	55 18 14	59 57 93	64 32 09	68 57 39
v	30 39 48	43 34 33	56 02 18	67 59 28	79 24 34	90 17 50	100 41 02	110 36 28	119 55 06	129 04 18	137 55 18
ω /	13 26 29	13 26 29	13 26 29	13 26 29	13 26 29	13 26 29	13 26 29	13 26 29	13 41 26		
log r	33390	34072	34920	35882	36902	37936	38944	39900			
u = v + ω	44 06 17	57 01 02	69 28 47	81 25 57	92 57 03	103 44 19	114 07 31	124 02 57	133 36 32	142 45 44	151 36 44
log sin u	9.84259	9.92368	9.97153	9.99513	9.99946	9.98739	9.96031	9.91832	9.85978	9.78184	9.67709
log r	33390	34072	84920	35882	36902	37936	.38944	.39900	40790	41576	.42256
log cos u	9.85617	9.73591	9.54475	9.17313	8.69667n	9.37567n	9.61144	9.74811	9.83868n	9.90098n	9.94436n
log 3 sin u	0.17649	.26440	.32073	.35395	.36848	.36675	.34975	.31732	.26768	.19760	.09965
log 2 cos u	.19007	.07663	9.89395	9.53195	9.06569n	9.75503n	.00088n	.19711n	.24658	.31674	.36692
log sin v	9.70756	9.83842	9.91877	9.96714	9.99254	9.99999	9.99241	9.97628	9.93782n	9.89006n	9.82617n
log cos v	9.93459	9.86002	9.74713	9.57344	9.26432	7.71496n	9.26809n	9.54610n	9.69811	9.79954	9.87054
log cos E	9.94942	9.89204	9.80650	9.68061	9.48306	9.08761	8.77321n	9.34120n	9.59799n	9.73764n	9.83179n
cos v	.86019	.72447	.55863	.37475	.18379	.00519	−.18539	−.35197	−.49802	−.63029	−.74224
cos E	.89007	.77990	.64048	.47931	.30413	+.12234	−.05932	−.23507	−.39627	−.54657	~~−.72428~~ .67885
cos v + cos E	+1.75026	+1.50437	+1.19915	+0.85406	+.48792	+.11715	−.24471	−.58704	−.89529	−1.17686	−1.42109
log (cos v + cos E)	0.24310	0.17735	.07886	9.93149	9.68835	9.06874	9.38865n	9.76867n	0.95196n	0.07072n	.15262n
log (p + r)	33390	34072	34920	35882	36902	37936	38944	39900			
log p/2	.04517	.03835	.02987	.02025	.01005	9.99971	9.98963	9.98007			
p/2	+1.1096	+1.0923	+1.0712	+1.0477	+1.0234	+.9993	+.9744	+.9551	+.93632	+.91950	+.90524
p/2 + 1	0.32420										
log (p/2 + 1)	32420	.32062	.31622	.31127	.30608	.30088	.29544	.29117	.28698	.28319	.27995
log 2 sin u	.04146	.17914	.26797	.32596	.36156	.37935	.38185	.37028	.34572	.30582	.24873
log 2 sin u (p/2 + 1)	.36566	.48976	.58419	.63723	.66764	.68023	.67729	.66145	.63270	.58901	.52868

	Dec 2	1872 Jan 11	Feb 20	Mar 31	May 10	Jun 19	Jul 29	Sept 7	Oct 17	Nov 26	1873 Jan 5
M	137 45 26	148 08 04	158 27 51	168 50 39	179 13 27	189 36 15	199 59 03	210 21 51	220 44 39	231 07 27	241 30 15
E	142 14 20	151 36 51	160 52 29	170 06 30	179 18 45	188 30 54	197 44 31	207 01 17	216 22 56	225 50 42	235 26 43
sin E	9.78701	9.67707	9.51539	9.23493	8.07914	9.17046	9.48391	9.65736	9.77318	9.86579	9.91577
log e''											
log e'' sin E	4.20774	4.09780	~~9.93612~~ 3.93847	3.65801	2.50222	3.59354	3.90659	4.08044	4.19626	4.27887	4.33875
e'' sin E	4 28 54	3 28 46	2 24 39	1 15 50	+0 5 18	−1 5 22	−2 14 32	−3 20 34	−4 21 53	−5 16 45	−[illegible] 3 37
E_1	142 14 20	151 36 50	160 52 30	170 06 29	179 18 45	188 30 53	197 44 31	207 01 17	216 22 46	225 50 42	235 26 38
$\frac{1}{2}E_1$	71 07 10	75 48 25	80 26 15	85 03 15	89 39 22	94 15 26	98 52 15	103 30 38	108 11 23	112 55 21	117 43 19
sin ½ E_1	9.97598	9.98654	9.99392	9.99838	9.99999	9.99880	9.99477	9.98781	9.97774	9.96428	9.94705
cos ½ E_1	9.50999	9.38950	9.22043	8.93558	7.77829	8.87060	9.18811	9.36846	9.49438	9.59049	9.66763
log √ sin ½ v	~~9.72932~~	~~9.60883~~	~~9.43986~~	~~9.15501~~	~~7.99772~~	.21823	.21420	.20724	.19717	.18391	.16648
log √ cos ½ v	9.67354	9.29587 9.55305	9.21335 9.38377	9.21781 9.09892	7.21942 7.94163	9.03394	9.35145	9.53180	9.65772	9.75383	9.83097
log tan ½ v	~~.05578~~	~~.05578~~	.82938	1.11889	2.27799	1.18429	.86275	.67544	.53545	.42988	.33551
½ v	.52177	.65282				−86 15 23	−82 11 23	78 04 41	73 53 35	69 36 48	65 12 40
½ v	73 15 38	77 27 37	81 34 42	85 39 03	89 41 52	93 44 35	97 48 37	101 55 19	106 06 25	110 23 12	114 47 20
v	146 31 16	154 55 14	163 09 24	171 18 06	179 23 44	187 29 10	195 37 14	203 50 38	212 12 50	220 46 24	229 34 40
ω											
u = v + ω	160 12 42	168 36 40	176 50 50	184 59 32	193 05 10	201 10 36	209 18 40	217 32 04	225 54 16	234 27 50	243 16 06
log sin u	9.52962	9.29549	8.74035	8.93962n	9.35496n	9.55980n	9.68982n	9.78479n	9.85623n	9.91049n	9.95094n
log r	42822	43272	43612	43812	43886	43832	43650	43342	42912	42360	41692
log cos u	9.97357n	9.99136n	9.99934n	9.99835n	9.98857n	9.96919n	9.94050n	9.89927n	9.84252n	9.76434	9.65303
log 3 sin u	9.95784	9.72821	9.17647	9.37774n	9.79377n	9.99612n	.12630n	.21821n	.28535n	.33409n	.36783n
log 2 cos u	.40175n	.42408n	.43546	.43647n	.42743n	.40751	.37700n	.33269	.27164	.18794	.06995
log sin v	9.74165	9.62724	9.46203n	9.17964	8.02323n	9.11490n	9.430[illegible]	9.60664n	9.72679n	9.81496n	9.88158n
log cos v	9.92121	9.95699	9.98096	9.99448	9.99997	9.99628	9.9836[illegible]	9.96126	9.92740	9.87927	9.81185
log cos E	9.89794n	9.94437n	9.97534n	9.99350n	9.99997n	9.99519n	9.97889n	9.94980	9.90585n	9.84298n	9.75873n
~~log cos v~~											
cos v	−.83409	−.90572	−.95711	−.98857	−0.99994	−.99148	−.96308	−.91467	−.84607	−.75731	−.64841
cos E	−.79058	−.87978	−.94480	−.98515	−0.99994	−.98900	−.95245	−.89085	−.80511	−.69660	−.56720
cos v + cos E	−1.62467	−1.78550	−1.90191	−1.97366	−1.99988	−1.98048	−1.91553	−1.80552	−1.65118	−1.45391	−1.21561
log (cos v + cos E)	0.21076n	.25176n	.27912n	.29527n	.30101n	.29677n	.28229n	.25660n	.21779n	.16253n	.08479n
log p/2	.89350	.88431	.87709	.87306	.87157	.87266	.87636	.88256	.89134	.90274	.91678
log (p/2 + 1)	.27727	.27518	.27349	.27255	.27220	.27245	.27331	.27475	.27677	.27938	.28256
log 2 sin u	9.76587	.05996	9.89815	9.61776	8.46209	9.55322	9.86668	.04006	.15591	.23856	.28447
log 2 sin u (p/2 + 1)	.44714	.33571	.17164	9.89031	8.73429	9.82567	.13999	.31481	.43268	.51791	.58103

	1873 Feb 14	Mar 26	May 5	Jan 14	July 14 ~~Aug 4~~	July 24 ~~Aug 13~~	Sept 12 ~~Sept 2~~	Oct 12 (4.42299)	Nov 21	Dec 31	~~Jan 20~~ Feb 9 1874
M	257 58 03	262 15 51	272 38 39	283 01 27	~~293 24 15~~ 282 35 24	~~303 47 03~~ 292 58 42	~~314 09 57~~ 303 22 00	313 45 18	324 08 36	334 31 54	344 55 12
E	245 12 15	255 09 06	265 18 38	275 42 07	275 15 51	285 54 11	296 48 00	307 57 15	319 21 02	330 57 40	342 44 15
sin E	9.95799	9.98525	9.98854	9.99789	9.99910	9.98305	9.95065	9.89680	9.81387	9.68610	9.47239
log e						4.42299	4.42299	4.42299	4.42299	4.42299	4.42299
log e″ sin E	4.38107	4.40833	4.42162	4.42093	4.42299	4.40604	4.37364	4.31979	4.23686	4.10909	3.89538
e″ sin E	−6 40 48	−7 06 46	−7 20 01	−7 19 20	−7 19 33	−7 04 31	−6 34 00	−5 48 03	−4 47 34	−3 34 16	−2 10 59
E	245 12 15	255 9 05	265 18 38	275 42 07	275 15 51	285 54 11	296 48 00	307 57 15	319 21 02	330 57 38	342 44 13
½E	122 36 07	127 34 32	132 39 19	137 51 03	137 37 55	142 57 06	148 24 00	153 58 37	159 40 31	165 28 49	171 22 06
sin ½E	9.92554	9.89903	9.86655	9.82676	9.82859	9.77995	9.71932	9.64220	9.54076	9.39918	9.17633
cos ½E	9.73144	9.78519	9.83097	9.87006	9.86855	9.90207	9.93030	9.95357	9.97208	9.98590	9.99505
	.14497	0.11846	.08598	.04619	.04789	9.99925	9.93862	9.86150	9.76006	9.64848	9.39563
	9.89478	9.94853	9.99431	0.03340	.03178	.06530	.09353	.11680	.13531	.14913	.15828
tan ½v	.25019	.16993	.09167	.01279	.01611	9.93395	9.84509	9.74470	9.62475	9.46935	9.23735
½v	−60 39 36	−55 56 02	−51 00 10	−45 50 19	−46 03 46	40 39 36	34 59 30	29 03 12	22 57 12	16 25 09	9 47 59
v	119 20 24	124 03 58	128 59 50	134 09 41	133 56 14	139 20 24	145 00 30	150 56 48	157 08 48	163 34 51	170 12 01
2v	238 40 48	248 07 56	257 59 40	268 19 22	267 52 28	278 40 48	290 01 00	301 53 36	314 17 36	327 09 42	340 24 02
ω					13 46 03						
u = v + ω′	252 22 14	261 49 24	271 41 06	282 00 48	281 38 31	292 26 57	303 47 03	315 39 39	328 03 39	340 55 45	354 10 05
log sin u	9.97911n	9.99556n	9.99982n	9.99038n	9.99097n	9.96578n	9.91967n	9.84442n	9.72344n	9.51420n	9.00694n
log r	.40918	.40044	.39092	.38088	.38100	.37058	.36024	.35040	.34162	.33442	.32932
log cos u	9.48125	9.15298	8.46834	9.31883	9.30491	9.58187	9.74513	9.85444	9.92871	9.97548	9.99775
log r sin u	.38829n	.39600n	.39074n	.37126	.37197n	.33636	.27991	.19482n	.06509	9.84862	9.33626
log r cos u	9.89043n	9.55342n	8.85926n	9.69923n	9.68591n	9.95245	.10537	.20484	.27033n	.30990n	.32707n
log sin v	9.93160n	9.96757n	9.99040n	9.99981	9.99970n	9.99509n	9.97294n	9.92892	9.85478	9.73422n	9.52562n
log cos v	9.71585n	9.57109n	9.31808	8.46641	8.56925	9.17873	9.53440	9.72291n	9.84406n	9.92438	9.97408
log cos E	9.62261n	9.40869n	8.91254n	8.99718n	8.96259n	9.43777	9.65406	9.78870	9.88007	9.94165	9.97948
cos v	−.51980	−.37247	−.20806	−.02927	−.03709	+.15092	+.34230	+.52834	+.69833	+.84020	+.94208
cos E	−.41939	−.25627	−.08176	+.09935	+.09175	+.27400	+.45088	+.61504	+.75870	+.87429	+.95495
cos v + cos E	−.93919	−.62874	−.28982	+.07008	+.05466	+.42492	+.79318	1.14338	1.45703	1.71449	1.89703
log (cos v + cos E)	9.97275n	9.79847n	9.46213n	8.84559	8.73767	9.62831	9.89937	0.05819	0.16346	0.23414	.27807
log p					9.99792	.00834	.01868	.02852	.03730	.04450	.04966
$\frac{p}{2}$	.93322	.95219	.97329	.99605	~~9.99962~~ .99523	1.01940	1.0439	1.0679	1.0897	1.1079	1.1210
log $(\frac{p}{2}+1)$	.28628	.29052	.29519	.30017	.29999	.30522	.31046	.31553	.32008	.32385	.32654
log r sin v	.34078n	.36801n	.38132n	.38069n	.38070n	.36558n	.33318n	.27932n	.14640n	.06864n	9.85494n
log $(\frac{p}{2}+1)$ r sin v	.62706	.65853n	.67651n	.68086n	.68066n	.67080n	.64364n	.59485n	.57648n	.39249n	.18148n

			° ′	° ′	° ′	° ′		° ′	° ′
326 17	336 10		346 58	358 18	10 11	22 35	2+A+ω′	35 27	41
235 33	245 26		256 15	267 34	279 27	291 57	2+B+ω′	304 43	317 57
239 29	249 22		260 10	271 30	283 23	295 47	2+ω′	308 39	321 54
9.74436n	9.60646n		9.35318	8.47226	9.24748	9.58436	sin(2+A+ω′)	9.76342	9.87568
.35076	.38084		.37042	.36008	.35024	.34146	log r a	.33426	.32916
9.91625	9.95879		9.98737	9.99961	9.99407	9.96762	sin(2+B+ω′)	9.91486	9.82593n
.34618	.33626		.32584	.31550	.30566	.29688	log r b	.28508	.28458
9.93525	9.97121		9.99357	9.99885	9.98804	9.95445	sin(2+ω′)	9.84264	9.79031n
.02672	.01880		.00638	9.99604	9.98620	9.97742	log r c	9.57022	9.46512
+1.3650	+.9712		−.5292	−.0680	+.3960	+.8430	x	+1.2522	+1.6027
+.7138	+.1169		−.2195	−.7836	+1.0030	−.7694	y	−.1787	+.4966
−.18299	−.19727		−.20569	−.20659	−.19940	−.18390	z	−.16015	−.12898
+.6546	+.9258		+.9107	+.5884	+.0082	−.5741		−.8880	−.7745
−.9162	−.9728		−1.0000	−.9906	−.9424	−.8548		−.7292	−.5694
+.2841	+.4017		+.3452	+.2550	+.0036	−.2491		−.3853	−.3382
9.81371	9.93161n		.05926	9.93024	9.78319	8.86688			
.06415n	.01991n		9.87431	.16953	.29794	.38257			
.25544	.08830		.18595	.23929	.51475	.51569			
60 57.3	50 47.1		56 53.1	60 25	73 0.2	85 57.9			
16 3.8	15 23.1		15 57.5	16 0.2	16 52.0	17 43.9			

+1.2522	+1.6027
+.1683	+.3626
−1.6015	−1.2898
~~−.8885~~	−.5745
−.7292	−.5694
−.3855	−.2494
.15275	.32389
.39620	.27059
.24345	9.89670
60 16.8	38 15.0
299 43.2	321 45.0
310 58	
.45745	.47885
~~.00604~~	9.91377
~~.21406~~	
5.58971 9.58881	9.43486
−21 14.7	−15 12.5
18 29	
log a .48799	.49433
453	

33218

11 15

.491

				h m									log a	
294	48			19 58.9	44.6		~~26 15~~ ~~−29 29~~						.48888	+5
310	53	11	10	20 43.5		1.1	18 32	2	46	37			458	+1
321	45	10	52	21 27.0	43.5	1.3	15 14	3	18	32			454	−4
332	18	10	33	22 9.2	42.2		11 25	3	44	28			450	8
342	31	10	13	22 50.1	40.9	1.3	7	8	4	12	18		482	13
352	23	9	52	23 29.5	39.4	1.5	−2 41	4	28	8			469	17
1	58	9	35	0 7.9	36.4	1.0	+1 38	4	19	1			452	22
11	18	9	20	0 45.2	37.3	1.1	9 53	4	18	21			430	27
20	11	8	53	1 20.4	35.5	1.8	13 28	3	57	22			403	32
28	41	8	30	1 54.4	34.0	1.5	16 33	3	35	30			371	38
36	32	7	51	2 26.1	31.4	2.6	19 5	3	05	32			333	44
43	20	6	48	2 53.3	27.2	4.2	20 57	2	32	40			289	48
48	37	5	17	3 14.5	21.2	6.0	22 16	1	52	33			241	52
51	13	+2	36	3 24.9	+10.4	10.8	22 46	1	19	43			189	46
50	47	−0	26	3 23.2	−1.8	12.2	22 17	+	.30				143	38
47	08	−3	39	3 8.5	14.6	12.8	20 38	−	.25				115	4
42	0	−5	8	2 48.0	20.5	+5.9	19 29	1	19				119	37
38	11	−3	45	2 32.4	15.3	−5.2	18 41	1	24				156	57
37	20	−0	51	2 29.3	34	11.9		1	48				213	

Mar 21	Apr 30	Jun 9	July 19	Aug 28	Oct 7	Nov 16	Dec 26 1215	~~Dec 46~~				
355 18 30	5 41 48	16 05 06	26 28 24	36 51 42	47 15 00	57 38 18	68 01 36	78 24 54				
354 37 04	6 32 02	18 24 28	30 10 12	41 45 42	53 8 07	64 15 55	9.98523					
9.97220	9.05611	9.49938	9.70119	9.82350	9.90312	9.95464	9.98522					
4.42299	4.42299	4.42299	4.42299	4.42299	4.42299	4.42299	4.42281					
4.39519	3.47910	3.92237	4.12418	4.24649	4.32611	4.37763	4.40821					
−0 41 24	50 14	+2 19 23	+3 41 50	+4 54 00	+5 53 09	6 37 37	7 6 38					
354 37 06	6 32 02	18 24 29	30 10 14	41 45 42	53 08 09	64 15 55	75 08 14					
177 18 33	3 16 01	9 12 14	15 05 07	20 52 51	26 34 04	32 04 57	37 34 07					
8.67160	8.75578	9.20398	9.41540	9.55197	9.65656	9.72581	9.78512					
9.99952	9.99929	9.99437	9.98477	9.97050	9.95154	9.92779	9.89907					
8.89090	8.97508	9.42328	9.63470	9.77127	9.86986	9.94571	.00442					
0.16275	9.16252	0.15960	.14808	.13373	.11477	.09102	.06230					
9.72815	8.81256	9.26568	9.48670	9.63754	9.75509	9.85408	9.94212					
−3 3 40	+3 42 58	10 26 46	17 03 01	23 27 48	29 38 19	35 33 05	41 11 36					
176 56 20												
353 52 40	7 25 56	20 53 32	34 06 02	46 55 36	59 16 38	71 06 10	82 23 12					
7 38 43	21 11 59	34 39 35	47 52 05	60 41 39	73 02 41	84 52 13	96 09 15					
9.12304	9.55825	9.75488	9.87017	9.94151	9.98070	9.99826	9.99749					
.32674	.32690	.32972	.33504	.34242	.35134	.36122	.37160					
9.99612	9.96957	9.91515	9.82662	9.68658	9.46484	8.95139	9.03021n					
9.44978	9.88515	.08460	.20521	.28393	.33204	.35948	.36909					
.32286	.29647	.24487	.16166	.02900	9.81618	9.31261	9.40181					
9.02796	9.11178	9.58219	9.74869	9.86361	9.93432	9.97594	9.99615					
9.99752	9.99634	9.97046	9.91806	9.83437	9.70833	9.57038	9.12217					
9.99808	9.99717	9.97719	9.93678	9.87269	9.77809	9.63769	9.40969					
+99432	.99162	.93425	.82806	.68293	.51090	.32388	.13248					
+99560	.99351	.94885	.86453	.74592	.59992	.43420	.25650					
1.98992	1.98513	1.88310	1.69259	1.42885	1.11082	.75808	.38898					
0.29883	0.29728	0.27487	0.22855	0.15497	0.04462	9.87972	9.58993					
.05218	.05202	.04920	.04388	.03650	.02758	.01770	.00732					
.11277	.11273	.11200	.11063	.10877	.10616	.10416	.10120					
32791	32783	32634	32352	31967	31505	30997	30471					
9.35470	9.43868	9.88191	08373	20603	28566	33716	36775	27 32 18	40 34 12	53 10 00	65 15 28	76 48 34
9.68261	9.76651	.20825	.40725	.52570	.60071	.64713	.67246 pr	33209	33850	34673	35619	36638
								Jun 29	Aug 8	Sept 17	Oct 27	Dec 6
62 10	75 43	89 11	102 23	115 13	127 34	139 23	150 41	95 50	108 52	121 27	133 33	145 06
331 26	344 59	358 27	11 39	24 39	36 50	48 39	59 57	5 5	18 08	30 43	42 49	54 22
335 22	348 55	2 23	15 36	28 25	40 46	52 36	63 53	8 2	22 04	34 39	46 45	58 18
9.94660	9.98636	10.00000	9.98978	9.95651	9.89908	9.81358	9.68887	9.99774	9.97602	9.93098	9.86020	9.75751
32658	32674	32956	33488	34226	35118	36106	37144	33193	33834	34657	35603	36622
9.67959n	9.41344n	8.43216n	9.30521	9.62021	9.77778	9.87546	9.93731	9.94745	9.49308	9.70824	9.83229	9.90896
.28200	.28216	.28498	.29030	.29778	.30660	.31648	.32686	.28735	.29376	.30199	.31145	.32164
9.61994n	9.28384n	8.61894	9.42962	9.67750	9.81490	9.90005	9.95323	9.19592	9.57482	9.75478	9.86235	9.92982
9.96154	9.96270	9.96552	9.97084	9.97822	9.98714	9.99702	.00740	9.96789	9.97430	9.98253	9.99194	.00218
+1.8758	+2.0564	+2.1358	+2.1119	+1.9896	+1.7793	+1.4950	+1.1516	2.1364	2.0624	1.8948	1.6453	1.3296
+.9359	+.9396	+.5181	−.1322	−.7251	−.9996	−.8245	−.2650	−.1322	−.7251	−.9996	−.8245	−.2680
−.9154	−.4962	−.0521	+.3940	+.8279	+1.2144	+1.5558	+1.8373	.1717	.6121	1.0238	1.3923	1.7045
−.3000	+.3207	+.7980	+.9248	+.6498	+.0905	−.5079	−.8695	+.9248	+.6498	+.0905	−.5078	−.8690
−.3815	−.1764	+.0384	+.2515	+.4526	+.6339	+.7890	+.9133	.1458	.3541	.5461	.7150	.8551
−.1302	+.1391	+.3462	+.4012	+.2819	+.0393	−.2203	−.3772	+.4012	+.2819	+.0393	−.2203	−.3773
+1.8758	2.0564	2.1358	2.1119	1.9896	1.7793	1.4950	+1.1516					
+.9968	+.7731	+.2045	−.4541	−.9144	−.9691	−.5815	+.0783					
−.9154	−.4962	−.0521	+.3940	+.8279	+1.2144	+1.5558	+1.8373					
+.0110	+.5932	+.9124	+.8339	+.3925	−.2217	−.7332	−.8992					
−.3815	−.1764	+.0384	+.2515	+.4526	+.6339	+.7890	+.9133					
+.0048	+.2574	+.3959	+.3618	+.1703	−.0962	−.3181	−.3902					
45828	45171	36927	21953	03149	9.90859	9.96071	0.08987	30194	.12623	9.95192	9.91424	0.02596
9.95636	8.90877	9.93465	08916	08650	9.99682	9.91519	9.97225	−04001	101.02	04700	9.94670	92169
9.49808	8.53506	9.56538	9.86963	.05501	.08823	9.95448	9.88238	9.73807	9.97479	.09508	.03246	9.89573
−17 28.5	+1 59.8	20 11.0	36 31.5	48 37.0	50 47.0	42 0.0	37 20.0	28 41	43 20.3	51 13.3	47 8.3	38 11.3
342 31.5 352 23	~~356 53 81~~ 1 88							.35881 ~~.21688~~	.26451 23930	.15514	.08157	.13052
.47880	.45187	.39679	.31650	.21126	.10765	.08984	.18944					
9.57600	8.90818	9.63779	9.78767	9.79442	9.73054	9.67293	9.71885	9.~~76474~~ 73788	9.80346	9.76745	9.69434	9.67925
9.09720	8.45651	9.24100	9.47316	9.58316	9.62289	9.58329	9.52914	9.37917	9.53895	9.61231	9.61275	9.54873
−7 7.8	+1 38.2 −3 40	+9 53.0	+16 33.3	+20 57.3	+22 45.8	+20 57.7	+18 41.0	13 27.9	19 4.8	22 16.3	22 17.5	19 29.0
.48217	.45215	.40328	.33288	.24098	.14287	.11938	.21285	.37091	.28906	.18881	.11533	.15613
	469	430										

Lr
334
332 2
329 3
327 2
327 0
327 4
327
328
330
332
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338
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361
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372

Integration for June 25 1871 For ♃

	$\iint \frac{d^2v}{dt^2}$	$d\mu$	di	$d\Omega$	$d\varphi$	$d\pi$	dM	ω
	−95''	−.855''	+1	−13	+1'00''	+14'44''	−13'25''	
		934.806	2 36 31	323 59 00	7 19 19	337 25 29	−1 35	~~132 29~~
							−15 00	
							96 29 54	
							96 14 54	
		933951	2 36 32	323 08 47	7 20 19	337 40 13		134126
1872 ~~May 5~~ Feb 20 Feb. 20.5	−5'15''	−.6030	+8''	−.20''	+3'24''	+21'27''	−21'17''	−21'17
							158 30 42	158 49 08 01h
		934.203	2 36 39	323 58 40	7 22 43	337 46 56	158 09 25	158 27 51 134816
							+15	
1873 May 25		+.2088	+9''	−20''	+6'0''	+24'9''	158 24 26	
							−23 6''	
		935.010	2 36 40	323 58 40	7 25 19	337 49 38	277 53 42	
							−5 11 40	
						May 5	272 42 2 Ep.	

7 22 38

	1871 Jun 25	1872 Feb. 20	1873 May 25
φ	7 20 19	7 22 43	7 25 19
$\frac{1}{2}\varphi$	3 40 10	3 41 21	3 42 39
log tan $\frac{1}{2}\varphi$	8.80707	8.80941	8.81196
log μ	2.97032	2.97044	2.97082
log k	3.55001	3.55001	3.55001
log a	.38646	.38638	.38612
log $\sqrt{a}$	.19323	.19319	.19306
log cos φ	9.99643	9.99639	9.99635 9.99639
log cos² φ	9.99286	9.99278	9.99270
log a	.38646	.38638	.38612
log p	.37932	.37916	.37882
log $\sqrt{p}$	.18966	.18958	.18941
log e	9.10630	9.10866	9.11118
e	.12773	.12843	.12918

	1871	1871 Jun 25	1872 Feb. 20	1873 May 25
Ω				
N		165 19 50	165 19 50	165 19 50
ω		134126	134816	135058
ω − N		208 21 36	208 28 26	208 31 08
N'		30 15 19	30 15 19	30 15 19
Ω'		99 4 48	99 4 48	99 4 48
N + Ω'		129 20 07	129 20 07	129 20 07
I		3 39 22	3 35 22	3 35 22

37892

e + 1				
−e + 1	.87227			
log $\sqrt{1+e}$	0.2610			
log $\sqrt{a}$	.19323			
log $\sqrt{1-e}$	9.97032			
log $\sqrt{(1+e)a}$	.21933	.21943	21944	
log $\sqrt{(1-e)a}$	.16355	.16334	16303	

log a 38614

♃ ♄

log e	9.10630			9.10856
log e	5.31443			
log e''	4.42073	4.41993	4.42561	
log h'	8.65818	8.66851 4.42308	8.65850	8.65855
log 40 m' k	2.13176 = ♃	(1.60779 = ♄)		
log 120 k	.31476			
log (1) $\frac{40 m' k}{\sqrt{p}}$	1.94210	1.94218	1.94235	1.94230 1.41833
log (2) $\frac{1}{\sin i}$	1.34186	1.34149	1.34148	1.24145
log (3) a cos φ	.38289	38277	38247	.38253
log (4) $\frac{p}{e}$	1.27302	1.27050	1.26764	1.27036
log (5) $\frac{1}{e}$	0.89370	89134	88882	0.89144
log (6) tan $\frac{1}{2}$ i	8.35717	8.35759	8.35764	8.35745
log (7) $\frac{120 ke}{\sqrt{a}}$	9.22783	9.23023	9.23288	9.23025
log (8) $\frac{120 kp}{\sqrt{a}}$	.50085	50073	50052	.50061
log (9) p tan $\frac{1}{2}\varphi$	9.18639	.18857	9.19078	9.18826
log (10) 2 cos φ	.29746	29742	29738	.29742
log (11) tan $\frac{1}{2}\varphi$	8.80707	8.80941	8.81196	8.80934
log (12) p cot φ	1.26944	1.26650	1.26392	1.26674
log 13 cot (φ)	0.89012	.88774	.88517	.88782

	Sept. 18 1870	Oct 28	Dec 7	Jan 16	Feb 25	Apr 6	May 16	Jun 25	Aug 4	Sept 13	Oct 23
L'	73 53 09	77 22 28	80 50 41	84 17 48	87 93 48	91 8 41	94 32 24	97 55 00	101 16 27	104 86 46	107 55 57
u' = L' − (☊ + Ω')	304 33 02	308 02 21	311 30 34	314 57 41	318 23 41	321 48 34	325 12 17	328 34 53	331 56 20	335 76 39	338 30 50
lg sin u'											
lg sin I											
lg tan u'											
lg cos I											
lg tan λ'											
λ'	304 36 20	308 5 43	311 35 04	315 01 11	318 27 09	321 51 57	325 15 34	328 38 00	331 59 15	335 19 19	338 38 13
g	30 39 48	43 34 33	56 2 18	67 59 28	79 24 34	90 17 50	100 41 02	110 36 28	119 55 06	129 04 18	137 55 16
ω'	208 6 39	208 6 39	208 6 39	208 6 39	208 6 39	208 06 39	208 06 39	208 06 38	208 21 36	208 21 36	208 21 36
v + ω'	238 46 27	251 41 12	264 08 57	276 05 07	287 31 13	298 24 29	308 47 41	318 43 07	328 16 42	337 25 54	346 16 54
λ' − (v + ω')	65 49 53	56 24 31	47 26 07	38 55 04	30 55 56	23 27 28	16 27 53	9 54 29	3 42 33	357 53 25	352 21 19
lg sin β'	8.72040n	8.70097n	8.67906n	8.65445n	8.62683n	8.59585n	8.56104n	8.52175n	8.47715n	8.42608n	8.36687
lg r'	.70492	70603	70717	70833	70952	71073	71194	71316	71439	71562	71684
lg cos β'	9.99940	9.99945	9.99950	9.99956	9.99961	9.99966	9.99971	9.99976	9.99980	9.99985	9.99988
lg z' = lg r' sin β'	9.42532n	9.40700n	9.38623n	9.36278n	9.33635n	9.30658n	9.27298n	9.23491n	9.19154n	9.14170n	9.08371
lg sin(λ' − v + ω')	9.96010	9.92065	9.86718	9.79810	9.71098	9.59996	9.45244	9.23577	8.81085	8.56606n	8.12395n
lg r' cos β'	70432	70548	.70667	70789	.70913	.71039	.71165	71292	71419	71547	71672
lg cos(λ' − v + ω')	9.61247	9.74293	9.83022	9.89100	9.93338	9.96254	9.98182	9.99264	9.99909	9.99971	9.99612
lg cos γ' = cos β' cos(λ' − v + ω')	9.61187	9.74238	9.82972	9.89056	9.93299	9.96220	9.98153	9.99348	9.99889	9.99956	9.99600
lg r'	.70492	70603	70717	70833	70952	71073	71194	71316	71439	71562	71684
lg sin γ'	9.96022	9.92089	9.86759	9.79878	9.71205	9.60173	9.45567	9.23677	8.80919	8.56054	9.12378
lg r' cos γ'	0.31679	0.44841	.53689	.59889	.64251	.67293	.69347	.70660	.71328	.71518	.71284
r' cos γ'	−2.0739	−2.8081	−3.4427	−3.9709	−4.3905	−4.7090	−4.9371	−5.0887	−5.1675	−5.1902	−5.1623
ρ	2.1572	2.1914	2.2347	2.2847	2.3390	2.3953	2.4476	2.5062	2.5580	2.6044	2.6458
ρ − r' cos γ'	+.0833	−.06167	−1.2080	−1.6862	−2.0515	−2.3137	−2.4855	−2.5825	−2.6095	−2.5855	−2.5165
lg r' sin γ' = lg Q sin l'	.66514	.62692	.57476	.50711	.42157	.31246	.16761	9.94993	9.52358	9.27616	9.84062
lg Q cos l'	8.92064	9.79007	0.08207	22691	31207	36431	39541	0.41204	41656	41257	40080
lg tan l'	1.74450	.83685	.49269	.28020	.10950	9.94815	9.77220	9.53764	9.10702	8.86362	9.43982
log Q	.66521	.63147	59613	55989	52417	49049	.46063	43667	42009	41370	.41666
lg ρ	9.33479	9.36853	9.40387	9.44011	9.47583	9.50951	9.53937	9.56313	9.57991	9.58630	9.58834
lg 1/ρ³	8.00437	8.10559	8.21161	8.32033	8.42749	8.52853	8.61811	8.68939	8.73973	8.75890	8.75002
lg 1/2.1											
lg 1/2.3											
1/2.3	~~.007678~~										
1/ρ³	.010101	.012752	.016278	.020909	.026769	.033770	.041506	.048909	.054920	.057399	.056238
−1/2.3	007678	7619	7560	7499	7438	7376	7314	.007253	.007192	.007131	.007071
Δ = 1/ρ³ − 1/2.3	+.002423	.005133	.008718	.013410	.019330	.026394	.034192	.041656	.047728	.050268	.049167
lg Δ	7.38435	7.71037	7.94042	8.12743	8.28605	8.42151	8.53392	8.61968	8.67877	8.70129	8.69167
lg z'	9.42532n	9.40700n	9.38623n	9.36278n	9.33635n	9.30658n	9.27298n	9.23491n	9.19154n	9.14170	9.08371
lg (1)	1.94223n	1.94223n	1.94223n	1.94223	1.94223	1.94223	1.94223n	1.94210n	1.94210n	1.94210	1.94210
log W₀	8.75190n	9.05960n	9.26888n	9.43244n	9.56463	9.67032n	9.74913n	9.79669n	9.81241n	9.78509n	9.71748
lg Δ	7.38435	7.71037	7.94042	8.12743	8.28605	8.42151	8.53382	8.61968	8.67877	8.70129	8.69167
lg y'	66442	62613	.57385	50599	42011	31035	16409	9.94861	9.52504	9.28153n	9.84064
log S₀	9.99100	0.27873	0.45650	0.57565	0.64839	0.67409	0.64024	~~0.50877~~ 51029	~~0.15311~~ .14591	9.92492n	~~0.47444~~ .53229n
log 2	33350	34072	34926	35882	36902	37936	38944	39900	40790	41576	42256
lg 1/ρ³	8.00437	8.10559	8.21161	8.32033	8.42749	8.52853	8.61811	8.68939	8.73573	8.75890	8.75002
lg 2/ρ³	8.33827	8.44631	8.56081	8.67915	8.79651	8.90789	9.00755	9.08839	9.14764	9.17466	9.17258
lg 4	8.00437	8.10559	8.21161	8.32030	8.42745	8.52853	8.61811	8.68939	8.73573	8.75850	8.75002
lg x	31679	44841	53689	59889	64257	67293	68347	70660	71328	71578	71284
lg 4x	8.32116	8.55400	8.74850	8.91922	9.07000	9.20146	9.31158	9.39599	9.45301	9.47408	9.46286
4x	.020949	.035810	.056046	.083028	.11749	.15902	.20492	.24888	.28380	.29791	.29031
−2/ρ³	−.021791	−.027946	−.036376	−.047770	−.06259	−.08089	−.10175	−.12258	−.14049	−.14951	−.14879
4x − 2/ρ³	−.000842 ~~8158~~	+.007864	+.019669	+.035258	+.05490	+.07813	+.10317	+.12630	+.14331	+.14840	+.14152
lg 4	7.35435	7.71037	7.94042	8.12743	8.28605	8.42151	8.53382	8.61968	8.67877	8.70129	8.69167
lg x'	.31679	44841	53689	59889	64257	67293	68347	70660	71328	71578	71284
lg 4x'	7.70114	8.15878	8.47731	8.72632	8.92856	9.09444	9.22739	9.32628	9.39205	9.41647	9.40451
lg(4x − 2/ρ³)	.005025	.014414	.030013	.053250	.084830	.12429	.16881	.21197	.24663	.26090	.25381
lg (1)	−.021791	−.027946	−.036376	−.047770	−.06259	−.08089	−.10175	−.12258	−.14049	−.14957	−.14879
lg R	−.016766	−.013532	−.006363	+.005480	+.02222	+.04340	+.06706	+.08939	+.10614	+.11139	+.10502
	8.22443n	8.13136n	7.80366n	7.73878	8.34713	8.63749	8.82646	8.95129	9.02588	9.04685	~~9.01416~~ 9.02127
	0.16666n	0.07359n	9.74589n	9.68101	0.28936	0.57972	.76869	.89352	.96798	.98895	.96337

1871 Dec 2	1872 Jan 11	Feb 20	Mar 31	May 10	June 19	July 29	Sept. 7	Oct 17	Nov 26	Jan 5	Feb. 14	Mar 26
208 2136	208 2136	208 2826	208 2826	208 2826	208 2826	208 2826	208 2826	208 2826	208 2826	208 2826	208 2826	208 2826
146 3116	154 5514	163 924	171 1806	179 2344	187 2910	195 3714	203 5038	212 1250	220 4624	229 3440	238 4048	248 456
341 5559	345 1236	348 2807	351 4234	354 5559	358 824	1 1949	3 3025	7 3958	10 4837	13 5631	17 0340	20 1004
~~208 2636~~	~~208 2776~~	~~208 2836~~										
354 5252	3 1650	11 3850	19 46 32	27 5210	35 5736	44 0540	52 1904	60 4116	69 1450	78 0306	87 0914	96 3622
347 0307	341 5546	336 50 17	331 56 02	327 0349	322 1048	317 1409	312 11 21	306 5837	301 3347	295 5325	289 5426	283 3342
8.2970n	28.21251n	8.10634n	7.96448n	7.75160n	7.31689n	7.17136	7.59210	7.93062	8.07866	8.18741	8.27293	8.34298
~~71796~~	~~71920~~	~~72040~~	~~72159~~	~~72274~~	~~72386~~	~~72494~~	~~72598~~	~~72701~~	~~72798~~	~~72888~~	~~72974~~	~~73056~~
71805	71926	72044	72161	72275						72893	72982	73067
9.99991	9.99994	9.99996	9.99998	9.99999	10.00000	10.00000	9.99999	9.99988	9.99997	9.99995	9.99992	9.99989
9.01507n	8.93177n	8.82678n	8.68609n	8.47435n	8.04075n	7.89630n	8.31809	8.65763	8.80665	8.91634	9.00275	9.07365
							87653					
9.35038n	9.49162n	9.59497n	9.67255n	9.73537	9.78759n	9.83186	9.[illegible]	9.90248	9.93047	9.95406n	9.97324	9.98772n
71796	71920	72040	72159	72274	72386	72494	72598	72700	72796	72888	72974	73056
9.98882	9.97803	9.96350	9.94567	9.92390	9.89759	9.86580	9.[illegible]	9.77924	9.71887	9.64015	9.53212	9.37013
							9.82710					
9.98873	9.97797	9.96346	9.94565	9.92389	9.89759	9.86580	9.[illegible]	9.77922	9.71884	9.64010	9.53204	9.37001
71805	71926	72044	72161	72275	72386	72494	72599	72701	72799	72893	72982	73067
9.35190	9.49215	9.59497	9.67260	9.73538	9.78460	9.81849	[illegible]	9.90248	9.93048	9.95407	9.97325	9.98773
.70678	.69723	.68390	.66726	.64664	.62145	.59074	[illegible]	.50623	.44683	.36903	.26186	.10068
−.50908	−.49800	−.48296	−.46480	−.44324	.41827	.38971	.34424	.32080	.27979	−2.3380	−.18275	−.12609
2.6818	2.7085	2.7297	2.7423	2.7470	2.7436	2.7321	2.7122	2.68612	2.6522	2.6117	2.5656	2.5144
−.24090	−.22715	−.20998	−.19057	−.16854	−.14391	−.11650	0.[illegible]	−0.5218	−.1457	+.2727	+.7381	+.12535
9.38184	0.35631	0.32218	0.28005n	0.22670	0.15809	0.06633	9.[illegible]	9.71750	9.16346	9.43569	9.86812	0.09812
.06596	.21141	.31541	.39421	.45813	.51146	.55678	[illegible]	.62949	.65847	.68300	.70307	.71840
9.68811	9.85510	9.99323	.11416	.23143	.35337	.49045	[illegible]	.91199	1.49501	1.24731	.83455	.62028
.42817	.44624	.46968	.49510	.52240	.55041	.57836	.60688	.63273	.65824	.68369	.70766	.73053
9.57183	9.55376	9.53032	9.50490	9.47860	9.44959	9.42164	9.38412	9.36727	9.34176	9.31631	9.29234	9.26947
~~8.75354~~ 8.71549	8.66028	8.59096	8.51470	8.43280	8.34877	8.26492	8.18236	8.10182	8.02528	7.94893	7.87702	7.80841
~~.005794~~	~~.004574~~	~~.003805~~	~~.003271~~	~~.002709~~	~~.002232~~	~~.001840~~	~~.001476~~	~~.001264~~	~~.001060~~	.008891	.007534	.006433
.051984	.045739	.038[illegible]	.032712	−.027090	.022324	.018404	.015218	.012642	.010600			
.007012	.006954	.006897	.006858	.006788	.006736	.006686	.006638	.006591	.006547	.006505	.006465	.006427
+.044922	.038785	.032054	.025854	.020302	.015588	.011718	.008640	.006051	.004053	+.002386	+.001065	+.000006
8.65246	8.58866	8.50642	8.41253	8.30754	8.19279	8.06885	7.93349	7.78183	7.60778	7.37767	7.02898	4.77815
9.01507n	8.93177n	8.82678n	8.68609n	8.47435n	8.04075n	7.89630	8.31809	8.65763	8.80665	8.91634	9.00275	9.07365
1.94210	1.94210	1.94218	1.94218	1.94218	1.94218	1.94218	1.94218	1.94218	1.94218	1.94218	1.94218	1.94218
9.60963n	9.46253n	9.27538n	9.04080n	8.72407n	8.17572n	7.90733	8.19376n	8.38164	8.35661	8.23619	7.97391	5.79398
8.65246	8.58866	8.50642	8.41253	8.30754	8.19279	8.06885	7.93349	7.78183	7.60778	7.37767	7.02898	4.77815
.06834n	.21082n	.31517n	.39414n	.45811n	.57145n	.55680n	.59576	.62948	.65843	.68294	.70288	.71828
.88290n	0.74158n	0.76377n	0.74885n	.70783n	.64642n	.56783n	.47143n	.35349n	.20839n	.00279n	9.67414n	7.43861n
42822	43272	43612	43812	43886	43832	43650	43342	42912	42360	41692	40918	40044
8.71549	8.66028	8.59096	8.51470	8.43280	8.34877	8.26492	8.18236	8.10182	8.02528	7.94893	7.87702	7.80841
9.14371	9.09300	9.02708	8.95282	8.87166	8.78709	8.70142	8.61578	8.53094	8.44888	8.36585	8.28620	8.20885
8.65246	8.58866	8.50642	8.41253	8.30754	8.19279	8.06885	7.93349	7.78183	7.60778	7.37767	7.02898	4.77815
70678	69723	68390	66726	64664	62145	59074	55808	50624	44683	36903	26186	.10069
9.35924	9.28589	9.19032	9.07977	8.95418	8.81424	8.65959	8.48657	8.29007	8.05461	7.74670	7.29084	4.87884
+.22869	+.19315	.15499	.12017	.08988	.065200	.045666	.030660	.019501	.011340	.005581	.001954	.000076
−.13922	−.12388	−.10644	.08970	.07447	.061249	.050283	.041284	.033958	.028112	.023220	.019329	.016174
+.08947	+.06927	+.04855	+.03047	+.015573	+.003951	−.004617	−.010624	−.014457	−.016772	−.017639	−.017375	−.016098
8.95168	8.84055	8.68619	8.48357	8.19237	7.59671	7.66436	8.02629	8.16008	8.22458	8.24647	8.23992	8.20677
0.89378	0.78265	0.62837	.42605	.13455	9.53889	9.60654n	9.96849n	0.10226n	0.16676n	0.18865n	0.18210n	0.14895n

	May 5	Jun 14	Jun 14	July 24	Sep 2	Oct 12	Nov 21	Dec 31	Feb 9	Mar 21
L'	151 05 383	154 11 14	155 43 50	158 48 33	161 52 43	164 56 21	167 59 30	171 02 13	174 04 34	177 06 35
u' = L' − (Ω' + ω')	~~16 20 39~~ 23 16 22	26 23 43	26 20 38	29 25 21	32 29 31	35 33 09	38 36 18	41 39 01	44 41 22	47 43 23
log sin u'			9.64715	9.69130	9.73012	9.76451	9.79515	9.82255	9.84412	9.86917
log tan I			8.80480							
log tan u'			9.69477	9.75127	9.80404	~~9.84840~~ 9.85322	9.90223	9.94910	9.99529	.04134
log cos I			9.99911							
log tan λ'	23 15 48	26 20 56	9.69388	9.75038	9.80316	9.85411	9.90134	9.94821	9.99440	.04045
λ'	~~168 23 12~~		26 17 51	29 22 21	32 26 18	35 29 57	38 32 51	41 35 31	44 37 52	47 39 53
v	257 59 40	268 19 22	267 52 28	278 40 48	290 01 00	301 53 36	314 17 36	327 9 42	340 24 02	353 52 40
ω'	208 28 26	208 28 26	208 26 55							
v + ω'	106 28 06	116 48 48	116 19 23	127 07 43	138 27 55	150 20 31	162 44 31	175 36 37	188 50 57	202 19 35
λ' − (v + ω')	276 47 42	269 33 08	269 58 28	262 14 38	253 58 23	245 09 20	235 48 20	225 58 54	215 46 55	205 20 18
log sin β'	8.40197	8.45260	8.45195	8.49610	8.53452	8.56931	8.59995	8.62735	8.65192	8.67397
log r'	.73147	.73222	.73222	.73292	.73356	.73415	.73469	.73517	.73559	.73595
log cos β'	9.99986	9.99983	9.99983	9.99979	9.99974	9.99970	9.99966	9.99961	9.99956	9.99952
log z' = log r' sin β'	9.13344	9.18482	9.18417	9.22902	9.26848	9.30346	9.33464	9.36252	9.38751	9.40992
log sin λ' − (v + ω')	9.99694n	9.99958	10.00000n	9.99601n	9.98278n	9.95782n	9.91758n	9.85680n	9.76693	9.63141n
log r' cos β' } ψ'	9.73133	.73205	.73205	.73271	.73330	.73385	.73435	.73478	.73515	.73547
	9.07308	7.89293n	6.64936n	9.13023n	9.44105n	9.62341n	9.74974n	9.84192n	9.90915n	9.95607
log cos λ' (v + ω') λ' ψ'										
			6.64919	9.13002	9.44079	9.62311	9.74940	9.84153	9.90871	9.95559
log cos γ' = cos β' cos (λ' − v ω)	9.07294	7.89276n	~~7.38146~~	~~9.86294~~	~~.17435~~	~~.35726~~	~~.48408~~	~~.57670~~	.64430	.69154
log r'	73147	73222	73222	73291	73356	73415	73469	73517	73559	73595
log sin γ'	9.99694	9.99999	10.00000	9.99601	9.98261	9.95789	9.91773	9.85715	9.76778	9.63349
log 2r' cos γ'	9.80441	8.62498	7.38141	9.86293	.17435	.35726	.48409	.57670	.64430	.69154
−2r' cos γ'	−.63740	+.04217n	+.00241	+.72934	+1.4940	+2.2765	+3.0485	+3.7732	+4.4086	+4.9152
r²	+2.45995	2.40370	2.40450	2.34740	2.2821	2.2408	2.1960	2.1598	2.1346	2.1220
r² − 2r cos γ'	+1.82255	+2.44587	2.40691	3.07674	3.7861	4.5173	5.2445	5.9330	6.5432	7.0372
log z' = log ρ sin β	.72841	.73221	.73222	.72892	.71637	.69204	.65242	.59232	.50337	.36944
log ρ cos β	~~.245995~~ .26067	0.38844	.38146	.48809	.57819	.65488	.71970	.77327	.81580	.84741
log tan β	.46774	0.34377	.35076	.24083	.13818	.03716	9.93272	9.81905	9.68757	9.52203
log ρ	.75224	.77276	.77160	.79082	.80861	.82478	.83917	.85164	~~.83380~~ .86283	.87020
log 1/ρ	9.24776	9.22724	9.22840	9.20916	9.19139	9.17522	9.16083	9.14836	9.13717	9.12980
log 1/ρ³	7.74328	7.68172	7.68520	7.62754	7.57417	7.52566	7.48249	7.44508	7.41391	7.38940
log 1/r'³			2.19666	2.19873	2.20068	2.20245	2.20407	2.20551	2.20677	2.20785
log 1/r'³			7.80334	7.80127	7.79932	7.79755	7.79593	7.79449	7.79323	7.79215
1/ρ³	.005537	.004806	.0048440	.0042418	.0037512	.0033548	.0030374	.0027866	.0025936	.0024613
−1/r'³	−.006391	−.006356	−.0063583	63281	62997	62741	62508	62301	62120	61966
Δ	−.000854	−.001552	−.0015143	−.0020863	−.0025485	−.0029193	−.0032134	−.0034435	−.0036184	−.0037453
log Δ	6.93146n	7.19089n	7.18021n	7.31938n	7.40628n	7.46528n	7.50696n	7.53700n	7.55852n	7.57349n
log z'	9.13344	9.18482	9.18417	9.22902	9.26848	9.30346	9.33464	9.36252	9.38757	9.40992
A(1)	1.94218	1.94218	1.94230							
log W₀	8.00708n	8.31789n	8.30668n	8.49070n	8.61706n	8.71104n	8.78390n	8.84182n	8.88833n	8.92571n
log Δ	6.93146n	7.19089n	7.18021n	7.31938n	7.40628n	7.46528n	7.50696n	7.53700n	7.55852n	7.57349n
log y'	72827	73203	73205	72872	71608	69167	65193	59158	50208	366[illegible]
log S₀	9.60197n	9.86510n	9.85456	9.99046n	0.06466	0.09925	0.10119	0.07088	.00290	9.88267
log 2	39092	38058	38100	37058	36024	35040	34162	33442	32932	32674
log 1/ρ³	7.74328	7.68172	7.68520	7.62754	7.57417	7.52566	7.48249	7.44508	7.41391	7.38940
log 2/ρ³	8.13420	8.06260	8.06620	7.99812	7.93441	7.87606	7.82411	7.77950	7.74323	7.71614
log Δ	6.93146n	7.19089n	7.18021n	7.31938	7.40628	7.46528	7.50696n	7.53700n	7.55852	7.57349n
log x	9.80441n	8.62498n	7.38141n	9.86294	.17435n	.35726n	.48409	.57670	.64430n	.69154n
log Δx	6.73587	5.81587	4.56162	7.18232	7.58063	7.82254	7.99105	8.11370	8.20282	8.26503
Δx	−.000543	+.000065	+.0000036	+.001522	+.003807	+.006646	+.009796	+.012993	+.015952	+.018409
2/ρ³	−.013621	−.011550	−.011647	−.009957	−.008598	−.007517	−.006670	−.006019	−.005536	−.005202
Δx − 2/ρ³	−.014164	−.011485	−.011643	−.008435	−.004791	−.000871	+.003126	+.006974	+.010416	+.013207
log	8.15119n	8.06013n	8.06606n	7.92609n	7.68043n	6.94002n	7.49499	7.84348	8.01770	8.12080
log R₀	.09337n	0.00231n	.00836n	9.86839n	9.62273n	8.88232n	9.43729	9.78578	9.96000	0.06310

Jul 30	Aug 9	Aug 19	Aug 28	Sept 7	Sept 16
180 8 19	183 09 50	186 11 10	189 12 23	192 13 31	195 14 38
50 45 07	53 46 38	56 47 58	59 49 11	62 50 19	65 51 26
	9.90673	9.92260	9.93674	9.94926	9.96025
9.88897					
0.08799	.13520	.18416	.23541	.28982	.34849
.08690	.13431	.18327	.23452	.28893	.34760
50 41 40	53 43 20	56 44 46	59 46 08	62 47 29	65 48 45
7 25 56	20 53 32	34 06 02	46 55 36	59 16 38	71 6 10
215 52 51	229 20 27	242 32 57	255 22 31	267 43 33	279 33 05
194 48 49	184 22 53	174 11 49	164 23 37	153 03 56	146 15 40
8.69377	8.71153	8.72740	8.74154	8.75406	8.76505
.73626	.73650	.73668	.73680	.73686	.73683
9.99947	9.99942	9.99938	9.99934	9.99930	9.99926
9.43003	9.44803	9.46408	9.47834	9.49092	9.50188
9.40769	8.88307	9.00479	9.42980	9.62488	9.74461
.73573	.73592	.73606	.73614	.73616	.73609
9.98532	9.99873	9.99777	9.98369	9.95751	9.91992
9.98479	9.99815	9.99715	9.98303	9.95681	9.91916
~~.72105~~	~~.73465~~	~~.73383~~	~~.71983~~	~~.69367~~	~~.65599~~
.73626	.73650	.73668	.73680	.73686	.73683
9.41505	8.96417	9.05728	9.43798	9.62805	9.74627
.72105	.73465	.73383	.71983	.69367	.65599
+.52608	+.54282	+.54180	+.52461	+.49399	+.45259
2.1228	2.1366	2.1629	2.2000	2.2456	2.2973
7.3836	7.5648	7.5809	7.4461	7.1855	6.8262
.75131	9.70067	9.79396	.17478	.36491	.48310
.86827	.87880	.87972	.87193	.85646	.83418
9.28304	8.82187	8.91424	9.30285	9.50845	9.64893
.87612	.87975	.88118	.88052	.87754	.87336
9.12388	9.12025	9.11882	9.11948	9.12206	9.12644
7.37164	7.36075	7.35646	7.35844	7.36618	7.37932
2.20878	2.20950	2.21004	2.21040	2.21058	2.21049
7.79122	7.79050	7.78996	7.78960	7.78942	7.78951
.0023531	.0022948	.0022723	.0022827	.0023237	.0023851
61833	61731	61654	61603	61578	61590
−.0038302	−.0038983	−.0038931	−.0038776	−.0038341	−.0037639
7.58323	7.58864	7.59030	7.58856	7.58366	7.57564
9.43003	9.44803	9.46408	9.47834	9.49092	9.50188
8.95536	8.97897	8.99668	9.00926	9.01688	9.01982
7.58323	7.58864	7.59030	7.58856	7.58366	7.57564
14342	9.61899	9.74085	16554	36104	.48070
9.66895	9.14953	9.27345	9.69680	9.88700	9.99864
37164					
32680	32972	33504	34242	35134	36122
~~7.79122~~	~~7.79050~~	~~7.78996~~	~~7.78960~~	~~7.78942~~	~~7.78951~~
~~8.81812~~	7.36075	7.35646	7.35844	7.36618	7.37932
7.69854	7.69047	7.69150	7.70086	7.71752	7.74054
7.58323	7.58864	7.59030	7.58856	7.58366	7.57564
72105	73465	73383	71983	69367	65599
8.30428	8.32329	8.32413	8.30839	8.27733	8.23163
+.020150	+.021052	+.021093	+.020342	+.018938	+.017046
−.004995	−.004903	−.004915	−.005022	−.005218	−.005502
+.015155	+.016149	+.016178	+.015320	+.013720	+.011544
8.18056	8.20815	8.20892	8.18526	8.13735	8.06236
0.12286	0.15045	0.15122	0.12776	0.07965	0.00466

	1870			1871							
	Sept. 18	Oct 28	Dec 7	Jan 16	Feb. 25	Apr. 6	May 16	June 25	Aug 4	Sept 13	Oct 23
$di\ r\cos u\ W_0$	-.087	-.137	-.146	-.092	+.043	+.266	+.0562	+.879	+1.146	+1.264	+1.215
$d\Omega$-(2) $r\sin u\ W_0$	-1.863	-4.633	-8.540	-13.435	-18.835	-23.929	-27.589	-28.568	-26.421	-21.113	-14.421
(3) $\sin v\ R_0$	-1807	-1.971	-1.115	+1.073	+4619	+9169	+13.923	+17.680	+19.428	+18265	+14165
(3) $(\cos v + \cos E)\ S_0$	+4138	+6898	+8279	+7758	+5241	+1335	-2579	-4588	-3025	+2389	+10.232
$d\varphi$	+2.331	+4.927	+7.164	+8.831	+9.860	+10.504	+11.344	+13.092	+16.401	+20.654	+25.097
-(4) $\cos v\ R_0$	+23.714	+16.120	+5845	-3377	-6721	+0.370	+20.443	+51.734	+86.919	+115220	+127918
+(5) $(\frac{p}{2}+1)\ r\sin v\ S_0$	+17.838	+47.116	+86.173	+128.100	+162.445	+177.420	+163085	116525	+47.023	-25564	-76654
(6) $2\sin u\ W_0$	-2	-5	-9	-14	-19	-25	-29	-30	-28	-22	-15
$d\pi$	+41550	+63231	+92.009	+124.714	+155.705	+177.765	+183.499	+168.229	+133.914	+89.634	+49.049
-(7) $\sin v\ R_0$	+1262	+1377	+0779	∓0750	∓3228	∓6408	∓9730	∓1.2354	∓1.3548	∓1.2765	∓1.0408
-(8) $\frac{1}{2}\ S_0$	-1.4383	-2.4463	-4.0555	-5.2188	-6.0272	-6.2441	-5.6434	-4.0929	-1.7333	+1.0233	+3.5705
$d\mu$	-1.3121	-2.6086	-3.9776	-5.2938	-6.3500	-6.8849	-6.6164	-5.3283	-3.0911	~~+.7444~~ -.2556	+2.5297
-(9) $\cos v\ R_0$	+.193	+.131	+.048	-.027	∓.055	+.088	+.167	+.422	+.710	+.944	+1.048
-(10) $r\ R_0$	+6.281	+5.150	+2.358	-2.174	-9.033	-18.053	-28.550	-38.904	-47.135	-50.370	-48.239
+(11) $(\frac{p}{2}+1)\ r\sin v\ S_0$	+.145	+.384	+.703	+1.045	+1.324	+1.447	+1.329	+.950	+.385	-.209	-.646
(6) $r\sin u\ W_0$	-.002	-5	-9	-14	-19	-25	-29	-30	-28	-22	-15
dL	+6.616	+5.660	+3.100	-1.170	-7.783	-16.628	-27.083	-37.562	-46.068	-49.607	-47.852
+(12) $\cos v\ R_0$	-23.520	-15.988	-5797	+3349	+6666	-.3678	-20.276	-57.311	-86.206	-114270	-126870
-(10) $r\ R_0$	+6281	+5.150	+2.358	-2.174	-9.033	-18.053	-28.550	-38.904	-47.135	-50.370	-48.239
-(13) $(\frac{p}{2}+1)\ r\sin v\ S_0$	-17.692	-46.732	-85.470	-127.060	-161.120	-175.975	-161.680	-115.575	-46.638	+25.354	+78.206
dM =	-34.931	-57.570	-88.909	-125.885 *	-163.487	-194.366 ×	-210.506	-205.790	-179.979	-139.286	-96.903

1873										
	May 5	June 14	July 24	Sept 2	Oct 12	Nov 21	Dec 31	Feb. 9	Mar 21	Apr 30
$di'\ r\cos u\ W_0$	-.001	-.010	-.028	-.053	-.082	-.113	-.142	-.164	-.177	-.179
$d\Omega$ (2) $r\sin u\ W_0$	+.548	+1.047	+1.474	+1.731	+1.767	+1.550	+1.076	+.368	-.520	-1.521
(3) $\sin v\ R_0$	+2928	+2484	+1.762	+0951	+0.156	-473	-799	-738	-298	+414
(3) $(\cos v + \cos E)\ S_0$	-280	+094	+1003	+2221	+3467	+4438	+4870	+4608	+3665	+2235
$d\varphi$	+2.648	~~+2.550~~ +2.552	+2.765	+3.172	+3.623	+3.865	+4.071	+3.870	+3.367	+2.647
(4) $\cos v\ R_0$	-4808	-.705	+2.077	+2.696	+0751	-3562	-9560	-16.231	-21.456	-24.569
(+5) $(\frac{p}{2}+1)\ r\sin v\ S_0$	-14788	-26717	-35.698	-39.787	-38.508	-32.293	-22637	-11.907	-2.869	+2123
(6) $r\sin u\ W_0$	+.000	+.001	+1	+2	+2	+2	+1	+0	-0	-1
$d\pi$	-19.591	-27.415	-33.620	-37.109	-37.755	-35.853	-32.196	-28.138	-24.325	-22.447
(-7) $\sin v\ R_0$	-2061	-1731	-1241	-0670	-0110	+0333	+0563	+0520	+0210	+0292
(-8) $\frac{1}{2}\ S_0$	-.5150	-.9422	-1.3196	-1.6034	-1.7761	-1.8204	-1.7261	-1.4934	-1.1390	-.6961
$d\mu$	-.7211	-1.1153	-1.4437	-1.6704	-1.7871	-1.7871	-1.6698	-1.4414	-1.1180	-.7253
(-9) $\cos v\ R_0$	-.040	-.005	+.017	+.022	+.006	-.029	-.079	-.134	-.178	-.203
(-10) $r\ R_0$	+6049	+4862	+3439	+1.907	+.339	-1.192	-2.498	-3.861	-4.867	-5.587
(+11) $(\frac{p}{2}+1)\ r\sin v\ S_0$	-.122	-.221	-.296	-.329	-.319	-.267	-.187	-.096	-.024	+.018
+(6) $r\sin u\ W_0$	+0	+1	+1	+2	+2	+2	+1			-1
dL	+5.887	+4.636	+3.161	+1.602	+628	-1.486	-2.964	-4.094	-5.069	-5.773
(+12) $\cos v\ R_0$	+4.768	+0.699	-2060	-2654	-.745	+3533	+9.481	+16.096	+21.277	24.365
(-10) $r\ R_0$	+6.049	+4.862	~~-1.3196~~ +3439	~~-1.6034~~ +1.907	~~-1.7761~~ +0.339	~~-1.8204~~ -1.192	~~-1.7261~~ -2.498	~~-1.4934~~ -3.861	~~-1.1390~~ -4.867	~~-.6961~~ -5.587
(-13) $(\frac{p}{2}+1)\ r\sin v\ S_0$	+1.466	+26.489	+35.402	+39.456	+38.187	+32.025	+22.449	+11.809	+25.386	-2.105
	+25.478	+32.080	36.781	38.709	37.781	34.367	29.431	24.014	19.248	16.673

1872

1.23	Dec 2	~~Jan 11~~	~~Feb 20~~	~~Mar 31~~	~~May 10~~	~~June 19~~	~~July 29~~	~~Sept 8~~	~~Oct 18~~	~~Nov 26~~	14 Jan 5	Feb 14	Mar 26
15	+1.028	+0.770	+.514	+.300	+.142	+.038	+.019	−.034	−.045	−.035	−.020	.007	−.000
21	−.8176	−.3409	−0.621	+.576	+.723	+.326	+.237	−.567	−1.020	−1.062	−.882	−.505	−.003
65	+10.431	+6.206	+2.973	+.974	+.035	−.109	+.263	+.408	+1.629	+2.310	+2.838	+3.137	+3.157
32	+18.057	+23.781	+26.652	+26.723	+24.638	+21.182	+17.096	+12.806	+8.996	+5.671	+2.954	+1.071	+.004
99	+28.488	+29.987	+29.626	+27.697	+24.673	+21.073	+17.359	+13.814	+10.625	+7.986	+5.792	+4.208	+3.161
918	+122.460	+102.960	+75.829	+49.151	+25.411	+6.393	−7.256	−15.857	−19.960	−20.727	−18.664	−14.738	−9.784
854	−100.875	−93.410	−67.105	−33.925	−2.156	+23.091	+39.734	+47.598	+47.590	41.461	+29.865	+15.580	+0.097
15	− 8	− 3	− 1	+ 1	+ 1	+ 0	+ 0	− 1	− 1	− 1	− 1	0	0
049	+21.582	+9.547	+8.723	+15.225	+23.257	+29.484	+32.478	+31.740	+27.629	+20.788	+11.200	+0.842	−9.687
808	−.7299	−.4342	−.2092	−.0685	−.0024	+.0077	−.0185	−.0639	−.1146	−.1629	−.1997	−.2208	−.2222
105	+3.4390	+6.4523	+6.7357	+6.4783	+5.8844	+5.1149	+4.2861	+3.4594	+2.6613	+1.9298	+1.2207	+.5830	+.0034
97	+4.140 +4.7091	+6.0181	+6.5265	+6.4098	+5.8820	+5.1226	+4.2676	+3.3935	+2.5467	+1.7669	+1.0210	+.3622	−.2188
048	+1.0034	+.843	+.628	+.407	+.210	+.053	−.060	−.131	−.165	−.168	−.155	−.122	−.081
239	−41.636	−32.571	−23.010	−14.507	−7.427	−1.882	+2.190	+5.004	+6.742	+7.722	+7.998	+7.739	+7.028
646	−.826	−.760	−.556	−.281	−.018	+.191	+.329	+.394	+.384	+.343	+.247	+.129	+.001
15	− 8	− 3	− 1	+ 1	+ 1	+ 0	+ 0	− 1	− 1	− 1	− 1		~~1.048~~
.852	−41.467	−32.496	−22.939	−14.380	−7.234	−1.638	+2.459	+5.267	+6.971	+7.897	+8.090	+7.746	+6.948
870	−124.600	−102.210	−75.203	−48.745	−25.201	−6.340	+4.196	+15.726	+19.795	+20.556	+18.510	+14.617	9.707
239	−41.636	−32.571	−23.010	−14.507	−7.427	−1.882	+2.190	+5.004	+6.742	+7.722	+7.998	+7.739	+7.028
206	+100.035	+92.6213	+66.557	+33.644	+21.378	−22.800	−39.406	−47.205	−47.197	−41.119	−29.618	−15.457	−.097
703	−63.051	−42.060 .038	−31.662	−29.608	−30.491	−31.122	−30.020	−26.475	−20.660	−12.841	−3.110	+6.905	+16.635

June 9	July 19	Aug 28	Oct 7	Nov 16
−.167	−.144	−.109	−.068	−.022
−.2541	−.3494	−.4311	−.4902	−.5257
+1.217	1.906 +~~2.150~~	+2.364	+2.492	+2.309
+0.642	−~~1.208~~ 1.766	−1.715	−2.061	−1.823
+1.858	+1.384 ~~1.950.442~~	+0.649	+0.431	+0.484
−25.004	−22.823	−18.647	−13.431	−8.199
+1.777	−3.734	−13.000	−23.941	−34.452
− 2	− 3	− 4	− 5	− 6
−23.229	−26.560	~~19.551~~ 31.651	~~15.880~~ 37.377	~~11.630~~ −42.637
−.0857	−.1349	−.1665	−.1755	−.1625
−.2093 +~~.2748~~ −.2950	+.2748 +.1399	+.4164 +.5499	.0896 +.9141	+1.3741 +1.2116
−.208	−.189	−.154	−.111	−.068
−5.992	−6.077	−5.853	−5.357	−4.606
+.015	−.031	−.108	−.198	−.285
− 2	− 3	− 4	− 5	− 6
−6.186	−6.306	−6.119	−5.665	−4.965

+24.886 −20	22.633	18.491	13.319	8.111
−5.992	−6.077	−5.853	−5.351	−4.606
−1.762	~~1.762~~ +3.703	~~+2.703~~ +12.892	~~+12.892~~ +23.744	+34.166
17.042	20.259	25.530	31.712	37.671

	$\frac{\omega^2}{d\tau}\overset{b}{d}u\,d\tau^2$	$'f$	$''f$	$\frac{\omega di}{d\tau}$	$'f$	$\frac{\omega d\Omega}{d\tau}$	$'f$	$\frac{\omega d\varphi}{d\tau}$	$'f$	$\frac{\omega d\pi}{d\tau}$	$'f$
1870 Sept 18	-1.3121		-.1087	-.087	~~+.002~~	-1.863		+2.331		+41.550	
		+.0540			+.002		+.120		-.109		-.906
Oct 28	-2.6086		-.0547	-.137		-4.633		+4.927		+63.231	
		-2.5546			-.135		-4.513		+4.818		+62.325
Dec 7	-3.9776		-2.6093	-.146		-8.540		+7.164		+92.009	
		-6.5322			-.281		-13.053		+11.982		+154.334
1871 Jan 16	-5.2938		-9.1415	-.092		-13.435		+8.831		+124.714	
		-11.8260			-.373		-26.488		+20.813		+279.048
Feb 25	-6.3500		-20.9675	+.043		-18.835		+9.860		+155.705	
		-18.1760			-.330		-45.323		+30.673		+434.753
Apr 6	-6.8849		-39.1435	+.266		-23.929		+10.502		+177.765	
		-25.0609			-.064		-69.252		+41.177		+612.518
May 16	-6.6164		-64.2044	+.562		-27.589		+11.344		+183.499	
		-31.6773			+.498		-96.841		+52.521		+796.017
June 25	-5.3283		-95.8817	+.879		-28.568		+13.092		+168.229	
		-37.0056			+1.377		-125.409		+65.613		+964.246
Aug 4	-3.0911		-132.8873	+1.146		-26.421		+16.401		+133.914	
		-40.0967			+2.523		-151.830		+82.014		+1098.160
Sept 13	-0.2556		-172.9840	+1.264		-21.113		+20.654		+89.634	
		-40.3523			+3.787		-172.943		+102.668		+1187.794
Oct 23	+2.5297		-213.3363	+1.215		-14.421		+25.097		+49.049	
		-37.8226			+5.002		-187.364		+127.765		+1236.843
Dec 2	+4.7091		-251.1589	+1.028		-8.116		+28.488		+21.582	
		-33.1135			+6.030		-195.480		+156.253		+1258.425
1872 Jan 11	+6.0181		-284.2724	+.770		-3.409		+29.987		+9.547	
		-27.0954			+6.800		-198.889		+186.240		+1267.972
Feb 20	+6.5265		-311.3678	+.514		-0.621		+29.625		+8.723	
		-20.5689			+7.314		-199.510		+215.865		+1276.695
Mar 31	~~+5.8820~~ 6.4098		-331.9367	+.300		+0.576		+27.697		+15.223	
		-14.1591			+7.614		-198.934		+243.562		+1291.920
May 10	~~+5.1226~~ 5.8820		-346.0958	+.142		+.723		+24.673		+23.257	
		-8.2771			+7.756		-198.211		+268.235		+1315.177
June 19	~~+4.2676~~ 5.1226		-354.3729	+.038		+.326		+21.073		+29.484	
		-3.1545			+7.794		-197.885		+289.308		+1344.661
July 29	~~+3.3935~~ 4.2676		-357.5274	+.019		+.237		+17.359		+32.478	
		+1.1131			+7.813		-197.648		+306.667		+1377.139
Sept 7	~~+2.5467~~ 3.3935		-356.4143	-.034		-.567		+13.814		+31.740	
		+4.5066			+7.779		-198.215		+320.481		+1408.879
Oct 17	~~+1.7669~~ 2.5467		-351.9077	-.045		-1.020		+10.625		+27.629	
		+7.0533			+7.734		-199.235		+331.106		+1436.508
Nov 26	~~+1.0210~~ +1.7669		-344.8544	-.035		-1.062		+7.986		+20.733	
		+8.8202			+7.699		-200.297		+339.092		+1457.241
1873 Jan 5	+1.0210		-336.0342	-.020		-.882		+5.792		+11.200	
		+9.8412			+7.679		-201.179		+344.884		+1468.441
Feb 14	+.3622		-326.1930	-.007		-.505		+4.208		+0.842	
		+10.2034			+7.672		-201.684		+349.092		+1469.283
Mar 26	-.2188		-315.9896	-.000		-.003		+3.161		-9.687	
		+9.9846			+7.672		-201.687		+352.253		+1459.596
May 5	-.7211		-306.0050	-.001		+.548		+2.648		-19.591	
		+9.2635			+7.671		-201.139		+354.901		+1440.005
June 14	-1.1153		-296.7415	-.010		+1.047		~~+2.552~~		-27.415	
		+8.1482			+7.661		-200.092		+357.453		+1412.590
July 24	-1.4437		-288.5933	-.028		+1.474		+2.765		-33.620	
		+6.7045			+7.633		-198.618		+360.218		+1378.970
Sept 2	-1.6704		-281.8888	-.053		+1.731		+3.172		-37.109	
		+5.0341			+7.580		-196.887		+363.390		+1341.861
Oct 12	-1.7871		-276.8547	-.082		+1.767		+3.623		-37.755	
		+3.2470			+7.498		-195.120		+367.013		+1304.106
Nov 21	-1.7871		-273.6077	-.113		+1.550		+3.965		-35.853	
		+1.4599			+7.385		-193.570		+370.978		+1268.253
Dec 31	-1.6658		-272.1478	-.142		+1.076		+4.071		-32.196	
		-0.2059			+7.243		-192.494		+375.049		+1236.057
1874 Feb 9	-1.4414		-272.3577	-.164		+.368		+3.870		-28.138	
		-1.6513			+7.079		-192.126		+378.919		+1207.919
Mar 21	-1.1180		274.0090	-.177		-.520		+3.867		-24.325	
		-2.7693			+6.902		-192.646		+382.786		+1183.594
Apr 30	-.7253		-276.7783	-.179		-1.521		+2.649		-22.447	
		-3.4946			+6.723		-194.167		+384.935		+1161.147
June 9	-.2950		-280.2729	-.167		-2.541		+1.859		-23.229	
		-3.7896			+6.555		-196.708		+386.794		+1137.918
July 19	+.1399		-284.0625	-.144		-3.494		+1.150		-26.560	
		-3.6497			+6.411		-200.202		+387.944		+1111.358
Aug 28	+.5499		-287.7122	-.109		-4.311		+.649		-31.651	
		-3.6998			+6.302		-204.513		+388.593		+1079.707
Oct 7	+.9141		-290.8120	-.068		-4.902		+.430		-37.377	
		-2.1857			+6.234		-209.415		+389.023		+1042.330
1874 Nov 16	+1.2116		-292.9977	-.022		-5.257		+.484		-42.637	
		-0.9741			+6.212		-214.672		+389.507		+999.693
			-293.9718								

$\omega\frac{dL}{dt}$	f	$\omega\frac{dM}{dt}$	f
+6.616		-34.931	
	-.054		+.852
+5.660		-57.570	
	+5.606		-56.718
+3.100		-88.909	
	+8.706		-145.629
-1.170		-125.885	
	+7.536		-271.512
-7.983		-163.487	
	-0.447		-434.999
-16.603 28		-194.393	
	-16.850		-629.394
-27.083		-210.506	
	-43.933		-839.900
-37.562		-205.790	
	-81.395		-1045.690
-46.068		-179.979	
	-127.463		-1225.669
-49.657		-139.286	
	-177.120		-1364.955
-47.852		-96.903	
	-224.972		-1461.858
-41.467		-63.051	
	-266.439		-1524.909
-32.496		-42.038	
	-298.935		-1566.947
-22.939		-31.662	
	-321.874		-1598.609
-14.380		-29.608	
	-336.254		-1628.217
-7.234		-30.491	
	-343.488		-1658.708
-1.638		-31.122	
	-345.126		-1689.830
+2.459		-30.020	
	-342.667		-1719.850
+5.267		-26.475	
	-337.400		-1746.325
+6.971		-20.660	
	-330.429		-1766.985
+7.897		-12.841	
	-322.532		-1779.826
+8.080		-3.110	
	-314.442		-1782.936
+7.746		+6.905	
	-306.696		-1776.031
+6.948		+16.635	
	-299.748		-1759.396
+5.887		+25.478	
	293.861		-1733.918
+4.636		+32.080	
	-289.225		-1701.868
+3.161		36.781	
	-286.064		-1665.087
+1.602		38.709	
	-284.462		-1626.378
+ .028		37.781	
	-284.434		-1588.597
-1.486		34.367	
	-285.920		-1554.230
-2.764		29.431	
	-288.684		-1524.799
-4.094		24.044	
	-292.778		-1500.755
-5.069		19.248	
	-297.847		-1481.507
-5.773		16.673	
	-303.620		-1464.834
-6.186		17.042	
	-309.806		-1447.792
-6.300		20.259	
	-316.106		-1427.533
-6.119		25.530	
	-322.225		-1402.003
-5.668		31.712	
	-327.890		-1370.291
4.565		+37.671	
	-332.855		-1332.620

M = Mean opposition magnitude

m = Observed magnitude at opposition

$$h = \frac{a^2(a-1)^2}{2^2 4^2}$$

$$M = m + \frac{\log h}{.4082}$$

Or.

$$m = M - 5\log(a^2 - a) + 5(\log 2 + \log 4)$$

log a .38638
log a² .77276
~~a² .59260~~
a 2.4344
a-1 1.4344
log(a-1) .15667
log(a-1)² .31334
log a² .77276
log a²(a-1)² 1.08610
log 2² 4² .94980
log h .13630
h - 1.37

log 2 .3565
log 2² .9130
log a² 23.68
9.498

log 4 1184

log h 1.08610

Integrations

$\omega^2\frac{du}{dt}dt^2$		$\frac{du}{dt}$		di		dΩ		dφ		dπ	
Z_1	h	Z_1	h	Z_1	h	Z_1	h	Z_1	h	Z_1	h
311.368	−4.995	−23.882	−.3688	+7.057	+.07	−199.15	−2.42	+201.05	+2.85	+122.33	+15.11
+5.44	+.007	~~+.0116~~	−.0009	+.02	+.00	−.16	.00	+.09	−.0	−.24	−.1
−310.824	−4.988	−23.848	−.370	+7.06	+.07	−199.31	−2.42	+201.14	+2.85	+122.09	+15.10
−4.988		−.370		+.07		−2.42		2.85		+15.10	
−315.812		−24.218		+7.13		−201.73		+203.99		+137.19	
		−.60545									
		−.60545		+7.13		−3′ 21.73″		+3′ 23.99″		+2′ 27.19″	
				+.84		+1 50.75				+1 40.47	
		−.60545		+7.97		−1 30.98		+3 23.99		+23 7.66	

~~934.80598 2 36 31.08 323 58 59.73 7 19 19.14~~

934.20053 2 36 39.05 323 57 28.75 7 22 43.13 ~~48 13~~

~~For May 25 1873~~

2.9704401
3.5500066
0.5795665
.1931888
.3863776

85

New Elements for oct 28.5 1870 = the date of

	934.80598	2 36 31.08	323 58 59.73	7 19 19.14	337 25 29.00
	−60545	+7.97	− 1 30.98	+ 3 23.99	23 7.66
For Feb 1.205 1872	934.20053	2 36 39.05	323 57 28.75	7 22 43.13	337 48 36.66

For May 25 1873

Z_1	−301.33	+9.2462	+7.67	−3 21.12	+5 54.90	+23 59.65
h	−46.58	+.0100	+.12	−2.20	+5.77	+11.25
	−347.91	9.2562	+7.79	−3 23.32	+6 00.67	+24 10.90
sec			+1.25	+2 46.12		+2 30.70
B.M.T.						
		+.23141	+9.04	−0 37.20	+6 0.67	+26 41.66
		934.80598	2 36 31.08	323 58 59.73	7 19 19.14	337 25 29.00
For May 25.5		935.03739	2 36 40.12	323 58 22.53	7 25 19.81	337 52 10.66

2.9708290
3.5500066
0.5791776
.1930592
.3861184

New Elements

For oct 27.5 1874

ω

Z_1 −291.99	−.05433	+6.23	−3 29.43	+6 29.02	+17 22.11	
−8.09	+.00325	+.14	−2.71	+3.13	−18.21	
−300.08	−.05108	+6.37	−3 32.14	+6 32.15	+17 3.90	
		+1.67	+3 41.50		+3 20.94	
	−.05108	+8.04	+9.36	+6 32.15	+20 24.84	
	934.72991	2 36 39.66	324 02 52.06	7 16 37.03	337 48 55.50	
	934.67883	2 36 47.70	324 03 01.42	7 23 9.18	338 09 20.34	14 06 18.92

dL dM dΩ

n_1 h n_4 h = Feb. 20.5 1872

+31040 −3.75 +158278 −18.87
−.75 −.1 −.52 −.00
+31115 −3.76 −158330 −18.87
− 3.96 − 18.87
+314.91 160217
−314.91 − 315.81
′ ″ − 1867.98
−5 14.91 − 31 57.98
−5 15.81 25 28 44.65
−10 30.72
+1 40.47
8 50.25
24 56 46.67

′ ″
+24 38.64
13 26 29.27
13 51 7.91

For Oct. 18.5 1870

M = 31 42 40.00
2 35 48.06
Oct 8.5 829 06 51.94

For Sept. 24.5

M = 25 28 44.65

osculation

32 13 49.60
− 31 57.98
31 41 51.62
1 26 43 5.31
158 24 56.93

13 26 29.27
+24 38.64
13 51 7.91

For Mar 5.5

M = 158 24 56.93
+ 3.37 58.81
M = 162 02 55.74

−4 53.87
− 2.38
−4 56.25
−5 47.91
−10 44.16
+2 30.70
−8 13.46

′ ″
− 28 53.62
− 13.64
− 5 47.91
− 34 55.17

− 34 55.17
32 13 49.60
31 38 54.43
246 09 55.97
277 48 50.40

+27 18.80
13 26 29.27
13 53 48.07

−5 27.87
− 5.53
−5 33.40

− 22 50.04
+ 12.69
− 22 37.35
− 5. 0.08
−27 37.43
28 50 46.61
28 23 09.18
− 1 52.58
28 20 36.60

28 50 46.61
24 16 40.27
53 07 26.88
−27 37.43
52 39 49.45

	1870	1872	1873
Ω	323 58 59.73	323 57 28.75	323 58 22.53
Ω−n	143 58 59.73	143 58 44.37	143 59 11.26
½(Ω−n)	71 59 29.86	71 58 44.37	71 59 11.26
i	2 36 31.68	2 36 39.05	2 36 41.12
ε	23 27 22.30	23 27 21.36	23 27 20.88
i+ε	26 03 53.38	26 04 00.41	26 04 1.00
i−ε	−20 50 57.22	−20 50 42.31	−20 50 40.76
½(i+ε)	13 01 56.69	13 02 00.20	13 02 0.50
½(i−ε)	−10 25 25.61	−10 25 21.15	−10 25 20.38
sin ½(Ω−n)	9.9781857	9.9781546	9.9781730
sin ½ i+ε	~~9.9886672~~ 9.3531509	9.3531828	9.3531855
sin ½ i'' sin ½(Ω'+a)	9.3313366	9.3313374	9.3318585
cos ½ i'' cos ½ Ω'+a	8.7476820	8.7479253	8.7477425
tang ½(Ω'+a)	.5836546	0.5834121	0.5836160
½(Ω'+a)	75 22 53.41	75 22 25.77	−75 22 49.43
sin ½(i−ε)	9.2578043	9.2574532	9.2574444
cos ½(Ω−n)	9.4901777	9.4904721	9.4902981
cos ½(i−ε)	9.9927728	9.9927745	9.9927749
φ		7 22 43.13	7 25 19.81
cos φ		9.9963886	9.9963458
sin ½(Ω−n)	9.9781857	9.9781546	9.9781730
cos ½(i+ε)	9.9886672	9.9886654	9.9886652
cos ½ i'' sin ½(Ω'−a)	9.9668529	9.9668200	9.9665382
cos ½ i'' cos ½(Ω'−a)	9.4829505	9.4832466	9.4830730
tang ½(Ω'−a)	.4839024	0.4835734	0.4837652
½(Ω'−a)	71 49 54.35	71 49 8.04	71 49 35.03
½(Ω'+a)	104 37 6.09	104 37 34.23	104 37 10.57
Ω'	176 27 0.44	176 26 42.27	176 26 45.60
a	32 47 11.74	32 48 26.19	~~71 49 35.03~~ 32 47 35.14
ω	13 26 29.27	13 51 7.91	13 58 48.07
ω'	340 35 17.53	~~46 39 34.10~~ 341 02 41.72	~~46 41 23.61~~ 341 06 12.53
sin ½ i''	9.3456280	9.3456443	9.3456524
cos ½ i''			
½ i''	12 48 17.18	12 48 18.94	12 48 19.81
i''	25 36 34.36	25 36 37.88	25 36 39.62
sin Ω'	8.792	8.7924352	8.7923162
cos i''		9.9550879	9.9550859
cos Ω'		9.9991635	9.9991640
sin i''		9.6357364	9.6357440
− cos Ω'		9.9991635	9.9991640
cos i'' sin Ω'		8.7475171	8.7474021
tang A		1.2516464	1.2517619
A		86 47 30.84	86 47 39.90
log a		9.9998439	9.9998447
− sin Ω'		~~4475~~ 8.7924272	8.7923162
− cos i'' cos Ω'		9.9542514	9.9542499
tang B		8.8381778	8.8380663
B		−3 56 27.88	−3 56 25.34
log b		9.9552796	9.9552776
		356 04 32.12	
A+ω'		67 50 15.66	67 53 52.43
B+ω'		337 06 13.84	337 09 48.29
ω'		341 02 41.72	341 06 12.53
log a		9.9998439	9.9998447
log b		9.9552796	9.9552776
log c		9.6357364	9.6354440
log e		9.1086530	9.1111929
e		.1284260	.1291793
log(1+e)		.0524731	.0527698
log(1−e)		9.9403043	9.9399288
log √(1+e)		.0262865	.0263864
log √a		1931888	1930592
log √(1−e)		9.9701521	9.9699664
			.2194466
log √(a(1+e))		.2194253	~~.2576449~~
log √(a(1−e))		.1633409	.1630246
log e		9.1086530	9.1111929
log C		5.3144251	5.3144251
log e''		4.4230781	~~4.4256240~~ 4.4256180

	1872 Mar 15	1873 May 25		
M	162 02 55.74	277 48 50.40	162 02 55.74	277 48 50.40
Π	164 04 6.81	270 24 47.56		270 24 45.91
	9.4388217	9.9999887		9.9999887
	1.4230781	4.4256180		4.4256180
	3.8615998	4.4255805		4.4256068
	2 1 11.10	−7 24 2.84		
Π'	164 4 6.84	270 24 47.56	2 1 11.10	7 24 4.44
½Π'	82 02 3.42	135 12 23.78	164 04 6.84	270 24 45.56
sin ½	9.1417023	9.8479133	82 02 3.42	135 12 22.98
cos ½	9.9957893	9.8510454	9.9957892	9.8479150
			9.1417023	9.8510438
tan ½ u	.2151646	.0673525	0.2152145	.0673556
log cos² ½ u	9.3050432	.0140709	9.3050432	.0140684
	.9101213	.0532816	0.9101913	.0532872
	~~7 0 4380~~	−48 30 21.21	82 59 20.61	−48 30 22.54
	82 59 18.75	131 29 38.79		131 29 37.46
	.4368496	3857136	4369480	3857150
	165 58 35.50	262 59 17.58	165 58 41.22	262 59 14.92
u+A+ω'	233 48 54.06	330 53 10.01	233 48 59.78	330 53 7.35
u+B+ω'	143 04 49.34	240 09 5.67	143 04 55.06	240 09 3.21
u+ω'	147 05 17.22	244 5 30.11	147 01 22.94	244 05 27.45
	9.9069355n	9.6871250n	9.9069443n	9.6871350n
	.4366935	.3855577	.4367917	.3855591
	9.7786574	9.9381921n	9.7786373	9.9381890n
	.3921290	.3409912	.3922276	.3408926
	9.7358583	9.9539985n	9.7358397	9.9539958
	.0725860	.0214596	.0726844	.0214590
x	−.22061183	−.11821775	−.22066629	−.11822082
X	+.5620910	+.4325916	+.9620910	+.4325916
x'	−1.2440280	−.7495859	−1.2445719	.7496166
y	+1.4817761	−1.9018810	+1.4820570	−1.9018734
Y	−1.4773156 −.2249328	+.8408186	−0.2244328	+.8408186
y'	+1.2573433	+1.0610628	1.2576242	−1.0610548
z	+.6433955	−.9450530	+.6434637	−.9450500
Z	−.0973822	+.3648259	−.0973822	+.3648259
z'	+.5459633	−.5802281	+.5460815	.5802241
log a cos a	.0948301n	9.8748214	.0950200	9.8748392
log a sin a	.0994539	0.0257400	.0995509	0.0257378
log tan a	.0046238n	0.1508946	.0045309n	.1508986
a	45 18 18.00	~~5 42 24 68~~ 54 45 38.58	45 17 55.93	54 45 34.07
	134 41 42.00	234 45 38.78	134 42 4.07	234 45 34.07
	− 6.52	+ 6.14	− 6.52	+ 6.14
c	134 41 35.48	234 45 44.92	134 41 57.55	234 45 40.21
o	134 54 11.00	235 6 54.30	134 54 11.00	235 06 54.30
c−o	−12 35.52	−21 9.38	−12 13.45	−21 14.1
log a sin d	.2474693	113 6517 9.8791298	.2478122	.1136556
log a cos d	9.7371634	9.7635980n	9.7372575	9.7635958n
log tan d	9.4894941	9.8844682n	9.4894453	9.6499402n
δ	+17 09 13.95	9.6499463n	+17 09 07.4	−24 03 59.94
	+3.82		+3.8	−5.5
c	+17 09 17.77	−24 04 00.82	+17 09 11.2	−24 04 5.4
o	17 5 24.40	− 5.49	17 5 24.4	−24 8 42.5
c−o	+3 53.4	−24 04 6.31	+3 46.8	+4 37.1
		−24 8 42.5		
		+4 36.2		

Δα	+1.6	−1.1	−755.5	−1269.4	−733.4	−1274.1
Δδ	+3.6	+0.9	+233.9	+276.2	+226.8	+277.1
					1872	1873
	1870	1870	1872	1873	May 15	May 25
	Sept. 24.5	Oct. 11.5	May 5.5	May 25.5		
cos M	9.61335	9.62580	9.50786n	9.35217n		
log sin M	9.95992	9.95731	9.97623	9.98872	9.97623	9.98872
log cos δ	9.99332	9.99555	9.98051	9.96024	9.98036	9.96024
log Δα	.20412	.04139n	2.87823	3.10360n	2.86534n	3.10520
log I	0.15736	9.99425n	2.83497	3.05256	2.82105	3.05416
log cos M	9.61335	9.62580	9.50786	9.35217n	9.50786	9.35217n
log Δδ	.55630	9.95424	2.36810	2.44122	2.35564	2.44264
log II	.16965	9.58004	1.87596	1.79339n	1.86350n	1.79481n
I	+1.44	−0.99	−~~683.4~~ 683.9	−1128.6	−663.7	−1132.8
II	+1.48	+.38	−75.1	−62.1	−73.0	−62.3
Δα cos θ	+2.9	−0.6	−~~760.5~~ −759.0	−1190.7	−736.7	−1195.1
log cos M	9.61335	9.62580	9.50786	9.35217	9.50786	9.35217
cos δ	9.99332n	9.99555n	9.98051	9.96024	9.98036	9.96024
log Δα	.20412	.04139	2.87823	3.10360n	2.86534n	3.10520
log I	9.81079n	9.66274	2.36660n	2.41601n	2.35356	2.41761
log sin M	9.95992	9.95731	9.97623	9.98872	9.97623	9.98872
log Δδ	.55630	9.95424	2.36810	2.44122	2.35564	2.44264
log II	.51622	9.91155	2.34433	2.42994	2.33187	2.43136
I	−.64	+.46	−233.00	−260.62	−225.8	−261.6
II	+3.28	+.82	+220.97	+269.12	+214.7	+270.0
dθ	+2.6	+1.3	−11.6	+8.5	−11.0	+8.4

a b c d e f S log S.

0 = +2.9 + ooo dΩ′ + ooo di′ + 2.2599 dL′ − .2313 d log a + 2.2818 dφ − 4.4517 dχ −1.413
−0.6 +2.2387 −.1729 +2.2928 −4.3631 10 −.0040
−736.7 +1.1486 −3.8284 +0.9231 +3.0041 −11.2484
−1195.1 +1.6839 −11.0546 −3.3770 +0.2061 −12.5416

0 = +2.6 −.7689 dΩ′ +.4254 −.0101 −.0428 +.0341 +.0468 −.3155
+1.3 −.7300 +.6050 +.0024 −.0199 +.0580 +.0388 −.0337
−11.0 +.5380 +.7995 −.0017 +.0193 +.0100 −.0093 +1.3558
+8.4 +1.5385 +.3185 −.0045 +.1174 +.0119 +.0695 −1.0307

	a	b	c	d		e	f		
log n	0.4623980	9.7781513n	2.8672907n ~~2.8802418~~n	3.0774042 3.0758029n		0.41497	0.11394	1.04139n ~~1.06446~~	0.92428
log a						9.88584	9.86332n	9.73078n	.15710n
log b						9.62880n	9.81624	9.90282n	9.50311
log c	.3540892	.3499959	.0605468	.2263163		8.00432	7.38021	7.23045	7.97772
log d	9.3641756n	9.2377950n	0.5830173	1.0435432		8.63144n	8.77743	8.28556n	9.06967
log e	.3582776	.3603662	9.9652488n	.5285311n		8.58275	8.77085n	8.00000	8.07555
log f	.6485259n	.6397952n	.4777144	9.3140780n		8.64024	8.59988	7.96846	8.84198
log s	9.1501422n	7.6532125n	.0963538	1.0983500n		9.49900n	8.82763n	.1325	.0313

na na na nb nb nc nc nd nd ne ne nf nf ns ns.

84 +6.554 6.671 6.617 12.910 0.410
.4 .671 1.343 .704 1.376 2.618 .073
5760810 6.672.547 2905.707 700632 2250.112 947.536
14177665 12.910 2065.020 13162.718 4020.994 245.403 24540.23 14933.286
.67
.17 1.999 1106 .0262 ~~.089~~ .20 .111 ~~.122~~ .089 .077 ~~.122~~ ~~.820~~ .820
134.2 0.949 .851 .003 .078 .052 .044
.721 6.241 9.274 9.274 .020 .224 .116 .108 15.728
13.074 ~~2.707~~ 2.707 .081 ~~.100~~ 1.002 .101 .591 8.761
1774071.0

+15.632 2888.099 16070.538 12.652 4027.715 702.034 2.618 2539.838 .166 .217 .282 .591 14942.050 964.538
15.632 12.652 702.034 2.618 .166 .282 964.538
− 2868.467 + 16057.886 + 3325.681 − 2537.220 −.051 −.309 + 13977.520
ne nd nc nf na nb

a — b — c — d — e — f — s — n

ℓ(aa) ~~.1502988~~

~~nn~~ na na nb nb nc nc nd nd ne ne nf nf ns ns

nn na na na nb nb nc nc nd nd ne ne nf nf ns ns

−1.999 +1.106 +6.554 −7. −.671 +6.617 12.910 .410

949 851 −1.343 .104 1.376 2.618 .003

6.241 9.274 872.547 2905.759 700.632 2280.112 947.536

13.078 2.707 2006.020 13162.718 4020.994 245.403 14933.286

.026 111 089 .820

003 078 077 108 .044

020 224 116 122 15.728

.081 1.022 101 052 .591 3.761

13078 9.189 +1.958 −11.981 +6.658 −2878936 16068.581 2.084 4027777 702225 2.900 2539016 14942.050 964.538

9.189 1.957 6.658 2.084 702.225 2.900 964.538

+3.889 −10.024 −2872278 +16066.497 +3325.552 −2536116 +13977.524

0 = +2.9 +1566.4 +21.3 −676.4 −872.2 = −0.7″ 0 = +2.6 −3.8 +8.5 −7.0 −3.9 −10.1 +9.2 = −4.5″

0 = −0.6 +1551.8 −15.9 −679.7 −854.9 = +0.7 +1.3 −3.6 +13.1 +1.7 −5.5 −14.5 +9.8 = −2.7

0 = −757.0 +796.9 −352.5 −273.7 +588.6 = +0.3 −11.6 +2.6 +16.0 −1.2 +1.8 −3.0 −1.8 = +2.8

0 = −1190.7 +1167.2 −1018.0 +1001.1 +40.4 = +0.0 −8.5 −7.6 +6.4 −6.6 +10.8 −3.5 +13.6 = +4.6

lg(1 − cos i′) 8.99255 lg cos i′ 9.95508 dL +10 33.14 lg b 0.17609 lg M 4.32335

lg dΩ′ .69173 lg dΩ′ .69173 (1 − cos i′)dΩ′ + 48 lg u 2.97007 lg dlg a 1.80024

lg(1 − cos i′)dΩ′ 9.68428 lg cos i′ dΩ′ 0.64681 dL′ +10 33.62 lg i″ 4.68557 6.12355

(1 − cos i′)dΩ″ 0.48 − cos i′ dΩ′ − 4.43 dπ′ +32 39.78 lg C 7.83218 dlog a +.0001940 87.54

dχ′ +32 39.30 dχ′ 32 39.30 dM −22 6.16 lg dlg a 1.80024 lg a .3861902

dπ′ +32 39.78 lg dμ 9.63242 9.96377 lg a ~~.3860373~~

dΩ′ + 4.92 dω′ +32 34.87 −.62571 dμ −.42896 .62571 .3863842

dω′ +32 34.86 934.80598 μ 934.80598 80598

934.18027 μ 935.23494 .43169 −.62642 934.17956

9.9704307 lg M .9709416 9710121 80598

3.5500066 lg C 3.5500066 5500066 934.19956

.5795759 lg Va 1.930217

1.931920 lg a .3860434 3859964 .3863842

~~.727640~~

.3863840

M″ ω′ Ω′ i′ φ μ log a

~~24 28 44.65 13 26 29.27 323 58 59.73 23~~

25 28 44.65 340 39 17.58 176 27 0.47 25 36 34.11 7 19 19.14 934.80598 .3861901

−22 6.16 +32 34.87 + 4.92 + 19.96 −4 56.46 −.62642 + 1941

25 6 38.49 341 11 52.45 176 27 5.39 25 36 54.07 7 14 22.68 934.17956 .3863842

na na nb nb nc nc nd nd ne ne nf nf ns ns

.000 −1.999 +1.106 6.554 − ~~.671~~ .671 +6.617 12.910 .410

.000 −.949 .851 8.784 −1.343 .104 1.376 2.618 .003

.000 −5.918 ~~9.274~~ 846.910 2820.382 680.047 2213.121 919.696

−12.924 2.675 −2012.428 +13211.355 +4035.850 ~~2463.101~~ 246.310 14588.465

.026 111 .089 .108 .820

.003 .078 .077 .122 .044

.019 ~~.080~~ .212 .110 102 19.914

.080 .986 .100 .583 8.658

−21.790 +4.632 +6.576 −2860.787 16032.827 1.072 4042.733 681.533 3.533 2472.341 ~~4676.222~~ −944.542

−8.794 6.576 1.072 ~~1.072~~ 681.533 3.533 +14988.468

−21.780 −4.162 −2854.211 +16031.755 +3361.200 −2468.808 −4~~672.689~~ +14043.984

0 = +2.9 +996.3 −26.9 −369.9 −626.0 = +0.7″ −7.5 0 = +2.6 +5.6 −4.4 +0.5 −5.5 +6.6 = +8.1

−0.6 +947.0 −1.9 −371.4 −613.5 = −0.7 +1.3 −7.2 +8.6 +4.1 −0.7 −9.6 +5.6 = −0.9

−436.7 +506.8 −42.8 +149.6 +422.4 = +0.1 −11.0 +5.3 +10.6 −0.7 +0.2 −1.6 −1.3 = +1.5

−1195.1 +742.4 −123.9 +544.4 +32.0 = +0.0 +8.4 −15.1 +4.2 −4.2 +1.3 −1.9 +9.8 = +2.5

lg(1 − cos i′) 8.99255 log cos i′ 9.95508 dL″ = +7 20.87 log b .17609 log μ 2.9706861 log M 4.32335

lg dΩ′ .99171 dΩ′ 99171 (1 − cos i′)dΩ′ + 96 lg μ 2.97069 3.5500066 lg dlg a 1.04854

.98426 lg cos i′ dΩ′ .94679 dL′ +7 21.83 4.68557 .5793205 5.37219

(1 − cos i′)dΩ′ + 0.96 − cos i′ dΩ′ − 8.84 dπ′ +23 27.16 lg const. 7.83298 1931068 + .0000236

dχ 23 26.20 dχ 23 26.20 dM −16 5.33 lg dlg a 1.04854 .3862138 .3861902

dπ′ +23 27.16 dω′ 23 17.36 8.88159 .3862138

dΩ′ + 9.81 lg dμ −.07604 ~~3085~~

dω′ +23 17.35 μ 934.80598

μ 934.72994

			176 27 0.47	1872	1873	1877	
Ω'	176 27 53.9		176 27 10.28	176 26 52.08	176 26 55.41	176 27 0.10	
i'	25 36 54.01		25 36 47.31	25 36 51.08	25 36 52.82	25 36 52.41	
$\sin\Omega'$	9.9972410	8.7916448	8.7914788	8.7920965	8.7919836	8.7918007	
$\cos i'$	9.9550714	9.9550714	9.9550782	9.9550743	9.9550726	9.9550730	
$\cos\Omega'$	9.0506197	9.9991665n	9.9991672n	9.9991648	9.9991652	9.9991660n	
$\sin i'$	9.6358069	9.6358069	9.6357778	9.6357943	9.6358020	9.6358002	
$\cos\Omega'$	9.9550714	9.9991665	9.9991672	9.9991648	9.9991652	9.9991660	
$\cos i' \sin\Omega'$	9.9523124	8.7467162	8.7465570	8.7471708	8.7470562	8.7468737	
$\tan A$	0027590	1.2583503	1.2526102	1.2519940	1.2521090	1.2522923	
A		86 47 58.84	86 48 02.37	86 47 46.05	86 47 49.10	86 47 53.95	
$\log a$		9.9998444	9.9998446	9.9998441	9.9998442	9.9998444	
$\sin\Omega'$		8.7916448	8.7914788	8.7920965	8.7919836	8.7918007	
$-\cos i' \cos\Omega'$		9.9542379n	9.9542454n	9.9542391	9.9542378	9.9542390	
$\tan B$		8.8374069	~~8.8457292~~ 8.8372334n	8.8378574	8.8377458	8.8375617	
B		−3 56 02.80	−3 55 57.15	−3 56 17.45	−3 56 18.81	−3 56 04.82	356 03 52.18
$\log b$		9.9552625	9.9552691 356 04 2.85	9.9552658	9.9552640	9.9552643	
$A+\omega'$		67 59 50.59	67 30 37.31	68 13 45.73	68 17 11.99	68 11 23.5	
$B+\omega'$		337 15 49.65	337 06 37.79	337 29 41.63	337 33 16.08	337 27 0.56	
ω'		341 11 52.45	341 02 34.94	341 25 55.08	341 29 29.89	341 23 8.38	
$\log a$		9.9998444	9.9998446	9.9998441	9.9998442	9.9998444	
$\log b$		9.9552625	9.9552691	9.9552658	9.9552640	9.9552643	
$\log e$		9.6358069	9.6357778	9.6357943	9.6358020	9.6358002	
φ		7 14 22.68	7 16 37.03	7 20 1.02	7 22 37.70	7 23 9.18	$\cos\varphi$ 9.9963815
$\frac{1}{2}\varphi$		3 37 11.34	3 38 18.51	3 40 0.51	3 41 18.85	3 41 34.59	
$(45-\frac{1}{2}\varphi)$		41 22 48.66	41 21 41.49	41 19 59.49	41 18 41.15	41 18 25.41	
$\tan(45-\frac{1}{2}\varphi)$		9.9445779	9.9446928	9.9442598	9.9439271	9.9438603	$\log\mu$ 2.9706623
$\log e$		9.1004377	9.1026587	9.1060091	9.1085646	9.1090763	3.5500066
e		.1260145	.1266656	.1276466	.1283999	.1285513	.5793443
$1+e$							.1931148
$1-e$		.8739805	.8733344	.8723534	.8716001	.8714487	.3862296
$\log(1+e)$		.0515459	.0517950	.0521730	.0524631	.0525213	
$\log(1-e)$		9.9415017	9.9411806	9.9406925	9.9403173	9.9402419	
$\log\sqrt{1+e}$		.0257729	.0258975	.0260865	.0262315	.0262606	
$\log\sqrt{a}$		.1931921	.1931068	.1932006	.1930710	.1931148	
$\log\sqrt{1-e}$		9.9707508	9.9705903	9.9703462	9.9701586	9.9701209	
$\log\sqrt{a(1+e)}$		.2189650	.2190043	.2192871	.2193025	.2193754	
$\log\sqrt{a(1-e)}$		.1639429	.1636971	.1635468	.1632296	.1632357	
$\log e$		9.1004377	9.1026587	9.1060091	9.1085646	9.1090763	
$\log\rho$		5.3144251	5.3144251	5.3144251	5.3144251	5.3144251	
$\log e''$		4.4148628	4.4170838	4.4204342	4.4229897	4.4235014	

	M	ω'	Ω'	i'	φ	μ	log a	
Corr.	25 25 44.65	340 39 17.58	176 27 0.47	25 36 34.11	7 19 19.14	934.80598	.3861801	1870
	−16 5.33	+ 23 17.36	+ 9.81	+13.20	− 2 42.11	− 07607	+ 236	Sept 24.5
	25 12 39.32	341 02 34.94	176 27 10.28	25 36 47.31	7 16 37.03	934.72991	+.3862137	
	25 12 37.32					M		
	28 50 46.61	341						
	162 02 55.74	341 02 41.72	176 26 42.27	25 36 37.88	7 22 43.13	934.20053	.3863776	1872
	−16 5.33	+ 23 17.36	+ 9.81	+ 13.20	− 2 42.11	− 07607	+ 236	May 5
	161 46 50.41	341 25 57.08	176 26 52.08	25 36 57.08	7 20 1.02	934.12446	.3864012	
	−39.10							
	161 46 11.31							
	277 48 50.40	341 06 12.53	176 26 45.60	25 36 39.62	7 25 19.81	935.03739	.3861184	1873
	−16 5.33	+ 23 17.36	9.81	13.20	− 2 42.11	− 07607	+ 236	May 25.5
	277 32 45.07	341 29 29.89	176 26 55.41	25 36 52.82	7 22 37.70	934.96132	.3861420	
	−1 13.13							
	277 31 31.94							

	Sept. 24.5 1870	Oct. 1.5 1871	Mar 5.5 1872	May 25.5 1873
M	25 12 40.39	31 26 38.91	161 46 11.31	277 31 31.94
		35 40 30.70	163 48 32.82	270 10 7.63
		9.7658098	9.4453622	9.9999981
		4.4170838	4.4204342	9.4229897
		4.1828936	3.8657804	9.4229878
		4 13 56.79	2 2 21.59	7 21 24.26
		35 40 30.70	163 48 32.86	270 10 7.68
½E		17 50 15.35	81 54 16.42	135 05 3.84
		9.4861754	9.9956505	9.8488444
		9.9786044	9.1486718	9.8501237
		9.7051797	0.2149376	.0681469
		.1423015	4.3122186	.0133533
		9.5628782	9.9027190	.0549936
½v		20 04 37.08	82 52 08.24	−48 36 17.51
½v		40 09 14.16	~~165 59 44.22~~	131 23 42.49
v			165 44 16.48	262 47 24.98
log r		3390570	4866200	.3859776
v+α+ω'		107 59 51.47	239 58 01.61	331 04 43.97
v+β+ω'		17 15 51.95	143 13 58.15	240 20 91.06
v+ω'		21 11 49.10	147 10 15.56	244 16 54.87
sin(v+α+ω')		9.9782122	9.9077764	9.6844908
log r a		.3389016	.4364641	.3858218
sin(v+β+ω')		9.4724377	9.7771113	9.9390289
log r b		.2943261	.3918858	.3412416
sin(v+ω')		9.5581986	9.7341061	9.9546959
log r c		9.9748348	.0724143	.0217796
x		+2.0754569	−2.2092279	−1.1757436
		−.8994842	+.9620910	+.4325916
		+1.1759727	−1.2471369	−.07431520
		+.5844722	+1.4756966	−1.9066478
		−.3913523	+.2244328	+.8408186
		+.1931199	+1.2512643	−1.0658292
		+.3412191	+.6405020	−.9472738
		−.1698059	−.0978822	+.3648259
		+.1714132	+.5431198	−.5824479
log Δ cos δ cos α		.0703973	.0959142	9.8710776
log Δ cos δ sin α		9.2858271	.0973490	0.0276876
log tan α		9.2154298	.0014348	0.1566100
α		9 19 33.43	−45 05 40.71	55 06 49.58
		+20.75	134 54 19.29	+6.14
		9 19 54.18	−6.52	55 6 55.72
		9 19 55.00	134 54 12.77	235 06 55.7
C−O		−0.82	134 54 11.00	235 6 55.9
		= −0.8	+1.8	+2.0
log Δ cos δ		.0761759	.2471478	.1137205
log Δ sin δ		9.2340443	9.7348956	9.7652571
[illegible]		9.1578684	9.4877478	9.6515366
		+8 11 6.24	17 05 20.60	−24 08 42.36
		+8.44	3.8	−5.49
C		+8 11 14.7	17 05 24.4	−24 8 47.8
O		8 11 16.0	17 5 24.4	−24 8 45.0
C−O		−1.3	+0.0	−2.8

	°	′	″			°	′	″
Ω'	176	27	10.28		i'	25	36	47.31
½Ω'	88	13	35.14		ε	23	27	22.30
					i'+ε	49	04	9.61
					i'−ε	2	09	25.01
					½(i'+ε)	24	32	4.80
					½(i'−ε)	1	4	42.50

cos ½(i'−ε)
b cos ½(i'+ε)
tan ½Ω'
sin ½(i'−ε)
c cos ½(i'+ε)

Ω = 324 02 52.06
4 = 32 43 28.50
ω' = 341 02 34.94
ω 13 46 3.44

tan ½(Ω − n + 4)
tan ½(Ω − n − 4)

(Ω − n + 4)	88 82 16.29 88 23 10.28	10.28
(Ω − n − 4)	58 14 47.17 55 39 41.78	41.78
Ω − n	146 47 03.46 144 02 47.55	52.06
Ω	324 02 44.59	52.06
4	32 43 32.45	28.50
ω'	341 2 34.94	34.94
ω	13 46 7.39	3.44
Ω	324 02 47.59	52.06
π	337 48 54.98	55.50

sin ½Ω' 9.9998944
cos ½(i'−ε) 9.9995230
9.9997129
8.4465700
~~1.5530385~~
1.5501545

cos ½Ω' ~~8.4478108~~ 4906569
cos ½(i'+ε) 9.9588039
~~8.4067150~~
8.4495600

sin ½Ω' 9.9997919
sin ½(i''−ε) 8.2746608
8.2744500
~~8.0661139~~
8.1085600
~~0.2083761~~
.1654727

cos ½Ω' 8.4906569
~~8.4478108~~
cos ½(i''+ε) 9.6183031
~~8.0661139~~
8.1089600

8.3576196
sin ½ i'' ~~8.4065551~~
½ i'' ~~1 27 44~~
1 18 19.88
i' 2 36 39.86

log cos Δ 9.92494
log di'' 1.12045
log I 1.04539

− log sin 4 9.13337 (289)
log sin i'' 9.63578
log dΩ' .99171
0.36086

log sin i' 9.63578
cos Δ 9.92494
dΩ' 99171
log I 0.55243

log a 4.97328
log ai'' 1.12045
log II 0.85380
.334

log(1 − cos i) 7.01281
log dΩ 2.37071
log dΩ(1 − cos i) 9.38352
.24

I + 11.103
II − 2.293

di = +8.81
2 36 34.4

I + 3.5680
II + 7.1841
I+II 10.7081
log(I+II) 1.02947
sin i 8.65856
log dΩ 2.37092
dΩ 234.92 = 3′ 54.92″
323 58 59.73
324 02 54.65

dχ +23 26.20
dπ +23 26.44
dΩ + 3 54.81
dω + 19 31.63
ω₀ 13 26 29.27
13 46 00.90

cos φ 9.98689
cot φ 9.55228
log a .88614
log p .37892

For Saturn.

1873 | 1874

Dates	June 14	July 24	Sept 12	Oct 12	Nov 21	Dec 31	Feb. 9	Mar 21	Apr 30	Jun 9	Jul 19
L'	298 12 17	299 25 21	300 38 32	301 51 46	303 05 07	304 18 34	305 32 06	306 45 45	307 58 30	309 13 21	310 27 19
L'−(N'+ω')	125 41 03 168 31 14	170 44 18	171 57 29	173 10 43	174 24 04	175 37 31	176 51 03	178 04 42	179 18 27	180 32 18	181 46 16
log tan u'	[illegible]	9.20667	9.14581	9.07472	8.98929	8.88240	8.73985	8.52547	8.08229	7.97292	8.49006
log tan β	8.29 32	8.13920									
log tan u'	[illegible]	9.21237	9.15007	9.07781	8.99136	9.88367	8.74054	8.52572	8.08282	7.97292	8.49024
log cos I	9.99840										
log tan λ'	9.21844	9.21077	9.14847	9.07621	8.98976	9.88207	8.73891	8.52412	8.08072	7.97132	8.48866
v	267 52 28	278 40 48	290 01 00	301 53 36	314 17 36	327 09 42	340 24 02	353 52 40	7 25 56	20 53 32	34 06 02
v+ω'	117 02 06	127 50 26	139 10 38	151 03 14	163 27 14	176 19 20	189 33 40	203 02 18	216 35 34	230 03 10	243 15 40
λ'	169 32 29	170 46 18	171 59 16	173 12 12	174 25 18	175 38 29	176 51 45	178 05 07	179 18 36	180 32 11	181 45 52
λ'−(v+ω')	52 31 23	42 55 52	32 48 38	22 08 58	10 58 04	359 19 09	347 18 05	335 02 49	322 43 02	310 29 01	298 30 12
log tan β'	8.19231	8.13714	8.07833	8.00724	7.92181	7.81452	7.67237	7.45799	7.01481	6.90544	7.42257
log r'	9.99969	9.99946	9.99922	9.99896	9.99871	9.99844	9.99815	9.99785	9.99755	9.99723	9.99692
log cos β'	9.99995	9.99996	9.99997	9.99998	9.99999	9.99999	10.	10.	10.	10.	10.
log z' = log r' sin β'	9.19200	9.13865	9.07785	9.00620	8.92052	8.81336	8.67052	8.45584	8.01236	6.90267	8.41949
log sin(λ'−v+ω')	9.89960	9.83322	9.73389	9.57637	9.27934	8.07491	9.34207	9.62518	9.78229	9.88115	9.94388
log r' cos β'	99964	.99942	99919	.99894	99870	99843	99815	99785	99755	99723	99692
log cos(λ'−v+ω')	9.78422	9.86462	9.92452	9.96671	9.99199	9.99997	9.98925	9.95744	9.90073	9.81240	9.67871
log cos γ' = cos β' cos	9.78417	9.86458	9.92449	9.96669	9.99198	9.99996	9.98925	9.95744	9.90273	9.81240	9.67871
log r'	99969	99946	99922	99896	.99871	99844	99815	99785	.99755	99723	99692
log sin γ'	9.89962	9.83325	9.73396	9.57642	9.27961	8.10717	9.34192	9.62516	9.78228	9.88115	9.94388
log r' cos γ'	−.78886	.86404	.92371	.96565	.99069	.99840	.98740	.95529	.89828	.80963	.67563
−r' cos γ'	−.60799	−.73121	−.83890	−.92396	−.97880	−.99633	−.97141	−.90218	−.79120	−.64570	47384
r	2.4045	2.3474	2.2921	2.2408	2.1960	2.1598	2.1346	2.1220	2.1228	2.1366	2.1629
r−r' cos γ'	−.36749	−.49647	−.60969	−.69988	−.75920	−.78035	−.75795	−.68998	−.57892	−.43144	−.25755
log r' sin γ' = log sin l	.56525	.69589	.78511	.84502	.88036	.89229	.87964	.83884	.76262	.63492	.41086
log sin l	.89937	.83241	.73318	.57538	.27832	9.10561	.34007	.62301	.77983	.87838	.94088
log tan l	.33406	.13682	9.94807	9.73036	9.39786	8.21232	9.46043	9.78417	.01721	.24346	.52994
log a	.94155	.92542	.91121	.90013	.89347	.89285	.89702	.90722	.92151	.93964	.95894
log b/a	2.82465	2.77626	2.73363	2.70039	2.68041	2.67705	2.68106	2.72166	2.76573	2.81892	2.87682
log 1/a³	7.17535	7.22374	7.26637	7.29961	7.31959	7.32295	7.30894	7.27834	7.23427	7.18108	7.12318
log ½	5.00031	5.00054	5.00078	5.00104	5.00129	5.00156	5.00185	5.00215	5.00245	5.00277	5.00308
log ½ 3	7.00093	7.00162	7.00234	7.00312	7.00387	7.00468	7.00555	7.00645	7.00735	7.00832	7.00924
$\frac{1}{a^3}$	.0014975	.0016739	.0018466	.0019935	.0020873	.0021036	.0020368	.0018982	.0017151	.0015173	.0013279
$-\frac{1}{r_0^3}$	−.0010023	−10037	−10054	−10072	−10090	10109	10129	−10150	10171	10193	10215
a	+.0004952	+.0006702	+.0008412	+.0009863	+.0010783	+.0010927	+.0010239	+.0008832	+.0006980	+.0004980	+.0003064
log a	6.69478	6.82620	6.92490	6.99401	7.03274	7.03850	7.01026	6.94606	6.84386	6.69723	6.48629
log z'	9.19200	9.13865	9.07755	9.00620	8.92052	8.81336	8.67052	8.45584	8.01236	6.90267	8.41949
log (1) = log W₀	7.30511	7.38318	7.42078	7.41854	7.37159	7.22019	7.09911	6.82023	6.27455	5.01823	6.32411
log a	6.69478	6.82620	6.92490	6.99401	7.03274	7.03850	7.01026	6.94606	6.84386	6.69723	6.48629
log y'	89924	83264	.73308	57531	.27804	9.07334	.34022	62303	.77884	.87838	.94080
log (1) log δ₀	9.01235	9.07717	9.07631	8.98765	8.72911	7.53017	8.76881	8.98742	9.04203	8.99394	8.84542
log r	.38100	.37058	.36024	.35040	.34162	.33442	.32932	.32674	.32680	.32972	.33504
log $\frac{1}{a^3}$	7.17535	7.22374	7.26637	7.29961	7.31959	7.32295	7.30894	7.27834	7.23427	7.18108	7.12318
log $\frac{2}{r_0}$	7.55635	7.59432	7.62661	7.65001	7.66121	7.65737	7.63826	7.60508	7.56117	7.51080	7.45822
log a	6.69478	6.82620	6.92490	6.99401	7.03274	7.03850	7.01026	6.94606	6.84386	6.69723	6.48629
log x'	78386	86404	92371	96565	99069	99840	98740	95529	89828	80963	67563
log ax'	7.47864	7.69024	7.84861	7.95966	8.02343	8.03690	7.99766	7.90135	7.74214	7.50686	7.16192
ax'	.0030105	.0049005	.0070569	.0091130	.0105545	.0108870	.0099463	.0079681	.0055226	.0032126	.0014519
$-\frac{2}{a_0^3}$	−.0036004	−.0039294	−.0042327	−.0044670	−.0045837	−.0045433	−.0043478	−.0040280	−.0036406	−.0032419	−.0028723
ax' − $\frac{2}{r_0}$	−.0005899	+.0009711	+.0028242	+.0046460	+.0059708	+.0063437	+.0055985	+.0039401	+.0018820	−.0000293	−.0014204
log v₀	6.77078	6.98682	7.45090	7.66708	7.77603	7.80234	7.74807	7.59551	7.27462	5.46687	7.15241
log l / log l₀	8.18911	8.40515	8.86923	9.08541	9.19436	9.22067	9.16640	9.01384	8.69295	6.88520	8.57074

46 55 36 59 16 38 71 6 10

Aug 28	Oct 7	Nov. 16
311 41 24	312 55 36	314 09 56
183 00 21	184 14 33	185 28 53
8.71964	8.86810	8.98011
8.72024	8.87029	8.98216
8.71864	8.86869	8.98056
206 43 14	268 25 16	280 15 48
182 59 41	184 13 37	185 27 44
286 54 27	275 47 21	265 11 56
7.65216	7.80162	7.91263
99655	99625	99591
10.	9.99999	9.99998
8.64871	8.79787	8.90854
9.98081	9.99778	9.99847
99655	99624	99589
9.46364	9.00375	8.82274
9.46364	9.00374	8.82272
.99655	.99625	99591
9.98081	9.99778	9.99848
.46019	9.99999	9.91863
−28853	−~~1.0000~~ 99998	+.08291
2.2000	2.2456	2.2973
→0.68553	+1.24558	+31264
9.83544	0.09545	.49504
.97736	.99403	.99439
1.14148	.88558	.49935
.97849	.99747	1.01515
293847	292241	304540
7.06453	7.00758	6.95455
9.00748	9.00345	9.02409
7.1036	7.01025	7.01228
.0011002	.0010176	.0008006
.001244	10262	−.10280
+.0001414	.0000101	−.0001110
1861	086	1281
6.13386	4.93450	6.10755
8.64871	8.79787	8.90854
6.20090	5.15070	6.43442
6.13386	4.93450	6.10755
.97736	.99402	.99436
8.52955	7.34685	8.52024
34242	35134	36122
7.06453	7.00759	6.95455
7.40695	7.35893	7.31577
6.13386	4.93450	6.10755
46019	9.99999	9.91863
6.59405	4.93449	6.02618
.0003927	.0000860	.000106
−.0025524	−.0022852	−.0020691
−.0021597	−.0022766	−.0019629
7.83439	7.35729	7.29290
8.75272	8.77562	8.71123

Für Saturn.

Dates 1873	$\frac{a^2 d\omega}{dt} dt^2$	$'\int$	$''\int$	$\frac{di}{dt}$	$'\int$	$\frac{d\Omega}{dt}$	$'\int$	$\frac{d\varphi}{dt}$	$'\int$	$\frac{d\pi}{dt}$	$'\int$
May 5	-.1083			+.004		-.0804		+.047		-3.117	
		+.0116			+.119		-2.200		+5.773		+11.287
Jun 14	-.1381		-4.6523	+.001		-.104		+.037 +.051		-3.852	
		-.1265			+.120		-2.304		+5.824		+7.435
Jul 24	-.1568		-4.7788	+.002		-.115		~~-.060~~ +.062		-4.431	
		-.2833			+.122		-2.419		+5.886		+3.004
Sept 2	-.1529		-5.0621	+.003		-.110		~~-.168~~ +.060		-4.559	
		-.4362			+.125		-2.529		+5.946		-1.555
Oct 12	-.1198		-5.4983	+.004		-.090		-.249 +.019		-4.176	
		-.5560			+.129		-2.619		+5.965		-5.731
Nov. 21	-.0583		-6.0543	+.004		-.060		-.270 -.082		-3.406	
		-.6143			+.133		-2.679		+5.883		-9.137
Dec 31	+.0202		-6.6686	+.003		-.029		-.217 -.231		-2.537	
		-.5941			+.136		-2.708		+5.652		-11.674
Feb. 9	+.0955		-7.2627	+.001		-.006		-.119 -.388		-1.881	
		-.4586			+.137		-2.714		+5.264		-13.555
Mar 21	+.1469		-7.7613	+.000		+.004		-.027 -.433		-1.549	
		-.3517			+.137		-2.700		+4.831		-15.104
Apr 30	+.1632		-8.1130	+.000		+.003		+.015 -.573		-1.413	
		-.1885			+.137		-2.703 .697		+4.258		-16.517
Jun 9	+.1461		-8.3015	+.000		-.003		+.001 -.447		-1.254	
		-.0424			+.137		-2.700		+3.811		-17.771
Jul 14	+.1060		-8.3439	+.000		-.005		-.050 -.336		-.819	
		+.0636			+.137		-2.705		+3.475		-18.590
Aug 28	+.0557		-8.2803	+.000		-.007		-.100 -.217		-.164	
		+.1193			+.137		-2.712		+3.258		-18.754
Oct 7	+.0118		-8.1610	+.000		-.001		-.129		+.444	
		+.1311			+.137		-2.713		+3.129		-18.255
Nov. 16	-.0374		-8.0299	+.000		+.014		-.056		+1.455	
		+.0937			+.137		-2.699		+3.073		-16.800
			-7.9362			0.151					

$\frac{d\Omega}{dt}$	ι'	$\frac{dM}{dt}$	ι' ''
~~+0.184~~	~~+.184~~	+3.301	
	-2.378		-13.673
+0.042		+3.895	
	-2.336		-9.568
-.155		+4.276	
	-2.491		-5.502
-.375		+4.184	
	-2.866		-1.318
-.576		+3.601	
	-3.442		+2.283
-.709		+2.698	
	-4.151		+4.981
-.733		+1.804	
	-4.884		+6.785
-.639		+1.244	
	-5.528		+8.029
-.448		+1.101	
	-5.971		+9.130
-.249		+1.143	
	-6.190		+10.323
-.009		+1.246	
	-6.199		+11.569
+.152		+.972	
	-6.047		+12.541
+.245		+.410	
	-5.802		+12.954
+.270		-.229	
	-5.532		+12.725
+.246		-1.210	
	-5.286		+~~12.185~~ 11.515

	°	′	″
Ω	324	03	14.2
$(\Omega - \omega)$	144	3	1.42
$\frac{1}{2}(\Omega - \omega)$	72	1	30.71

	°	′	″
i	2	36	47.70
ε	23	27	20.41
$i'+\varepsilon$	26	04	8.11
$i'-\varepsilon$	-20	50	32.71
$\frac{1}{2}(i'+\varepsilon)$	13	02	4.07
$\frac{1}{2}(i'-\varepsilon)$	-10	25	16.35

$\sin\frac{1}{2}(\Omega - \omega)$ 9.9782683
$\sin\frac{1}{2}(i'+\varepsilon)$ 9.3532180
$\sin\frac{1}{2}i'' \sin\frac{1}{2}(\Omega'+a)$ 9.3314863
$\sin\frac{1}{2}i'' \cos\frac{1}{2}(\Omega'+a)$ 8.7467923
.5846940
$\log\frac{1}{2}(\Omega'+a)$ 75 24 54.33
$\frac{1}{2}(\Omega'+a)$ 104 35 5.67

$\cos\frac{1}{2}(\Omega - \omega)$ 9.4893941
$\sin\frac{1}{2}(i''-\varepsilon)$ 9.2573982
8.7467923

$\sin\frac{1}{2}i'$ 9.3457116
$\frac{1}{2}i''$ 12 48 26.205
i' 25 36 52.41

$\sin\frac{1}{2}(\Omega' - \omega)$ 9.9782683
$\cos\frac{1}{2}(i'+\varepsilon)$ 9.9886636
9.9669319
$\cos\frac{1}{2}i' ~~\sin~~\frac{1}{2}(\Omega'-a)$ 9.4821705
$\cos\frac{1}{2}i' \cos\frac{1}{2}(\Omega'-a)$ 9.4847614
$\log\frac{1}{2}(\Omega'-a)$
$\frac{1}{2}(\Omega'-a)$ 71 51 55.73
$\frac{1}{2}(\Omega'+a)$ 104 35 5.67

$\cos\frac{1}{2}(\Omega' - \omega)$ 9.4893941
$\cos\frac{1}{2}(i'-\varepsilon)$ 9.9927764
9.4821705

Ω' 176 27 0.80
a 32 43 10.54
ω 14 06 18.92
ω' 341 23 8.38

Ephemeris for Opposition 1870

	Oct 7.5	11.5	15.5	19	23	27	31
M	47 28 15.85	48 30 34.57	49 32 53.29	50 35 12.01	51 37 30.73 57	52 39 49.45	53 42 08.17
	53 24 32.7	54 30 23.05	55 37 38.8	56 44 46.70	57 51 43.20	58 58 31.92	60 05 11.33
	9.9046219	9.9107207	9.9166561	9.9223360	9.9277651	9.9329541	9.9379084
	4.4235014	4.4235014	4.4235014	4.4235014	4.4235014		4.4235014
	4.3281233	4.3342221	4.3401575	4.3458575	4.3512665		4.3614098
	5 54 42.45	5 59 48.50	6 4 45.53	6 9 33.63	6 14 12.60	6 18 42.47	6 23 3.16
	53 29 3.28	54 30 23.05	55 37 38.84	56 44 46.70 45.63	57 51 43.33	58 58 31.92	60 05 11.33
	9.9046147	9.9107207	9.9166561	9.9223360	9.9277653	9.9329541	9.9379084
	4.3281233	4.3342221	4.3401575	4.3458380	4.3572667	4.3564555	4.3614098
E	53 22 58.30	54 30 23.05	55 37 38.84	56 44 45.64	57 51 43.33	58 58 31.92	60 05 11.33
½ E	26 41 29.15	27 15 11.52	27 48 49.42	28 22 22.82	28 55 51.66	29 29 15.96	30 02 35.66
sin ½ E	9.6524256	9.6607930	9.6689434	9.6768853	9.6845885	9.6921448	9.6995372
cos ½ E	9.9510647	9.9488976	9.9466827	9.9444198	9.9421203 6265	9.9397492	9.9373411
	9.8718010	9.8801684	9.8883188	9.8962607	9.9039[illegible]	9.9115502	9.9189126
	.1143064	.1121333	.1099184	.1076555	.1053560	.1029844	.1005766
log tan ½ v	9.7575006	9.7680351	9.7784004	9.7886052	9.7986575	9.8085653	9.8183358
½ v	29 46 31.83+	30 22 41.58+	30 58 41.73	31 34 32.25	32 10 12.09	32 45 44.24	33 21 05.68+
v	59 33 03.67	60 45 23.17	61 57 23.46	63 09 4.50	64 20 24.18	65 31 28.48	66 42 11.30
log r	.1757518	.1762706	.1767538	.1772415	.1777307	.1782287	.1787278
log r²	.3515836	.3525412	.3535076	.3544827	.3554614	.3564574	.3574556
u+A+ω'	127 44 6.00	128 56 25.50	130 08 25.79	131 20 6.83	132 31 28.57	133 42 30.81	134 53 13.63
u+B+ω'	37 0 4.23	38 12 23.73	39 24 24.02	40 36 5.06	41 47 26.74	42 58 29.04	44 9 11.86
u+ω'	40 56 12.05	42 8 8.55	43 20 31.84	44 32 12.88	45 43 34.56	46 54 36.86	48 5 19.68
log sin (u+A+ω')	9.8980940	9.8908680	9.8833581	9.8755578	9.8674000	9.8590000	9.8503350
log a	.3514280	.3523856	.3533520	.3543276	.3553108	.3563018	.3572956
log sin (u+B+ω')	9.7794748	9.7913389	9.8026509	9.8134421	9.8237929	9.8335779	9.8429712
log b	.3068479	.3078055	.3087719	.3097470	.3107307	.3117217	.3127195
log sin (u+ω')	9.8163902	9.8267042	9.8365480	9.8459462	9.8549208	9.8634920	9.8716786
log c	9.9878838	9.9888414	9.9893078	9.9902829	9.9912666	9.9922576	9.9932554
x	+1.7763233	1.7508680	1.7246861	1.6977934	1.6702089	1.6419443	1.6130155
X	−.9668214	−~~.9517593~~ .9461671	−.9209829	−~~.8953242~~ .8813886	−.8545327	−.8195722	−.7776601
x'	.8095019	.8047019	.8037032	.8064098	.8126762	.8223721	.8353554
y	+1.2198957	1.2564474	1.2924770	1.3279743	1.3629300	1.3973319	1.4311683
Y	−.2293739	−~~.2744586~~ .2897286	−.3486898	−~~.3989046~~ .4059615	−.4612680	−.5143575	−.5649836
y'	.9905218	.9667188	.9437872	.9220128	.9016620	.8829744	.8661847
z	+.6364643	+.6581993	.6696622	.6858500	.7014581	.7143805	.7327132
Z	−.0995210	−~~.1192147~~ .1257108	−.1512953	−~~.1730835~~ .1761453	−.2001402	−.2231724	−.2451374
z'	.5369433	.5274885	.5183669	.5097047	.5016179	.4942081	.4875753
	9.9082179	9.9056360	9.9050957	9.9065531	9.9099175	9.9150684	9.9218713
	9.9958640	9.9853002	9.9748741	9.9647369	9.9550438	9.9459481	9.9376105
	.0876461	.0796652	.0697784	.0581838	.0451263	.0308797	.0157392
α	50 44 33.66	50 13 32.88	49 34 59.51	48 49 35.83 32.57	47 58 16.95 31.97	47 02 36.86 31.43	46 02 16.77 31.41
	.1069482	.0996156	.0932908	0.0881029	.0841658	.0815878	.0803985
	9.7299293	9.7227130	9.7146373	9.7073186	9.7003731	9.6937097	9.6880417
log δ	9.6229811	9.6230974	9.6213465	9.6192157	9.6162073	9.6123380	9.6076432
δ	22 46 11.20	22 46 30.92	22 41 34.57	22 35 34.92 14.70	22 27 09.37 14.87	22 16 22.77 15.09	22 03 23.70 15.21
log Δ	.1421855	.1348703	.1283368	.1227803	.1184018	.1152476	.1134062
g	324 20	324 49	325 21	325 54	326 29	327 06	327 43
a					~~47 58~~	47 02	46 02
g+a					14 27	14 08	13 45
					9.3971	9.3877	9.3760
log q	1.1704	1.1744	1.1702	1.1822	1.1862	1.1904	1.1948
					9.9860	9.9866	9.9874
α				48 50 08.34	47 58 ~~24.24~~ 48.52	47 02 38.29	46 02 48.68
δ				22 35 52.62	22 27 24.24	22 16 37.81	22 03 38.91
t	3 22 58	3 20 54	3 18 19	3 15 18	3 11 53	3 08 08	3 4 9
	27.60	28.13	28.47	28.92	29.39 +1.58	29.88 1.55	30.40 1.51
δ − δ				2.51	31.90	31.43	31.51

Nov. 4.	6.	12.	~~No~~ 16.	20	24	28
5444 2689	5546 456	5649 433	5751 2305	5853 4177	5956 049	6058 1921
61 11 4154	62 18 2.50	63 24 1416		65 36 9.60	66 41 5328	67 47 27.61
9.9426347	9.9471391	9.9514274		9.9593768	9.9630478	9.9665225
4.4235014	4.4235014	4.4235014		4235014	4.4235014	4235014
4.3661361	4.3706405	4.3749288		4.3828751	4.3856549	4.3900239
46 271465	6 31 1689	6 35 985	6 38 5357	6 42 27.80	6 45 5281	6 49 844
61 11 41.54	62 18 2.50	63 24 14.18	64 30 26.56	65 36 9.60	66 41 53.39	67 47 27.65
9.9426347	9.9471391	9.9514274	9.9555049			
4.3661361	4.3706405	4.3749288	4.3790063			
61 11 4154	62 18 2.50	63 24 1418	64 30 16.56			
30 35 5077	31 09 1.25	31 42 409	32 15 8.28	32 48 480	33 20 5665	33 53 4382
9.7067202	9.7137304	9.7205735	9.7272552	9.7337811	9.7401562	9.7463850
9.9348840	9.9323788	9.9298239	9.9272187	9.9245606	9.9218618	9.9191075
9.9260956	9.9331058	9.9399489	9.9466306	9.9531565	9.9595316	9.9657604
.0981202	.0956148	.0930596	.0904554	.0878013	.0850973	.0823432
8.8279754	9.8374913	9.8468893	9.8561752	9.8653552	9.8744343	9.8834172
33 56 17.26	~~[illegible]~~	35 6 11.22	35 40 53.48	36 15 26.00	36 49 48.73	37 24 01.60+
	34 31 19.15+					
67 52 34.52	69 02 38.31	70 12 22.44	71 21 46.96	72 30 52.00	73 39 37.46	74 48 3.21
.1792301	.1797354	.1802436	.1807541	.1812669	.1817819	.1822986
.3584599	.3594708	.3604872	.3615082	.3625338	.3635638	.3645972
136 03 36.85	137 13 40.64	138 23 24.77	139 32 49.29	140 41 54.33	141 50 39.79	142 59 5.54
45 19 35.08	46 29 38.84	47 39 23.00	48 48 44.52	49 57 52.56	51 06 38.02	52 15 3.77
49 15 42.90	50 25 46.69	51 35 30.82	52 44 55.34	53 54 0.38	55 02 45.84	56 11 11.59
				8016795		
9.8412979	9.8319280	9.8222034	9.8121267	~~9.7722520~~	9.7908472	9.7796152
.3580643	.3593152	.3603316	.3613526	3623782	3634082	3644416
9.8579457	9.8605199	9.868[illegible]	9.8765449	9.8840287	9.8911799	9.8980121
.3137242	3147357	3157515	.3167725	3177981	.3188281	.3198615
9.8794977	9.8869658	9.8940975	9.9009067	9.9074061	9.9136088	9.9195246
9.9942601	9.9952710	9.9962874	9.9978084	9.9988340	9.9993640	.0003974
1.5834422	1.5532389	1.5224219	1.4810059	1.4590080	1.4264462	1.3933391
-.7319635	-.6826847	-~~.6368128~~	-.5743568	-.5158575	.4548481	.3916037
.8514787	.8705542	.6300607 .8923612	+.9166491	.9431505	.9715981	1.0017354
1.4644321	1.4971131	1.5292046	1.5606928	1.5915740	1.6218400	1.6514810
-.6128880	-.6578133	-~~.6944876~~ .6855166	-.7377783	-.7724091	-.8032516	-.8301607
.8515441	.8392998	.8296880	.8229145	.8191649	.8185884	.8213203
.7447525	.7624945	.7769354	.7910704	.8048976	.8184136	.8316145
-.2659246	-.2854196	-~~.3013338~~ .3035159	-.3201171	-.3351407	-.3485205	.3601957
.4818279	.4770749	.4734195	.4709533	.4697569	.4698931	.4714188
9.9301739	9.9397958	9.9505408	9.9622032	9.9745810	9.9874867	.0007537
9.9302072	9.9239171	9.9189148	9.9153546	9.9133713	9.9130654	9.9145726
.0000333	9.9841213	9.9683740	9.9531514	9.9387903	9.9255787	9.9137589
45 0 791	43 57 1012	42 54 5635	41 54 56.88	40 58 32.36	40 06 52.95	39 20 53.57
32.40	32.91	33.45	34.02	34.59	35.24	35.86
.0807056	.0825165	.0858180	.0905549	.0966404	.1039639	.1124016
9.6828920	9.6785866	9.6752462	9.6725775	9.6718732	9.6719990	9.6734070
9.6021864	9.5960701	9.5894282	9.5824234	9.5752325	9.5680351	9.5610054
21 48 25.79	21 31 48.98	21 13 58.10	20 55 21.60	20 36 29.54	20 17 50.35	19 59 50.77
15.40	15.59	15.79	16.01	16.23	16.46	16.70
.1129520	.1139291	.1163478	.1201806	.1253606	.1318050	.1394087
328 4	329 00	329 40	330 19	330 58	331 36	332 11
45 00	43 57	42 55	41 55	40 58	40 07	39 21
13 21	12 57	12 35	12 14	11 57	11 43	11 32
9.3634	9.3504	9.3382	9.3261	9.3160	9.3076	9.3009
1.1994	1.2041	1.2090	1.2143	1.2198	1.2255	1.2316
9.8881	9.8888	9.8894	9.8900	9.8805	9.8809	9.8811
45 00 40.31	43 57 43.03	42 55 29.80	41 55 30.35	40 59 06.95	40 07 28.16	39 21 29.37
21 48 41.19	21 32 4.58	21 19 13.89	20 55 37.66	20 36 45.78	20 18 6.81	20 00 7.47
3 0 00.0	2 55 48	2 51 39	2 44 39			
3094	3150	3208	3268	3330	3395	3462
1.46	1.41	1.37	1.34	1.29	1.26	1.24
32.40	32.91	33.45	34.02	34.59	35.21	35.86

℥

22 35 52.62

48 50 8.34 | 51 19.42 | | | | −8 28.38

47 58 48.92 | +4 51.21 | | ·0ct 23 22 27 24.24 | | −2 18.05

47 2 38.29 | +56 10.63 | +3 38.88 −1 12.23 | −7.55 27 22 16 37.81 | −10 46.43 | −2 12.47 | 5.58 | +8.07

46 02 48.68 | 59 49.61 | +2 18.76 −1 20.22 | −9.63 31 22 03 38.91 | −12 58.90 | 1 58.82 | +13.66 | +6.27

45 00 40.31 | 62 8.37 | + 48.91 −1 29.85 | −3.11 Nov 4 21 48 41.19 | −14 57.72 | 1 88.90 | 19.82 | +4.92

43 57 43.03 | 62 57.28 | − 44.05 −1 32.96 | +3.23 8 21 32 4.57 | −16 36.62 | 1.14.06 | 24.84 | +3.67

42 55 29.80 | 62 13.23 | −2 18.78 −1 29.73 | +7.46 12 21 14 13.89 | −17 50.68 | 4.55 | 28.57 | +1.38

41 55 30.35 | 59 56.45 | −3 36.05 −1 22.27 | +13.74 16 20 55 37.66 | 18 36.23 | −15.66 | 28.89 | −1.30

40 59 6.95 | 56 23.40 | −4 44.61 −1 8.56 | +13.17 20 20 36 45.77 | 18 57.89 | +12.23 | 28.59 | −1.90

40 07 28.16 | 51 38.79 | −5 40.00 −0 55.39 | 13 24 20 18 6.81 | 18 38.96 | +09.62 | +26.65

39 21 29.37 | 45 58.79 | −6 22 −0 42 | 28 20 00 7.47 | 17 59.34 | 24 / 686

✓

log 497.8 = 2,69705

	A_1	A_2	A_3	A_4	M.T.
1184018		12118			~~656~~ 658
	−31542		+1010		651
1152476		+13128			649
	−18414		+744		647
1134062		13872		+303	646
	−4542		+441		646
1129520		14313		338	646
	+9771		+103		647
1139291		14416		358	649
	+24187		+295		649
1163478		14121		314	651
	+38308		+605		654
1201786		13512		279	659
	+51820		+888		660
1253606		12624		−143	664
	+64444		+1031		669
1318050		+11593			674
	+76037				680
1394087					686

		$f\delta_2\alpha$	$f\delta_1\alpha$	$f_0\alpha$	$f\delta_2\delta$	$f\delta_1\delta$	$f\delta$		
	Oct 23.5	+18.24		47 58 48.92	-8.68		+22 27 24.24	2 28.75	
	24	17.16	13 38.05	47 45 10.87	8.63	2 28.75	22 24 55.49		8.63
x	25	16.05	13 55.21	47 31 15.66	8.56	-2 37.38	22 22 18.11	2 37.38	8.54
	26	14.90	14 11.24	47 17 4.42	8.46	2 45.92	22 19 32.19	2 45.92	8.46
	27	13.73	14 26.94	47 2 38.29	8.32	2 54.38	22 16 37.81	2 54.38	8.38
	28	12.54	14 39.83	46 47 58.36	8.11	3 2.76	22 13 35.05	3 2.76	8.11
x	29	11.31	14 52.37	46 33 5.99	7.90	3 10.87	22 10 24.18	3 10.87	7.90
	30	10.06	15 3.67	46 18 2.32	7.70	3 18.77	22 07 5.41	3 18.77	7.65
	31	8.72	15 13.73	46 2 48.68	7.45	3 26.47	22 03 38.21	3 26.42	7.60
	Nov 1	7.35	15 22.49	45 47 26.19	7.15	3 34.02	22 00 4.89	3 34.02	7.15
x	2	5.93	15 29.84	45 31 56.35	6.84	3 41.17	21 56 23.92	4 41.17	6.83
	3	4.57	15 35.76	45 16 20.59	6.52	3 48.00	21 52 35.72	3 48.00	6.53
	4	+3.07	15 40.27	45 00 40.31	6.20	3 54.52	21 48 41.19	3 54.53	6.25
	5	1.68	15 43.41	44 44 56.90	5.84	4 0.78	21 44 40.41	4 0.78	5.84
x	6	+0.11	15 44.99	44 29 11.91	5.46	4 6.62	21 40 33.79	4 6.62	5.45
	7	-1.35	15 45.11	44 13 26.80	5.06	4 12.07	21 36 21.72	4 12.07	5.08
	8	-2.79	15 43.76	43 57 43.03	4.65	4 17.13	21 32 4.57	4 17.15	4.64
	9	-4.23	15 41.05	43 42 01.98	4.22	4 21.79	21 27 42.78	4 21.79	4.22
x	10	-5.66	15 36.82	43 26 25.16	3.78	4 26.01	21 23 16.77	4 26.01	3.77
	11	-7.08	15 31.21	43 10 53.95	3.32	4 29.78	21 18 46.99	4 29.78	3.32
	12	-8.40	15 24.18	42 55 29.80	2.85	4 33.10	21 14 13.89	4 33.10	2.86
	13	-9.78	15 15.79	42 40 14.01	2.38	4 35.96	21 09 37.93	4 35.96	2.38
x	14	-11.05	15 6.01	42 25 8.00	1.90	4 38.34	21 04 59.59	4 38.34	1.91
	15	-12.30	14 54.97	42 10 13.01	1.44	4 40.25	21 0 19.34	4 40.25	1.43
	16	-13.51	14 42.67	41 55 30.35	-0.97	4 41.69	20 55 37.66	4 41.68	0.96
	17	-14.67	14 28.99	41 41 01.41	0.42	4 42.64	20 50 55.02	4 42.64	+.38
x	18	-15.78	14 14.27	41 26 47.14	-.07	4 43.22	20 46 11.60	4 43.22	-.11
	19	-16.84	13 58.52	41 12 48.62	+.51	4 43.11	20 41 28.49	4 43.11	.39
	20	-17.85	13 41.68	40 59 6.95	+.82	4 42.60	20 36 45.77	4 42.72	.71
	21	-18.79	13 23.75	40 45 43.20	1.23	4 42.01	20 32 03.76	4 42.01	1.23
x	22	-19.67	13 4.86	40 32 38.24	1.66	4 40.78	20 27 22.98	4 40.78	1.65
	23	-20.52	12 45.30	40 19 52.94	2.08	4 39.13	20 22 43.85	4 39.13	2.09
	24	-21.32	12 24.78	40 07 28.16	+2.49	4 37.05	20 18 6.81	4 37.04	2.53
	25	-22.05	12 3.42	39 55 24.74	2.87	4 34.51	20 13 32.30	4 34.51	2.87
x	26	-22.72	11 41.37	39 43 43.37	3.25	4 31.64	20 9 00.66	4 31.64	3.16
	27	-23.35	11 18.68	39 32 24.69	3.63	4 28.40	20 4 32.26	4 28.40	[illegible]
	28	-23.94	10 55.33	39 21 25.37	+4.00	4 24.77	20 00 7.47	4 24.75	

							lg4	Al.T
Oct 23.5	3 11 55.26				+7.59			1184018	10 54
24	3 11 00.72	-54.54	-1.14		7.75		9063	1174555	10 52
25	3 10 05.44	55.68	1.07	7	x 7.92	-44.82	8288	1166667	10 51
26	3 9 8.29	56.75	99	8	8.07	-82.72	7498	1159169	10 50
27	3 8 10.55	57.74	92	7	8.22	9079	6691	1152476	10 49
28	3 7 11.59	58.66	83	9	8.34		5866	1146610	10 48
29	3 6 12.40	59.49	76	7	x 8.46	-41.76	5032	1141578	10 47
30	3 5 12.15	1 00.25	65	11	8.56	-50.21	4187	1137391	10 47
31	3 4 11.25	1 0.90	60	5	8.66		3331	1134062	10 46
Nov 1	3 3 9.75	1 1.50	49	11	8.74		2453	1131609	10 46
2	3 2 7.76	1 1.99	39	10	x 8.83	- 691	-1579	1130030	10 46
3	3 1 5.88	1 2.38	31	8	8.89	-1522	-698	1129332	10 46
4	3 0 2.69	1 2.69	21	10	8.96		+151	1129520	10 46
5	2 58 59.79	1 2.90	10	11	8.98		1095	1130615	10 46
6	2 57 56.79	1 3.00	-00	10	x 9.00	+2853	+1993	1132608	10 47
7	2 56 53.79	1 3.00	+8	8	9.01	+1954	+2852	1135500	10 47
8	2 55 50.87	1 2.92	18	10	9.03		3953	1139291	10 48
9	2 54 48.13	1 2.74	29	11	8.99		4698	1143989	10 48
10	2 53 45.68	1 2.45	37	8	x 8.95	+6497	5597	1149586	10 49
11	2 52 43.60	1 2.08	47	10	8.90		6496	1156082	10 50
12	2 51 41.99	1 1.61	55	8	8.85		7386	1163478	10 51
13	2 50 40.93	1 1.06	66	11	8.76		8273	1171751	10 52
14	2 49 40.53	1 0.40	74	8	x 8.67	+10025	9149	1180900	10 54
15	2 48 40.87	59.66	81	7	8.57		10015	1190915	10 55
16	2 47 42.02	58.85	92	11	8.46		10872	1201786	10 57
17	2 46 44.09	57.93	98	6	8.33		11720	1213506	10 58
18	2 45 47.14	56.95	1.05	9	x 8.20	+13357	12553	1226059	11 00
19	2 44 51.24	55.90	1.12	7	8.05		13371	1239430	11 02
20	2 43 56.46	54.78	1.20	8	7.90		14176	1253606	11 04
21	2 43 02.88	53.58	1.25	5	7.75		14965	1278571	11 06
22	2 42 10.55	52.33	1.31	6	x 7.60	+16482	15740	1294311	11 09
23	2 41 19.53	51.02	1.37	6	7.43		16498	1311809	11 11
24	2 40 29.88	49.65	1.42	5	7.25		17241	1318050	11 14
25	2 39 41.65	48.23	1.47	5	7.07		17968	1336018	11 17
26	2 38 54.89	46.76	1.52		+ 6.89	+19343	18675	1354693	11 20
27	2 38 9.65	45.24	1.55	3	6.68		19362	1374055	11 22
28	2 37 25.96	43.69	1.		6.47		20030	1394087	11 26

Ephemeris (112)

	1874 Dec 26	1875 Jan 15	Feb 4	Feb 24	Mar 16	Apr 5	Apr 25	May 15	Jun 4	Jun 24	Jul 14
M	58° 06 42"	73 18 16	78 29 50	83 41 24	88 52 58	94 04 32	99 16 06	104 27 40	109 39 14	114 50 48	120 02 22
E	75 14 0	80 34 14	85 50 26	91 03 20	96 12 37	101 17 17	106 20 11	111 19 16	116 15 31	121 8 55	126 00 5
cos E	9.98541	9.99409	9.98885	~~91 03 20~~	9.99744	9.99152	9.98210	9.96921	9.95270	9.93239	9.90795
log e	4.42350	42350	4.42350	4	4.42350	42350	42350	42350	42350	42350	42350
log e sin E	4.40891	4.41759	4.42235		4.42094	4.41502	4.40560	4.39271	4.37620	4.35589	4.33145
e sin E	.25639	26157	26445.		26360	26003	25445	24701	~~[illegible]~~	.	.
"	7 7 20	7 15 57	7 20 46	7 21 53	7 19 20	7 13 22	7 4 5	6 51 41	6 36 20	6.18 13	5 57 32
E	75 14 02	80 54 13	85 50 36	91 03 17	96 12 18	101 17 54	106 20 11	111 19 21	116 15 34	121 09 00	125 59 54
E/2	37 37 01	40 17 06	42 55 18	45 31 38	48 06 9	50 38 57	53 10 5	55 39 40	58 7 47	60 34 30	62 59 57
log sin E/2	9.78560	9.81063	9.83315	9.85344	9.87177	9.88834	9.90331	9.91683	9.92903	9.94002	9.94888
cos E/2	9.89879	9.88243	9.86468	9.84545	9.82465	9.80214	9.77777	9.75135	9.72264	9.69133	9.65706
log r sin v	.00498	.03001	.05285	.07282	.09115	.10772	12269	.13621	14841	15940	16926
log r cos v	.06203	.04567	.02992	.00869	9.98789	9.96538	9.94101	9.91459	9.88588	9.85457	9.82030
log tan v	9.94295	9.98434	.02461	.06413	.10326	.14234	.18168	.22162	.26253	.30483	.34896
v/2	41 14 52	43 58 02	46 37 23	49 12 55	51 44 54	54 13 23	56 38 58	59 01 23	61 21 01	63 38 7	65 52 46
log r	.18588	18850	.19108	19363	19611	19852	.20084	20304	20513	20710	20894
log 2	.37176	.37700	.38216	.38726	.39222	.39704	.40168	.40608	.41026	.41420	.41788
v	82 29 04	87 56 04	93 14 46	98 25 50	103 29 48	108 27 06	113 17 56	118 02 46	122 42 02	127 16 14	131 45 32
v+Ω+ω	150 40 06	156 07 06	161 25 48	166 36 52	171 40 50	176 38 08	181 28 58	186 13 48	190 53 04	195 27 16	199 56 34
v+ω'	63 52 12	69 19 12	74 37 54	79 48 58	84 52 56	89 50 14	94 41 04	99 25 54	104 05 10	108 39 22	113 08 40
v+ω'+3	59 56 05	65 23 5	70 41 47	75 52 51	80 56 49	85 54 7	90 44 57	95 29 47	100 09 3	104 43 15	109 12 33
log sin(v+A+ω)	9.69008	9.60729	9.50306	9.36456	9.16044	8.76854	8.41291n	9.03551n	9.27607n	9.42565n	9.53286n
log r a	.37160	.37684	.38200	.38710	.39206	.39688	.40152	.40592	.41010	.41404	.41772
log sin(v+B+ω)	9.98725	9.95862	9.97487	9.98668	9.99456	9.99889	9.99996	9.99800	9.99326	9.98551	9.97512
log r b	.32702	.33226	.33742	.34252	.34748	.35230	.35694	36134	36552	36946	37314
log sin(v+C+ω)	9.95318	9.97108	9.98419	9.99310	9.99827	10.00000	9.99855	9.99409	9.98674	9.97656	9.96356
log r c	.00756	.01280	.01796	.02306	.02802	.03284	.03748	.04188	.04606	.05000	.05368
x	+11526	+0.9641	+0.7675	+0.5645	0.3560	+0.1464	−.0652	−2763	−4855	−6914	−8925
X	+.0785	+.4152	+.7008	+.9008	+.9922	+.9657	+.8263	+.5918	+.2903	−.0439	−.3733
y	+1.8377	+1.9538	2.0525	21340	21981	2.2454	22746	2.2874	22843	22645	22298
Y	−.8992	−.8181	−.6365	−.3770	−.0719	+.2418	+.5273	+.7523	+.8921	+.9317	+.8673
z	+.9136	+.9686	+1.0050	1.0379	1.0624	1.0786	1.0865	1.0864	1.0785	10631	10405
Z	~~+1.0865~~ −.3901	~~1.0864~~ −.3550	~~1.0785~~ −.2762	−1686	−0312	+1049	+2288	+3264	+3871	+4043	+3763
log Δ cos δ cos α	.09029	13966	16681	16533	12975	04614	88144	9.49900	9.29048 ~~9.2520~~	9.86646	.10237
log Δ cos δ sin α	9.97243	.05526	15106	24477	32760	38571	44795	48288	50194	50463	49105
log tan α	9.88214	9.91560	9.98425	.07944	.19785	.34889	.36601	0.98383	1.21146	.64339	.38866
α	37 19 09	39 28 03	43 57 41	50 12 41	57 37 20	~~65 52 49~~ 65 54 34	74 48 41	84 04 28	−86 29 01 93 30 59	−77 02 41 102 57 19	−67 46 25 112 13 35
log Δ sin δ	9.71892	9.78433	9.86261	9.94166	01334	07317	11902	15008	16602	16655	15731
log Δ cos δ	18978 ~~47086~~	.25205	.30960	.35917	.40098	.43529	.46291	.48516	50276	.51588	.52456
log tan δ	9.52914	9.53228	9.55301	9.58249	9.61236	9.63788	9.65611	9.66492	9.66326	9.65072	9.62675
δ	+18 40 57	+18 48 29	+19 39 40	+20 55 33	+22 16 28	+23 28 47	24 22 16	+24 48 40	+24 43 40	+24 06 19	+22 56 12
log Δ	.21333	.27589	.33569	~~.37130~~ .38881	.43466	.47282	.50344	.52721	.54453	.55546	.56036

	°	'	°	'			h	m			
	37	19	+2	9			2	29.3	+86		
Jan 15	35	28	4	30	+2 21	−36	2	37.9	180	+9.4	2.5
Feb 4	43	58	6	15	+1 45	−34	2	55.9	24.9	6.9	2.1
Feb 24	50	13	7	24	+1 04	−26	3	20.8	29.7	4.8	1.4
Mar 16	57	37	8	18	+0 44	−19	3	50.5	33.1	3.4	.9
Apr 5	65	55	8	53	+ 35	−12	4	23.6	35.6	2.5	1.0
Apr 25	74	48	9	16	+ 23	−12	4	59.2	37.1	1.5	.8
	84	04	9	27	+ 11	−12	5	36.3	37.8	+.7	.8
	93	31	9	26	− 1	−8	6	14.1	37.7	−.1	.5
	102	57	9	17	− 9	−10	6	51.8	37.1	−.6	.6
	112	14	8	58	− 19	−4	7	28.9	35.9	1.2	.4
	121	12	8	35	− 23	−8	8	4.8	34.3	1.6	.4
	129	47	8	4	− 31	−5	8	39.1	32.3	2.0	.4
	137	51	7	28	− 36	−8	9	11.4	29.9	2.4	.6
	145	19	6	44	− 44	−12	~~9~~	~~41.3~~	26.9	3.0	.7
	152	03	5	48	− 56	−17	10	8.2	23.2	3.7	1.2
	157	51	4	35	− 73		10	31.4	18.3	4.9	1.7
	162	26	2	55	90	−17	10	49.7	11.9	6.6	1.7
	165	21									

18	29	−0 48	+1 55
+18	41	+ 7	+ 45
18	48	+ 52	24
19	40	1 16	+ 4
20	56	1 20	− 7
22	16	1 13	− 20
23	29	0 53	− 26
24	22	+ 27	− 32
24	49	+ 5	− 33
24	43	− 38	− 31
24	06	−1 09	− 28
22	57	−1 37	+ 25
21	20	−2 2	+ 16
19	18	−2 18	+ 11
17	00	−2 29	+ 0
14	31	−2 29	+ 8
12	02	−2 21	+ 21
9	41	−2 08	+ 35
7	[illegible]	−1 25	

Aug 3	Aug 23	Sept 12	Oct 2	Oct 22	Nov 11	Dec 1	Dec 21	Dec 41
125 13 56	130 25 30	135 37 4	140 48 38	146 00 12	151 11 46	156 23 20	161 34 54	166 46 28
130 48 20	135 34 51	140 19 02	145 02 02	149 42 53	154 23 9	159 1 14	163 39 07	168 16 11
9.87906	9.84504	9.80518	9.75822	9.70269	9.63579	9.55929	9.44644	9.30815
42350	42350	42350	42350	42350	42350	4.42350	42350	42350
4.30256	4.26834	4.22868	4.18172	4.12619	4.05929 11463	3.97742	3.~~40558~~ 3.78294	9.73165
5 34 30	5 09 18	4 42 10	4 13 16	3 42 52	3 11 5	2 38 13	2 4 22	1 29 50
130 48 26	135 34 48	140 19 17	145 01 54	149 43 04	154 22 51	159 01 31	163 39 16	168 16 18
65 24 13	67 47 24	70 9 37	72 30 57	74 51 32	77 11 25	79 30 46	81 49 38	84 8 9
9.95869	9.96652	9.97343	9.97946	9.98466	9.98905	9.99268	9.99557	9.99772
9.61933	9.57749	9.53070	9.47777	9.41697	9.34579	9.26011	9.15277	9.00928
17807	18590	19281	19884	20404	20843	21206	21495	.21710
9.78257	9.74073	9.69394	9.64101	9.58021	9.50903	9.42335	9.31601	9.17252
.39550	.44517	.49887	.55783	.62383	.69940	.78871	.89894	1.04458
68 05 15	70 15 47	72 24 31	74 31 40	76 37 30	78 42 04	80 45 40	82 48 20	84 50 36
.21064	~~6702~~ 21219	.21361	.21487	.21598	.21693	.21773	.21838	.21886
.42128	.42438	.42722	.42974	.43196	.43386	.43546	.43676	.43772
136 10 36	140 31 34	144 49 02	149 03 20	153 15 00	157 24 08	161 31 20	165 36 40	169 41 12
204 21 32	208 42 36	213 00 04	217 14 22	221 26 02	225 35 10	229 42 22	233 47 42	237 52 14
117 33 38	121 54 42	126 12 10	130 26 28	134 38 08	138 47 16	142 54 28	146 59 48	151 04 20
113 37 31	117 58 35	122 16 3	126 30 21	130 42 01	134 51 9	138 58 21	143 03 41	147 08 13
9.61537	9.68158	9.73612	9.78186	9.82070	9.85388	9.88238	9.90682	9.92781
.42112	.42422	.42706	.42958	.43180	.43370	.43530	.43660	.43756
9.96198	9.94603	9.92715	9.90515	9.87974	9.85060	9.81718	9.77884	9.73451
.37654	.37964	.38248	.38506	.38722	.38912	.39072	.39202	.39298
9.94769	9.92884	9.90684	9.88143	9.85223	9.81879	9.78039	9.73615	9.68460
1.05708	.06018	.06302	.06554	.06776	.06966	.07126	.07256	.07352
-1.0876	-1.2759	-1.4561	-1.6272	-1.7886	-1.9390	-2.0782	-2.2051	-2.3194
-.6609	-.8742	-.9882	-.9880	-.8729	-.6534	-.3550	-.0134	+.3300
2.1803	2.1168	2.0400	1.9505	1.8491	1.7367	1.6140	1.4821	1.3412
+.3961	+.4055	+.1721	-.1409	-.4374	-.6817	-.8436	-.9022	-.8457
1.0111	.9850	.9330	.8851	.8318	.7735	.7106	.6437	+.5730
+.3064	+.2020	+.0747	-.0612	-.1898	-.2958	-.3660	-.3915	-.3687

.24267	33246	38815	41759	42513	41370	38618	29872	39625	~~23194~~ .29872
46036	41201	34480	25758	14974	02325	9.88672	9.76335	76335	9.69152
.21769	.07955	9.95665	9.83999	9.72461	9.60955	9.50054	9.41710	9.41710	9.39280
-58 47 35	-50 13 09	-42 08 43	-34 40 34	-27 56 31	-22 08 40	-17 34 08	-16 [illegible]	-14 38 35	13 52 40
121 52 22	129 46 53	137 51 19	145 19 26	152 03 29	157 51 20	162 25 52	162 29 29 163 44 56 163 21 03	165 21 25	166 07 20
11970	.07078	.00333	9.91587	9.80753	9.67916	9.53732	9.40175	9.40175	
52824	52637	.51807	.50252	.47896	.44698	.40693	~~.35649~~ .36041	.36059	
9.59151	9.54441	9.48526	9.41835	9.32857	9.23218	9.13089		~~9.95884~~ 9.04116	
+21 19 33	+19 18 15	+16 59 50	+14 31 20	+12 01 46	+9 41 9	+7 41 28		+6 16 27	
.55904	.55150	.53746	.51662	.48860	.45322	.41075			

log Δ		
213		
276	+ 63	
335	59	+ 4
389	54	+ 5
435	46	+ 8
473	38	+ 8
503	30	+ 8
527	24	+ 6
544	17	+ 7
555	11	+ 6
560	+ 5	+ 6
559	- 1	+ 6
551	- 8	+ 7
537	- 14	+ 6
517	- 20	+ 6
489	- 28	+ 8
453	- 36	+ 8
411	- 42	+ 6
362	- 49	+ 6

362 56

06

	$\alpha = 2^h$ ^{m}	Corr $\alpha = 2^h$ ^{m}	$\delta = +$ ° '	Corr $\delta = +18°$ '
Dec 23	28.7	27.4	18 44	40
24	29.0	27.7	18 43	39
25	29.2	27.9	18 42	38
26	29.3	28.0	18 41	37
27	29.5	28.2	18 40	36
28	29.7	28.4	18 39	35
29	30.0	28.7	18 38	34
30	30.2	28.9	18 37	33
31	30.4	29.1	18 37	33
Jan 1	30.7	29.4	18 37	33
2	31.1	29.8	18 37	33
3	31.4	30.1	18 37	33
4	31.8	30.5	18 37	33
5	32.2	30.9	18 37	33
6	32.7	31.4	18 37	33
7	33.2	31.9	18 38	34
8	33.7	32.4	18 39	35
9	34.2	32.9	18 40	36
10	34.7	33.6	18 41	[illegible]

New discussion of (112)

Assumed Elements for Sept. 24.5 1870 B.M.T.

$d☊ = +55.375''$
$d\pi = +50.235$
$di = +.418$
Eq 1870

$M = 25° 12' 40''.39$
$☊' = 176\ 27\ 10.28$
$\varpi' = 341\ 02\ 34.94$
$i' = 25\ 36\ 47.31$
$\varphi = 7\ 16\ 37.03$
$\mu = 984.7299$
$\log \mu$ .8862187

$A + \varpi' = 67° 50' 37''31$
$B + \varpi' = 337\ 6\ 37.79$
$\varpi' = 341\ 2\ 34.94$
$\log a = 9.9958446$
$\log b = 9.9552691$
$\log e = 9.6354778$
$\log \sqrt{a(1+e)} = .2190043$
$\log \sqrt{a(1-e)} = .1636971$
$\log e'' = 4.4170138$

1871
Feb 5.5 . 6.0 8.5 12.0

Date	Sept. 24.5	20	22	26	28
M	25° 12' 40''39	24 10 21.47	24 41 30.93	25 43 49.86	26 14 59.31
E	28 41 45.40	27 31 36.22	28 6 41.54	29 16 47.81	29 51 48.71
½ E	14 20 52.70	13 45 48.11	14 03 20.77	14 38 23.90	14 55 54.35
l sin ½ E	9.3941192	9.3764171	9.3853682	9.4026816	9.4110614
l cos ½ E	9.9862380	9.9873490	9.9867985	9.9856658	9.9850820
l √r sin ½ v	9.6131235	9.5904214	9.6043725	9.6216859	9.6300657
l √r cos ½ v	.1499351	.1510444	.1504956	.1493629	.1487791
l tan ½ v	9.4631884	9.4443778	9.4538769	9.4723230	9.4812866
½ v	16 12 0.27	15 32 4.87	15 52 26.12	16 31 32.95	16 51 3.95
v	32 24 0.54	31 05 9.74	31 44 52.24	33 03 5.90	33 42 7.90
log r	.3350622	~~.3344700~~ .3344672	.3347622	.3353680	.3356488
A + v + ϖ'	100 14 37.85	98 56 17.43	99 35 29.55	100 53 48.21	101 32 45.21
B + v + ϖ'	9 30 38.33	8 12 17.91	8 51 30.03	10 09 43.69	10 48 45.69
v + ϖ'	13 26 35.48	12 8 15.06	12 47 27.18	14 05 40.84	14 44 42.84
log sin (A + v + ϖ')	9.9930215	9.9946939	9.9938860	9.9921000	9.9911218
log a	.3349068	.3343118	.3346068	.3352126	.3355234
log sin (B + v + ϖ')	9.2180912	9.1544693	9.1874982	9.2465820	9.2732803
log r b	.2903321	.2897363	.2900313	.2906371	.2909479
log sin (v + ϖ')	9.3663876	9.3227541	9.3451646	9.3865435	9.4057244
log r c	9.9708400	9.9702450	9.9705400	9.9711458	9.9714566
x	+21277877	+21330729	+21305554	+21247732	+21215107
X	−1.0019707	−1.0027460	−1.0029497	−.9998078	−.9964626
y	+.3224210	+.2781030	+.3002821	+.3445238	+.3665879
Y	−.0268533	+.0360895	+.0046220	−.0582974	−.0896702
z	+.2173838	+.1963356	+.2068734	+.2278711	+.2383313
Z	−.0116479	+.0156612	+.0020087	−.0252915	−.0386048
log Δ cos δ cos α	.0514678	.0532041	.0521573	.0511391	.0511711
log Δ cos δ sin α	9.4706540	9.4971964	9.4841631	9.4567097	9.4423507
log tan α	9.4191892	9.4439923	9.4320058	9.4055706	9.3911796
α	14 42 36.87	15 32 02.91	15 07 51.25	14 16 29.84	13 49 40.16
Δ α	+18.82	+18.53	+18.68	+18.97	+19.12
α (C)	14 42 55.69	15 32 21.44	15 8 9.93	14 16 48.81	13 49 59.28
log Δ cos δ	.0659414	.0693655	.0674806	.0647599	.0639437
log Δ sin δ	9.3133100	9.3263298	9.3199011	9.3065958	9.2997829
log tan δ	9.2473686	9.2569638	9.2524205	9.2418359	9.2358392
δ	+10 01 25.34	+10 14 34.62	+10 08 18.86	+9 53 57.66	+9 45 58.44
Δ δ	+7.21	+7.01	+7.11	+7.31	+7.42
δ (C)	+10 01 32.55	+10 14 41.63	+10 08 25.97	+9 54 4.97	+9 46 5.86
log Δ		.0763437	.07432	.0712	

M.. Oct 14 . 16 . 18 . 20 . 22 .. 24 . Dec 20 . Dec 21.

1870 ~~Hom~~

Sept. 20	15 32 21.44		-18.2	+10 14 41.63	-2 52.90	-10.2
21	15 20 24.16	11 57.28	-16.55	10 11 38.77	-3 2.86	-9.94
22	15 8 9.93	12 14.23	-15.69	10 08 25.97	-3 12.80	9.47
23	14 55 40.01	12 29.52	-14.40	10 5 3.50	-3 22.29	8.88
24	14 42 55.69	12 44.32	-13.18	10 01 32.55	3 31.15	8.60
25	14 29 58.19	12 57.50	-11.88	9 57 52.80	3 39.75	8.08
26	14 16 48.81	13 9.38	-10.71	9 54 4.97	3 47.83	4.84
27	14 3 28.72	13 20.09	-9.35	9 50 9.30	3 55.67	4.77
28	13 49 59.28	13 29.44		9 46 5.86	4 3.44	1.

Hamil bolle

	log h	μα	μ'α	log μ	log μ'	hμ	~~h²~~ h²μ'	sum	α₀	α(b)
Sept. 20	9.56003	-708.18	-9.10	2.85014n	0.95904n	-4 17.20	-1.20	-4 18.40	15 32 21.44	15 28 3.04
21	9.27903	-725.75	-8.47	2.86079n	92788n	-2 17.98	-0.30	-2 18.28	15 20 24.16	15 18 5.88
22	9.19363	-742.07	-7.84	2.87044n	89432n	-1 55.90	-0.19	-1 56.09	15 08 9.93	15 6 13.84
26	9.32968	-794.73	-5.35	2.90022n	72835n	-2 45.79	-0.24	-2 50.03	14 16 48.81	14 13 58.78
27	9.44685	-804.76	-4.67	2.90567n	66832	-3 45.18	-0.37	-3 45.55	14 3 28.72	13 59 43.17

	μδ	μ'δ	log μ	log μ'	hμ	h²μ'	sum	δ₀	δ(b)
Sept. 20	-178.00	-5.10	2.25042n	0.70757n	-1 04.63	-0.67	-1 05.30	+10 14 41.63	+10 13 36.33
21	-187.83	-4.97	2.27377n	0.69656n	0 35.71	-0.18	-0 35.89	10 11 38.77	+10 11 2.88
22	-197.58	-4.73	2.29563n	0.67446n	-30.85	-.11	-0 30.96	10 08 25.97	+10 7 55.01
26	-231.75	-3.52	2.36502n	0.58329n	-49.51	-.18	-0 49.69	9 54 4.97	9 53 15.28
27	-239.55	-3.88	2.37940	0.58883n	-1 07.03	-.30	-1 7.33	9 50 9.30	9 49 1.97

	α(b)	α(o)	Δα(c-o)	δ(b)	δ(o)	Δδ(b-o)
Sept. 20	15 28 3.0	27 56.8	+6.2	+10 13 36.3	13 35.0	+1.3"
21	15 18 5.9	18 0.6	+5.3	10 11 2.9	11 3.1	-0.2
22	15 6 13.8	6 11.6	+2.2	10 7 55.0	7 55.6	-0.6
26	14 13 58.8	13 55.3	+3.5	9 53 15.3	53 17.9	-1.6
27	13 59 43.2	59 38.2	+5.0	9 49 2.0	49 4.0	-2.0
			+4.44"			-0.62

Sept. 24.5 α = 14 42 55.69   δ = +10 01 32.55

Δα(c-o) + 4.44   - 0.62

10 1 33.17

α(0) (14 40 51.25 + 10 01 33.17) = Normal Place.

1872
Oct. 14
18
21
22
23

1870 Conversion of Equatorial Elements into Ecliptic Elements.

Ω' 176 27 10.28 sin $\frac{1}{2}\Omega'$ 9.9997919 · cos $\frac{1}{2}\Omega'$ 8.4906569 sin $\frac{1}{2}\Omega'$ 9.9997919 cos $\frac{1}{2}\Omega'$ 8.4900569

$\frac{1}{2}\Omega'$ 88 13 35.14 cos $\frac{1}{2}(i'-\varepsilon)$ 9.9999231 cos $\frac{1}{2}(i'+\varepsilon)$ 9.9589032 sin $\frac{1}{2}(i'-\varepsilon)$ 8.2746941 sin $\frac{1}{2}(i'+\varepsilon)$ 9.6183025

8.4495602 8.1089594

i' 25 36 47.31 cos $\frac{1}{2}i''$ sin $\frac{1}{2}(\Omega-\omega+a)$ 57997150

ε 23 27 22.06 cos $\frac{1}{2}i''$ cos $\frac{1}{2}(\Omega'-\omega+a)$ 8.4495682

$i'+\varepsilon$ 49 04 9.37 tang $\frac{1}{2}(\Omega-\omega+a)$ 1.5501548

$i'-\varepsilon$ +2 9 25.25 $\frac{1}{2}(\Omega-\omega+a)$

$\frac{1}{2}(i''+\varepsilon)$ 24 32 4.68 $\frac{1}{2}(\Omega-\omega+a)$ 88 23 10.28

$\frac{1}{2}(i''-\varepsilon)+1$ 4 42.62 $\frac{1}{2}(\Omega-\omega)-a)$ 55 39 41.85

sin $\frac{1}{2}i''$ sin $\frac{1}{2}(\Omega-\omega+a)$ 8.2749660

sin $\frac{1}{2}i''$ cos $\frac{1}{2}(\Omega-\omega+a)$ 8.1089594

tang $\frac{1}{2}(\Omega-\omega+a)$ 0.1655066

5066

sin $\frac{1}{2}i''$ 8.3576286

$\frac{1}{2}i''$ 1 18 19.98

i'' 2 36 39.86

$i'' = 2^\circ\ 36'\ 39.86''$

$\Omega-\omega$ 144 02 55.18

Ω 324 02 55.13 55.13

a 32 43 25.43 25,43

ϖ 341 02 34.94

$\omega=\varpi+a$ 13 46 0.37

Ω 324 02 55.13

π 337 48 55.50

Integration for Feb. 5 1871

$\mathcal{M}$	~~π~~ $\mathcal{M}$	~~Ω~~ π	~~i~~ Ω	~~φ~~ i	~~log a~~ φ	~~log a~~ μ	log a
for Perturbations Equinox.	~~125 12 40.39~~ ~~137 05 37.39~~ ~~162 18 14.98~~						

Integration fr. Feb. 20.5 1872

	M	Ω	π	φ	i	μ	log a
	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	″	
~~Perturbations~~	125 12 40.39	324 02 55.13	337 48 55.50	7 16 37.03	2 36 39.86	934.72991	
Equinox	133 27 31.16	− 3 21.73	+ 21 27.19	+ 3 23.99	+ 7.13	− .60545	
Elements.	158 40 11.55	+ 1 50.75	+ 1 40.47		+ .84		
	− 31 57.98						
Feb 20.5 M	158 08 13.57	324 01 24.15	338 12 03.16	7 20 01.02	2 36 47.83	934.12446	.3864012
ΔM	3 37 57.74						
mean 5.5	161 46 11.31						

	°	′	″
Ω	324	01	24.15
$\Omega - n$	144	01	24.15
$\frac{1}{2}(\Omega - n)$	72	00	42.07
i	2	36	47.83
ε	23	27	21.36
$i+\varepsilon$	26	04	9.19
$i-\varepsilon$	−20	50	33.53
$\frac{1}{2}(i+\varepsilon)$	13	02	4.60
$\frac{1}{2}(i-\varepsilon)$	−10	25	16.76

log $\sqrt{a(1+\varepsilon)}$ .2192871
log $\sqrt{a(1-\varepsilon)}$ .1635468

log e″ 4.4204342

Error in Ω

sin ½(Ω − n) 9.9782729
sin ½(i + ε) 9.3532229
9.3314958
8.7467533
0.5847425ₙ
− 75 24 59.94
104 35 0.06
~~9.345718~~
41 52 1.90
176 27 1.96

cos ½(Ω − n) 9.4893504
sin ½(i′ − ε) 9.2574029
8.7467533ₙ
sin ½i′ 9.3457181
½i′ 12 48 26.90
i′ 25 36 53.80

sin ½(Ω − n) 9.9782729
cos ½(i′ + ε) 9.9886633
9.9669362
9.4821266
.4848096

cos ½(Ω − n) 9.4893504
cos ½(i′ − ε) 9.9927762
9.4821266

~~9.9782729~~
9.9782761
9.3532229
9.3314990
8.7467282
0.5847758
−75 25 03.80
104 34 56.20
71 52 6.58
Ω′ 176 27 2.78
Δ 32 42 49.62
ϖ 14 08 39.01
ϖ′ 341 25 49.39

~~9.4893504~~
9.4893208
9.2574029
8.7467232

~~9.9782729~~
9.9782761
9.9886633
9.9669394
9.4820965
.4848429

9.3457192
12 48 27.02
i′ 25 36 54.04

9.~~4893504~~
9.4893203
9.9927762
9.4820965

sin Ω′ 8.7917335
cos i″ 9.9550714
cos Ω′ 9.9991662ₙ
sin ε 9.6358074

− cos Ω′ 9.9991662
cos i′ sin Ω′ 8.7468049
tang A 1.2523613ₙ
A 86 47 55.78
log a 9.9998444

− sin Ω′ 8.7917335ₙ
− cos i′ cos Ω′ 9.9542376ₙ
tang B 8.8374959
B − 3 56 05.65
B 356 03 54.35
log b 9.9552626
B 356 03 54.35

A + ϖ′ 68 13 45.16 log a 9.9998444
B + ϖ′ 337 29 43.74 log b 9.9552626
ϖ′ 341 25 49.39 log c 9.6358074

2(A + ϖ′) 136 27 30.34
2(B + ϖ′) 314 59 27.48
2ϖ′ 322 51 38.78

sin 2(A + ϖ′) 9.8381440 9.8495535
log a² 9.9996888 9.9105352
9.8378328 9.7600787ₙ

sin 2(B + ϖ′)
log b²

sin 2ϖ′ 9.7808559ₙ
log c² 9.2716148
9.0524707

I 6883874
II −5755442
III −1128430
6883872

8.7920941
9.9550742
9.9991648ₙ
9.6357948

9.9991648
8.7471683
1.2519965
86 47 46.12

8.7920941
9.9542390
8.8378551
− 3 56 17.37
356 03 42.63

9.9998441 68 13 45.32
9.9552656 337 29 41.83
9.6357948 341 25 59.20

9.

9.9782355
9.3532229
9.3314584
8.7471125
0.5843469
− 75 24 14.02
104 35 45.98
71 51 6.17
Ω′ 176 26 52.15
32 44 35.81
ϖ 14 10 39.01
ϖ′ 341 25 59.20

9.4897096
9.2574029
8.7471125

9.3457059
12 48 25.59
25 36 51.18

~~9.9782355~~
9.9782355
9.9886633
9.9668988
9.4824858
.4844130
71 51 6.19

9.4897096
9.9927762
9.4824858

B.M.T.

Date	Feb. 5.5	6.0	9.5	12.0	Feb. 28.5	Mar 1.5	3.5	5.5	7.5	9.5
M	.	.	.	.	~~164 43 54.81~~ 160 12 46.56	160 43 54.81	161 15 3.06	161 46 11.31	162 17 19.56	162 48 27.81
E					162 25 18.14	162 53 3.50	163 20 48.37	163 48 32.84	164 16 16.87	164 44 0.49
½E					81 12 39.07	81 26 31.94	81 40 24.18	81 54 16.42	82 08 8.43	82 22 0.24
sin ½E					9.9948700	9.1726260	9.9953977	9.9956505	9.9958960	9.9961344
cos ½E					9.1841195	9.9951375	9.1608160	9.1486718	9.1361743	9.1233024
					.2141591	.2144246	.2146848	.2149376	.2151831	.2154215
√ sin ½v					9.3476663	9.3361728	9.3243628	9.3122186	9.2997211	9.2868472
√ cos ½v					.8664908	.8782518	.8903220	.9027190	.9154620	.9285723
tan ½v					82 15 20.82	82 27 37.09	82 39 52.87	82 52 08.24	83 04 23.24	83 16 37.91
½v					164 30 41.64	164 55 14.18	165 19 45.74	165 44 16.48	166 08 46.48	166 33 15.82
log r					.4362724	4363916	4365075	4366200	.4367294	.4368358
					232 44 27.00	233 08 59.34	233 33 30.90	233 58 1.64	234 22 31.64	234 47 0.98
					142 00 25.61	142 24 57.95	142 49 29.51	143 14 0.25	143 38 30.25	164 02 59.59
					145 56 31.23	146 21 3.57	146 45 35.13	147 10 5.87	147 34 35.87	147 59 5.21
x					9.9008613n	9.9032020n	9.9055069n	9.9077765n	9.9100111n	9.9122114n
					4361168	4362360	4363519	4364644	4365738	4366802
					9.7892730	9.7852747	9.7812190	9.7771053	9.7729320	9.7686978
					3915350	3916542	3917701	3918826	3919920	3920984
					9.7482126	9.7435911	9.7389001	9.7341382	9.7293034	9.7243943
					.0720798	.0721950	.0723149	.0724274	.0725368	.0726432
x					-21725915	-21849321	-21971450	-22092256	-22211857	-22330149
X					+.9297186	+.9416538	+.9524494	+.9620910	+.9705655	+.9776612
y					+1.5163798	+1.5028958	+1.4893237	+1.4756654	+1.4619210	+1.448[illegible]
Y					-.3151070	-.2852217	-.2549848	-.2244323	-.1936023	-.1625353
z					+.6611385	+.6543200	+.6474631	+.6405685	+.6336366	+.6266679
Z					-.1367217	-.1237558	-.1106375	-.0973822	~~.1936023~~ -.0840061	-.0705264
log a cos δ cos a					.0944267	.0945700	.0950632	.0959147n	.0971254	.0986987
log a cos δ sin a					.0796416	.0855310	.0914344	.0973382	.1032284	.1090913
log tan a					9.9852149n	9.9904610	9.9963712	.0014235	.0061030	.0103926
a					-44 01 29.64	-44 24 13.67	-44 45 38.29	-45 05 38.03	-45 24 09.24	-45 41 7.71
a					135 58 30.36	135 35 46.33	135 14 21.71	134 54 21.97	134 35 50.76	134 18 52.29
Δa					- 7.17	- 6.95	- 6.73	- 6.52	- 6.31	- 6.11
					135 58 23.19	135 35 39.38	135 14 14.98	134 54 15.45	134 35 44.45	134 18 46.18
					2376744	2406125	2437714	2471426	2507183	2544722
log a cos δ					9.7196767	9.7247379	9.7298332	9.7349488	9.7400708	9.7451653
log a sin δ					9.4820018	9.4841254	9.4860618	9.4878062	9.4893575	9.4907131
					+16 52 38.25	+16 57 19.03	+17 01 36.04	+17 05 28.41	+17 08 55.67	+17 11 57.31
					+ 3.92	+ 3.89	+ 3.85	+ 3.82	+ 3.78	+ 3.75
					+16 52 42.17	+16 57 22.92	+17 1 39.85	+17 5 32.23	+17 8 59.45	+17 12 1.06

log A = 25679

	α ° ′ ″	′ ″	″	δ ° ′ ″	′ ″	″
Feb. 28.5	135 58 23.19	-11 31.49		+16 52 42.17	+2 23.29	
Mar. 0.5	135 46 51.70	11 12.32	+19.17	16 55 5.46	2 17.46	-5.83
1.5	135 35 39.38	10 52.58	19.74	16 57 22.92	2 11.52	5.94
2.5	135 24 46.80	10 31.82	20.76	16 59 34.44	2 5.45	6.07
3.5	135 14 14.98	10 10.57	21.25	17 1 39.89	1 59.27	6.18
4.5	135 04 4.41	9 48.56	21.61	17 3 39.16	1 53.07	6.20
5.5	134 54 15.45	9 26.84	22.12	17 5 32.23	1 46.77	6.30
6.5	134 44 48.61	9 4.16	22.68	17 7 19.00	1 40.45	6.32
7.5	134 35 44.45	8 41.00	23.16	17 8 59.45	1 34.00	6.45
8.5	134 27 3.45	8 17.27	+23.73	17 10 33.45	1 27.61	6.39
9.5	134 18 46.18			17 12 1.06		

	28	1.5	3.5	5.5	7.5	9.5
log 4	25679	25991	26324	.26676	27046	27434
log 4 7.8 ~~Abert~~	2.69705	2.69705	2.65705	2.69705	2.65705	2.65705
	2.44026	~~2.43714~~	2.43381	~~2.43029~~	~~2.42619~~	~~2.42271~~
Log Abb. T	2.95384	2.95696	2.96029	2.96381	2.96751	2.97139
Abb. T	= 14 59 15	-15 06	15 13	15 20	15 27	15 36

Comparison with Ephemeris

	Leipzig				Lund				Berlin	
date	Feb. 28	Mar 4	Mar 6	Mar 8	Mar 2	Mar 5	Mar 7	Mar 8	Mar 5	Mar 7
T	10 23 2	8 46 7	11 20 47	9 49 6	10 31 41	12 18 50	10 3 27	9 35 16	10 47 44	8 46 41
Red. to B.M.T.	+ ~~62 36~~	+ ~~58 36~~	~~53 36~~	~~58 36~~	+ 50	+ 50	+ 50	+ 50	00	00
B.M.T.	~~11 16 38~~ 10 27 9	8 39 43	~~12 14 23~~	9 53 07	10 32 31	12 15 40	10 4 17	9 36 06	10 47 44	8 46 41
Sb. T	−14 59	8 50 8 −15 13	11 24 48 −15 20	15 31	−15 9	15 20	15 27	15 31	15 20	15 27
Gm. T	10 12 4	8 34 55	11 9 28	9 37 36	10 17 22	12 4 20	9 48 50	9 20 35	10 32 24	8 31 14
T Dec.	.42504	35726	46490	40551	42871	50301	.40891	38930	.43917	35502
log T	−.07496	−.14274	−.03510	−~~.06446~~ .09889	−.07129	~~.6699~~ +.00301	−.09109	−.11070	−.06083	−.14458
	8.87483n	9.15455n	8.54831n	8.99515n	8.85303n	7.47857	8.95947n	9.04415n	8.78412n	9.16131n
μ(α)	−701.07	−~~599.79~~	−555.50	−509.14	−642.20	−574.90	−532.58	−509.14	−574.90	−532.58
μ'(α)	+ 9.58	+ 10.60	+ 11.34	+ 11.86	+ 10.38	+ 11.06	+ 11.58	+ 11.86	+ 11.06	+ 11.58
log μ(α)	0.84576n	1.03342	1.05461	1.07408	2.80767n	2.46185n	2.72638n	2.70684n	2.76185n	2.72638n
log μ'(α)	9.98136	2.77758n	2.74468n	2.70684n						
hμ(α)	+ 52.55	+ 85.61	+ 19.50	+ 50.35	+ 45.78	~~+17.40~~ +1.74	+ 48.57	+ 56.36	+ 35.15	+ 1 07.21
h²μ'(α)	+ .05	+ .20	+ .1	+ .10	+ .5	00	+ .9	+ .11	+ .4	+ .22
hμ+h²μ'	+ 52.60	+ 1 25.81	+ 19.49	+ 50.45	+ 45.83	+ 1.74	+ 48.62	+ 56.47	+ 35.19	+ 1 07.43
α(C)	135 58 23.19 135 59 15.79	135 4 4.41 135 5 30.22	134 44 48.61 134 45 8.10	134 27 3.45 134 27 53.90	135 24 46.80 135 25 32.63	134 54 15.45 134 54 17.19	134 35 44.45 134 36 ~~32.97~~ 33.07	134 27 3.45 134 27 59.92	134 54 15.45 134 54 50.64	134 37 44.45 134 38 51.88
μ(δ)	+ 146.20	+ 126.17	+ 103.61	+ 90.80	+ 128.49	+ 109.92	+ 97.23	+ 90.80	109.92	+ 97.23
μ'(δ)	− 2.91	− 3.10	− 3.16	− 3.20	− 2.97	− 3.15	− 3.22	− 3.20	− 3.15	− 3.22
log μ(δ)	2.22063	2.06509	2.01540	1.95809	2.10887	2.04108	1.98780	1.95809	2.04108	1.98780
log μ'(δ)										
hμ	− 12.46	− 16.58	− 3.64	− 8.98	− 9.16	+ 0.33	− 8.86	− 10.05	− 6.69	− 14.10
h²μ'	0	0	0	0	0	0	0	0	0	0
hμ+h²μ'	− 12.46	− 16.58	− 3.69	− 8.98	− 9.16	+ 0.33	− 8.86	− 10.05	− 6.69	− 14.10
δ_0	+16 52 42.17	+17 3 39.16	+17 7 19.00	+17 10 33.45	+16 59 34.44	+17 5 32.23	+17 8 59.45	+17 10 33.45	+17 5 32.23	+17 8 59.45
δ(C)	~~−16 52 54.63~~ +16 52 29.71	~~−17 3 55.74~~ 17 3 22.58	~~−17 7 22.69~~ 17 7 15.31	~~−17 10 42.43~~ 17 10 24.47	~~−16 59 43.60~~ 16 59 25.28	~~−17 5 31.90~~ 17 5 32.56	~~−17 9 8.31~~ 17 8 50.59	~~−17 10 43.50~~ 17 10 23.40	~~17 5 38.92~~ 17 5 25.54	~~−17 9 13.56~~ +17 8 45.35
log f par α									8.851	9.045
log a									.267	.270
log f par δ									.713	.716
par α									+57	−50
par δ									+27.9	+27.9

	28	4	6	8	2	5	7	8	5	7
α	135 59 17.0	135 5 24.3	134 44 58.0	134 27 48.7	135 25 29.2	134 54 10.5	134 36 32.7	134 27 51.5	134 54 50.25	134 37 03.15
Δα	− 0.1	− 1.1	− 1.1	0.0	+ 0.2	+ 1.6	.2	+ .6	+ 57	− 90
α O	135 59 16.9	135 5 23.2	134 44 56.9	134 27 48.7	135 25 29.4	134 54 12.1	134 36 32.5	134 27 52.1	134 54 50.8	134 37 2.2
α C	135 59 15.8	135 5 30.2	134 45 8.1	134 27 53.9	135 25 32.6	134 54 13.7	134 36 33.1	134 27 59.9	134 54 50.6	134 36 51.9
Δα(C−O)	− 1.1	+ 7.0	+ 11.2 *	+ 5.2 *	+ 3.2	+ 1.6	+ 0.6	+ 7.8 *	− 0.2	−(10.3)
δ	+16 52 24.0	+17 3 5.9	17 6 52.9	+17 10 1.3	+16 59 11.2	17 5 20.7	17 8 40.0	17 9 56.4	17 5 11.2	17 8 36.0
Δδ	+ 2.8	2.8	+ 2.9	+ 2.7	3.0	3.1	3.0	3.0	2.8	2.8
δ(O)	+16 52 26.8	+17 3 8.7	+17 6 55.8	+17 10 4.0	16 59 14.2	17 5 23.8	17 8 43.0	17 9 59.4	17 5 14.0	17 8 38.8
δ(C)	+16 52 29.7	17 3 22.6	+17 7 15.3	17 10 24.5	16 59 25.3	17 5 32.6	17 8 50.6	17 10 23.4	17 5 25.5	17 8 45.3
Δδ(C−O)	[illegible]	+ 13.9	+ 19.5 − 13.8 + 5.7	+ 20.5 − 15.0 + 5.5	+ 11.1	+ 8.8	+ 7.6	+ 24.0 ~~− 13.0~~ ~~+ 11.0~~	+ 11.5	+ 6.5

* Comp. star * Lund 1720
Mar 2, Mar 5, Mar 7
α = 9h 1m 24.93s δ = +17° 13′ 3.6″

Mar 8
α = 8 56 33.22 + 17° 10′ 42.3″

Leipzig
Feb 28 9 1 41.35 + 16° 56′ 10.6″
Mar 4 9 5 31.45 + 17 2 57.7
Mar 6 Mar 8 8 56 33.18 + 17 10 42.4

Ps	Δα(C−O)	Δδ(C−O)
Feb 28 Leipzig	−1.1″	+2.9″
Mar 2 Lund	+3.2	+8.8
Mar 4 Leipzig	+7.0	+13.9
Mar 5 Lund	+1.6	+7.6
Mar 5 Berlin	−0.2	+11.5
Mar 6 Leipzig	+11.2	+(4.5)
Mar 7 Lund	+0.6	+7.6
Mar 7 Berlin	−(10.3)	+6.5
Mar 8 Leipzig	+5.2	+5.5
Mar 8 Lund	+7.8	+9.0
	+3.81″	~~+8.38″~~ +7.78″

Mar 5.5

α = 134° 54′ 15.45″ δ = +17° 05′ 32.23″
−Δα(C−O) − 3.81 −Δδ(C−O) − 7.78
α(O) 134 54 11.64 δ(O) +17 05 24.45

* The same comparison star was used on these dates, viz BD +17° 1995 α = 8 56 33.18 δ = +17° 10′ 42.4″ (1720)

Comparison with Ephemeris in B.J. for 1873

Date	Leipsic May 29	Leipsic May 29	Wash. May 23	Wash. May 26	Wash. May 28
T	11 22 29	11 6 26	11 14 15	10 17 39	10 46 24
Red. to B	+ 4 1	+ 4	+ 6 1.47	6 1.47	6 1.47
B.M.T.	11 26 30	11 10 27	17 16 02	16 19 26	16 48 08
Ab. T	− 11 50	− 11 50	− 11 50	− 11 49	− 11 49
Corr. T	11 14 40	10 58 37	17 04 12	16 07 37	16 36 19
T′	−.03149	−.04262	.21125	~~.21362~~ .17196	.19189
log T′	8.49817n	8.62961n	9.32480	9.~~32964~~ 23543	9.28305
u(α)	− 59.60	− 62.43	− 62.43	− 61.38	− 60.27
u′(α)	+ .36	~~+.10~~	+ .10	+ .24	+ .32
log u	1.77525n	1.77525n	1.79539n	1.78803n	1.78010n
log u′	9.55630	9.55630	9.00000	9.38021	9.50515
hu	+ 1.88	+ 2.54	− 13.19	− 10.55	− 11.57
h²u′	.00	.00	+ .00	+ .01	+ .01
hu+h²u′	+ 1.88	+ 2.54	− 13.19	− 10.54	− 11.56
α₀	15 36 24.88	15 36 24.88	15 42 32.52	15 39 26.57	15 37 24.84
α(b)	15 36 26.76	15 36 27.42	15 42 19.33	15 39 16.03	15 37 13.26
log par α	8.447	—	8.658n	9.133	8.718n
log 4	.154		.154	.154n	.154n
log par δ	.935		.895	.880	.894
α(c)	15 36 26.72	15 36 26.92	15 42 18.63	15 39 15.52	15 37 13.15
Δα	+ .02	+ 0.00	− .04	− .09	− .04
α(O)	15 36 26.74	15 36 26.92	15 42 18.59	15 39 15.43	15 37 13.11
α C	15 36 26.76	15 36 27.42	15 42 19.33	15 39 16.08	15 37 13.26
Δα(C−O)	+ .02	+ .50	+ 0.74	+ .60	+ .13
u(δ)	+ 226.1	226.1	+ 206.9	+ 218.0	+ 223.8
u′(δ)	+ 1.1	+ 1.1	+ 2.1	+ 1.6	+ 1.3
log u	2.35430	2.35430	2.31576	2.33846	2.34986
log u′			0.32222	0.20412	.11394
hu	* − 7.12	9.64	+ 43.71	+ 37.49	+ 42.95
h²u′	+ .00	.00	+ .09	+ .04	+ .05
hu+h²u′	+ 7.12	+ 9.64	+ 43.80	+ 37.53	+ 43.00
δ₀	−23 54 5.20	~~−24 15 50.60~~	−24 15 50.60	−24 5 12.40	−23 57 50.30
δ(b)	~~−23 53 58.08~~	−23 54 14.84	−24 16 6.80	−24 4 ~~25.76~~ 34.87	−23 57 7.30
Δ	−23 54 12.32				
δ(c)	−23 54 14.6	−23 54 10.3	−24 15 6.8	−24 04 37.4	−23 57 5.5
Δδ	+ 6.0 +	+ 6.0	+ 5.5	+ 5.5	+ 3.5
δ(O)	−23 54 8.6	−23 54 4.3	24 15 1.3	−24 4 31.9	23 57 0.0
δ C	−23 54 12.3	−23 54 14.8	−24 15 6.8	−24 4 34.9	−23 57 7.3
Δδ(C−O)	− 3.7	− 10.5	− 5.5	− 3.0	− 7.3

		Δα(C−O)	Δδ(C−O)
May 18	Harvard College	+ .56	—
19	" Harvard College	+ .48	− 4.7
20	"	* + .48	− 6.0
23	Washington	+ .44	− 5.5
25	Harvard College	+ .67	− 4.3
26	Wash.	+ .60	− 3.0
28	" "	+ (.13)	− 7.3
29	Leipsic	+ (.02)	− 3.7
29	" " M.	+ .50	− 10.5
29	Harvard College	+ .69	− 5.3
31	" "	+ .53	− 2.3
276			

May 25

May = 11.8

+ .56	—	—
+ 48	− 4.7	− 4.7
+ 50	− 4.5	− 4.5
+ 48	− 6.0	− 5.5
+ 44	− 5.5	− 4.3
+ .67	− 4.3	− 3.9
+ 60	− 3.0	− 7.3
—	− 7.3	− 10.5
—	− 3.7	
+ 50	− 10.5	
+ 69	− 5.3	
+ 53	− 2.3	
+ .585	− 4.65	

May 25.5

α 15ʰ 40ᵐ 28.19ˢ δ −24° 08′ 48.8″

Δα − .58 Δδ + 4.6

α(O) 15 40 27.61 δ(O) −24 8 44.2

= 235 06 54.1

sin Ω′ 8.7919798 = cos Ω′ 9.9991653 sin Ω′ 8.7919798

cos i′ 9.9550726 cos i′ sin Ω′ 8.7470524 cos i′ cos Ω′ 9.9542379

cos Ω′ 9.9991653 log tan A 1.2521129 log tan B 8.8377419n

sin i′ 9.6358020 A 86 47 49.20 B − 3 56 13.68

log a 9.9998443 ~~log~~ B 356 03 46.32

A + ω′ 68° 17′ 19.14″ log a 9.9998443

B + ω′ 337 33 16.26 log b 9.9552641

ω′ 341 29 29.94 log c 9.6358020

Elements for May 25 1873

F	M	Ω	π	φ	i	μ
ΔP	25° 12′ 40.39″	324° 02′ 55.13″	337° 48′ 55.50″	7° 16′ 37.03″	2° 36′ 39.86″	934.72991
~~Δ Preces.~~	− 34 55.17	− 3 23.32	+ 24 10.90	+ 6 0.67	+ 7.79	+ .23141
Precess	94 37 48.22 252 53 46.52	+ 2 46.08	+ 2 30.72		+ ~~1.26~~	934.96132
M	277 31 32.14	324 02 17.89	338 15 37.12	7 22 37.70	2 36 48.91	934.96132

Ω 324 02 17.89

Ω − n 144 02 17.89

½(Ω − n) 72 01 8.94

i 2° 36′ 48.91″

ε 23 27 20.88

i + ε 26 04 9.79

i − ε −20 50 31.97

½(i + ε) 13 02 4.89

½(i − ε) −10 25 15.98

sin ½(Ω−n) 9.9782535 cos ½(Ω−n) 9.4895354 sin ½(Ω−n) 9.9782535 cos ½(Ω−n) 9.4895354

sin ½(i+ε) 9.3532255 sin ½(i−ε) 9.2573941n cos ½(i+ε) 9.9886631 cos ½(i−ε) 9.9927765

9.3314790 8.7469295n 9.9669166 9.4823119

8.7469295n 9.4823119

0.5845495n 0.4846047

− 75 24 37.60 9.3454135

½(Ω′+Δ) 104 35 22.40 ½ i′ 12 48 26.41

½(Ω′−Δ) 71 51 38.11 i′ 25 36 52.82

Ω′ 176 26 55.82

Δ 32 43 49.29 log √a(1+ε) .2193025

ω 14 13 19.23 log √a(1−ε) .1632296

ω′ 341 29 29.94

log e″ 4.4229897

May 25.5 1873

M	277 31 32.14
E'	270 10 7.88
½ E'	135 05 3.94
sin ½ E'	9.8488441
cos ½ E'	9.8501240n
√2 sin ½ v	.0681466
√2 cos ½ v	.0133536n
tang ½ v	.0547930n
½ v	−48 36 17.37
½ v	131 23 42.63
v	262 47 25.26
log r	.3859976
v + A + ω'	331 04 44.40
v + B + ω'	240 20 41.52
v + ω'	244 16 55.20
sin (v + A + ω')	9.~~8404868~~ 6844852n
log r a	.3858219
sin (v + B + ω')	9.9390294n
log r b	.3412417
sin (v + ω')	9.9546962n
log r c	.0217796
x	~~+1.1915105~~ 1.1757355
X	+.4325916
y	−1.9066505
Y	+.8408186
z	−.9472743
Z	+.3648259
log Δ cos δ cos α	9.~~8710752~~ .1640311n
log Δ cos δ sin α	.0276887
log tang α	9.8636576n
log α	0.1566135
α₀	55 06 50.36
Δα	+4.47
α (C)	235 06 54.83
α (O)	235 6 54.1
Δα(C−O)	+0.7"
log Δ C	
log Δ cos δ	1137205
log Δ sin δ	9.4652574
tang δ	9.6515369n
δ	−24 8 42.46
Δδ	−5.49
δ(C)	−24 8 47.95
δ(O)	−24 8 44.2
Δδ(C−O)	−3.7
ls	293 00
a	235 7
g + a	168 07
log tang δ	9.6515n
log sin (g + a)	9.3137
log g	.7483
log cos (g + a)	9.990n
I	−0.52
	+4.99
a' − a	+4.47
δ' − δ	−5.48

Elements for Oct 27.5 1874

	M	Ω	π	φ	i'	log μ
P₁	53 07 26.88	324 02 55.13	337 48 55.50	7 16 37.03	2 36 39.86	9.3472991
dP₁	−27 37.43	−3 32.14	+17 3.90	+6 32.15	+6.37	−.051080
M	52 39 49.45	+3 41.30	+3.20.94		+1.67	
	52 39 49.45	324 03 4.29	338 09 20.34	7 23 9.18	2 36 47.90	934.67883

Ω 324 03 4.29
n 144 03 4.29
½ (Ω − n) 72 01 32.15
i 2 36 47.90
ε 23 27 20.41
½ (i' + ε) 26 04 8.31
½ (i' − ε) −20 50 32.51
½ (i + ε) 13 02 4.15
½ (i − ε) −10 25 16.25

sin ½ (Ω − n) 9.9782683
sin ½ (i' + ε) 9.3532188
9.3314881
8.7467818n
0.5847063
~~−75 24 55.85~~
~~8 08 12.61~~
½ (Ω' + A) 104 35 4.25
½ (Ω' − A) 71 51 56.58
Ω' 176 27 0.83
A 32 43 −7.67
ω 14 06 16.05
ω' 341 23 8.38

cos ½ (Ω − n) 9.4893847
sin ½ (i' − ε) ~~9.9886630~~ 9.2573971
8.7467818
~~9.3536201~~
9.3457127
12 48 26.32
25 36 52.64

sin ½ (Ω − n) 9.9782683
cos ½ (i' + ε) 9.9886685
9.9669328
9.4821611
.4847717

cos ½ (Ω − n) 9.4893847
cos ½ (i' − ε) 9.9927764
9.4821611

sin Ω' 8.7917997
cos i'' 9.9550728
cos Ω' 9.9991660
sin i'' 9.6358012

−cos Ω' 9.9991660
cos i' sin Ω' 8.7468725
tang A 1.2522931
A 86 47 53.57
log a 9.9958444

−sin Ω' 8.7917997
−cos i' cos Ω' 9.9542388
tang B 8.8375609
B 3 56 7.80
B 356 03 52.20
9.9552641

A + ω' 68 11 2.35
B + ω' 337 27 0.58
ω' 341 23 8.38

log a 9.9958444
log b 9.9552641
log c 9.6358012

log μ 2.9706624
log b 3.5500066
log a 0.5793442
1931147
.3862294

log √a(1+ε) = .2193754
log √a(1−ε) .1632357

log e" 4.4235014

1877 July 4
−49.42
+18.7

9.63580
8.66164n
.00012
8.29756n
9.99992
9.95010
2.69390n
2.64392n

8.29756n
1.27184
9.56940n

−44.05
−.4
−44.09

Preliminary values of Δα(C−O) Δδ(C−O) for 1874

	Δα(C−O)	Δδ(C−O)
Oct 31	+1ᵐ 17.ˢ43	+5′ 6.5″
Nov 2	17.70	+ 0.6
3	17.49	10.7
4	17.23	15.5

+ 1.57.46 = 19′ 21.9″ = +1161.9″

+5 8.3 = +308.3
+308.3.

For Nov 4.5

α₀ 45 00 40.31
−19 21.9
α(C) 44 41 18.4

δ₀ 21 48 41.9
−5 8.3
δ(C) 21 43 32.9

$f_x = -\frac{3}{2}\mu\, t\, [illegible]$
$f_y = \frac{2+p}{a\cos\varphi}\sin E$
$f_z = 10\left(\frac{2r-t}{aa\cos\varphi}\right)$
$\varphi_y = -\frac{\cos E + e}{\cos\varphi}$
$\varphi_z = -10\tan\varphi\sin E$
$\cot\psi = \tan\varphi\, a\, E$
$c' = \frac{aa\cos\varphi}{\sin\Omega'}$
$\bar{M} = \frac{c}{\Delta}\sin i'(\sin i' \cos\Omega - n)$
$\bar{N} = \frac{2}{\Delta}\sin(i' - n)$
$M^0 = -\frac{c}{\Delta}\cos(i' + [illegible])$
$N^0 = -\frac{2}{\Delta}\sin(i' - n)\cos\theta$

Conditional Equations

		a	b	c	d	e	f	S
−0″1	0 = ~~+3″74~~ +0″0 n.000 di	+.000 dΩ	+2.260 dℓ	−.231 d log a	+2.282 d log	−4.452 d	−0.141
+1″1	+0.92 −16 +.000	+.000	+1.150	−3.828	+.923	+3.004	+1.249
+1″1	+1.45 +03 +.000	+.000	+1.684	−11.055	−3.377	+0.206	−12.542
	+1122.48 −34 +.000	+.000	+1.972	−20.154	+3.395	−2.135	−12.477 −16.922
−2″1	−2.36 +34 +.425	−.769	−.010	−.043	+.034	+.047	−0.316
−1.5	+8.54 −66 +.999	+.538	−.002	+.049	+.010	−.009	+1.355
−2.9	−3.47 −31 +1.538	+.318	−.009	+.117	+.012	+.070	−1.030
	−15.80 −43 +1.333	−.496	−.011	+.048	+.019	+.080	+0.973

	1870 Sept. 24	1872 Mar 5	1873 May 25	1874 Nov 4
Δα(c−o)	+4″44	+3″81	+0″70	+1161.90
Δδ(c−o)	−0.62	+7.78	−3.70	+308.30
a−Ω⁰				48 14
sin i⁰	9.63573	9.63573	9.63543	9.63580
cos(a−Ω⁰)	9.97755	9.87525	9.71622n	9.82354
sec θ	.0011	.0012	.0022	.0025
cos N₀	9.61339	9.51100	9.35187	9.45959
sin N₀	9.95991	9.97586	9.98873	9.98118
cos δ	9.99332	9.98039	9.96028	9.96800
log Δα	0.64738	0.58092	9.84510	+3.06517
log I	0.60061	0.53717	9.79411	3.01438
log cos N₀	9.61339	9.51100n	9.35187n	9.45959
log Δδ	9.79239n	0.89098	0.56820n	2.48897
log II	9.40578n	0.40198n	9.92007	1.94856
I	+3.99	+3.44	+0.62	+1033.65
II	−0.25	−2.52	+0.83	+88.83
dλ cos θ	+3.74	+0.92	+1.45	+1122.48

	1870 Sept 24	1872 Mar 5	1873 May 25	1874 Nov 4	
log cos N₀	9.61339	9.51100	9.35787	9.45959n	8.29756
cos δ	9.99332	9.98039	9.96028	9.96803	9.9[illegible]
l Δα	.64738	.58092	9.84510	3.06517	2.65350n
log I	.25409n	.07231	9.15725	2.49279n	0.94146n
l sin N₀	9.95991	9.97586	9.98873	9.98118	9.99992
l Δδ	9.79239	.89098	.56820	2.48897	1.27184
log II	9.75230n	.86684	.55693n	2.47016	1.27176
I	−1.79	+1.18	+0.14	−311.02	−8.74
II	−0.57	+7.36	−3.61	+295.22	+18.70
dθ	−2.36	+8.54	−3.47	−15.80	+9.56

(m sin θ = sin δ
m cos θ = cos δ sin(a − Ω⁰))
sin θ = n sin(θ − i⁰)
sin λ cos θ = n cos(θ − i⁰)
cos λ cos θ = cos(a − Ω⁰) cos δ

$\cos N = \frac{\sin i^0 \cos(a-\Omega^0)}{\cos\theta}$

1877 dλ cos θ = sin N cos δ dα + cos N dδ
dθ = − cos N cos δ dα + sin N dδ

	~~τ~~	0.2041200n	9.4771213	0.5314789n	.5314789	9.8195432n	.4913617n	.6334685n
log n	0.5728716	9.9637878	0.1613680	3.0501786	0.37291	0.93146	0.54033	1.19866
log a					9.62839n	9.90255	0.11696n	0.12483n
log b					9.88593n	9.78078	9.50243	9.69548n
log c	0.3541084	0.0606978	0.2263421	0.2949069	8.00000	7.30103	7.95424	8.04139
log d	9.3636120n	0.5829719	1.0435587	1.3043613n	8.63347n	8.27875	9.06819n	8.68124
log e	9.3583156n	9.9652017n	0.5285317	0.5808888	8.53148	8.00000	8.07918	8.27875
log f	0.6485552	0.4776999	9.3138672n	~~0.3633358~~	8.67210	7.95424	8.84510	~~8.74418~~
log s	9.1492191n	0.0965624	1.0983668n	~~1.0961788~~ .3293977n 1.2284517n	9.49969n	0.13194	0.01284n	~~9.97~~ 8.90309 9.98811

~~nn~~ na na nb ~~nb~~ nc nc nd nd ne ne ~~nf nf~~

nn na na. nb nb. +nc −nc. nd dn. ne ne. nf nf. ns ns.

~~8.1~~ 13.99
0.85
02.10
1259996.12
5.57
72.93
12.44
249.65
1260353.25

1.003
6.824
5.337 ~~21.062~~
21.062

1.867
4.590
7.837

1.103

+ ~~8432~~ ~~1.000~~
1.058
2.442
2213.531
.024
.031
.174

.017
.101
.162

−.0864
3.522
16.030
22622.463
.406
.458

8.535
.849
3810.819

4.897
.080
.085
~~.085~~
.042
300

~~16.650~~ 16.650
2.763
.299
~~2880.6~~ 2396.495
.111
.077
.243
~~.885~~
1.264

1.149
.746
11.572
3.574
~~14.963~~

.527
18.186
~~14007.421~~
18994.610
~~14.998~~
15.874

1260353.25 −9.904 +13.143 +2225.695

−22643.780 +3814.969 + ~~2575.778~~ ~~+0.925~~ −2411.778 −79011.646 ~~14024.078~~

−9.904
22643.780
22653.684
8629.585
14024.099

+13.143
2225.695
3814.969
2575.778
8629.585

0 = +3″74 + 41″726 − 14.01 − 236.06 − 170.075 = −0.01 −0.08
~~0 = +0.92 − 406.75 + 58.99 + 311.66 + 47.76~~ +0.09
0 = +0.92 + 212.32 − 232.23 + 95.76 + 114.88 = +0.13 −.10
0 = +1.45 + 310.91 − 670.65 + 350.36 + 7.88 = −0.05 −0.09
0 = +1122.48 + 364.08 − 1222.64 − 352.23 + 84.26 = −0.08

0 = −2.36 + 0.60 + 11.12 − 1.85 − 2.61 − 3.53 + 1.80 = +2.17 +3.37
0 = +8.54 + 1.12 − 7.78 − 3.92 + 1.15 − 1.04 − 0.34 = +1.29
0 = −3.47 − 2.18 − 4.60 + 1.66 + 7.10 − 1.25 + 2.68 = −3.38
0 = −15.80 + 4.89 + 7.17 − 2.03 + 2.91 − 1.93 + 2.14 = −5.05 −5.81

~~aa ab af ac ac ad ad ae ae af af as as~~

~~ac ae ae ad ad ae ae af af as as~~

aa	+ab	-ab	+ac	-ac	+ad	-ad	+ae	-ae	af	af	as	as
.5912		.3271	.0078		.0329			0262		0360	2426	
.2894	.4301			0009	0164		.0054			0050	7294	
~~1.4135~~ 2.3670		3752 .4900	+~~0052~~ .0146	~~+0570~~ 18	~~+0570~~	~~.0639~~ .1806		~~.0639~~ 0183	-0	~~.0701~~ .1069	+ ~~9965~~ 1.5557	

bb	bc	bc	bd	bd	be	be	bf	bf	bs	bs
.1810		.0043		0182	0145		0199			1342
.6392		.0014	.0154		0080			.0074	1.0840	
~~1.3546~~ .1014		0030	0374	~~.0046~~	+.0088		+.0222		~~+5994~~	.3283

cc	cd	cd	ce	ce	cf	cf	cs	cs
5.1071		5227	5.1566			10.8607		.3193
1.3215	1	4.4011	1.0612		3.4585		1.4352	
0001	0004			000.3		0005	0032	
0000		0000		0002		.0000		.0023

dd	de	de	df	df	ds	ds
0535		.5278	1.6297		.0327	~~4.7794~~
14.6566		3.5340		11.5009		4.7794
0018		0015		.0020	0135	
0004	.0002			.0002	0262	

ee	ef	ef	es	es
5.2066		10.4578		.3224
0.8529	2.7731		1.1524	
0012	0016			.0108
0001		.0001		.0020

ff	fs	fs
1.6290		
198176	3.7503	
7.0246		.0148
0022		.0126
0001		

log cos i′ 9.95508
cos i″ .90174
1 − cos i″ .09826
log(1 − cos i″) 8.99238
log dΩ′ 1.16001
log dΩ′(1 − cos i″) 0.15239ₙ
dΩ′(1 − cos i″) − 1.42
dχ + 6 22.42
dπ′ + 6 21.00
dΩ′ − 14.46
dϖ′ + 6 35.46

log cos i′ 9.95508
log dΩ′ 1.16001ₙ
log dΩ′ cos i′ 1.11509ₙ
− dΩ′ cos i′ + 13.03
dχ + 6 22.42
dϖ′ = + 6 35.45

dL + 3′ 4.62″
dΩ′(1 − cos i′) − 1.42
dL′ + 3 3.20
dπ′ + 6 . 21.00
dM − 3 17.80

log 3 .17609ₙ
log a 2.57069
log n − 14.68557
log L 7.83235ₙ
log d log a 1.78294
log dμ 9.61529ₙ
dμ − .41238
μ₀ 934.72991
μ 934.31753
log μ 2.97049.45
log C 3.55 00066
.5795121
1931707
log a = .3863414

log C 4.32335
log d log a 1.78294
log dμ 6.10629
d log a + .0001277
.3862137
log a .3863414

Corrected Elements.

For Sept. 24.5 1870 B.M.T.

											o.k.	
M =	25°	12′	40.39″	−	~~3′ 17.60~~ − 2 52.14	=	25°	9′	22.59″	25°	9′	48.25″
Ω′ =	176	27	10.28	−	~~14.46~~ − 13.83	=	176	26	55.82	176	26	56.45
ϖ′ =	341	02	34.94	+ 6 + 5	35.46 44.76	=	341	9	10.40	341	08	19.70
i′	25	36	47.31	+	1.42 + 1.01	=	25	36	48.73	25	36	48.32
φ	7	16	37.03	− 1 − 1	43.75 30.10	=	7	14	53.28	7	15	6.93
μ	934.72991			−	~~.41238~~ − .35803	=	934.31753			934.37188		
log a	.3862137			+	~~.0001277~~ 1109	=	.3863414			.3863246		

aa	ab	ab	ac	ac	ad	ad	ae	ae	af	af	as	as
.18068 6384 23655 1.7790 ~~+6.0872~~ 4.9615	4299	.32683 ~~41~~ 4891 6612 ~~-3.9887~~ -1.0472	.0138	.00428 .0016 .0197 -.0067	.0152 .0640	.0183 1800 ~~-2835~~ -.1198	.01448 .0080 .0253 ~~+1193~~ +.0292	.0185	.0200 ~~.0740~~ 1066 ~~+1685~~ +.0117	.0072 1077 ~~.0203~~	1.0827 1.5840 ~~1.2600~~ 970 ~~+2.5787~~ ~~+3.7971~~ +3.8294	.1343

bb	bc	bc	bd	bd	be	be	bf	bf	bs	bs
5914 2895 1011 2460 +1.2280	.0077 .0055 +.0092	.0011 .0029	.0331 .0102 .0372 +.0567	.0238	.0054 .0038	.0261 .0094 -.0263	.0223	.0361 .0048 ~~.0278~~ .0397 ~~-.0464~~ -.0588	.2430 7290 ~~+.1700~~ +.1625	.3276 ~~4707~~ 4826

cc	cd	cd	ce	ce	cf	cf	cs	cs
5.1076 1.3225 2.8358 3.8888 .0001 0000 0001 .0001 13.1550	0004	.5221 44022 18.6166 39.7437 ~~0004~~ 0000 .0011 .0005 -6.32866 858	5.1573 1.0614 6.6949 ~~0003~~ ~~0000~~ +7.2261	.56869 0003 .0000 .0001 .0002	34546 .8469 ~~4.5574~~ ~~.0005~~ 0000 0	10.0615 4.21102 0005 0006 0009 ~~+1.103~~ -10.4722	.4364 .0032 .0093	.3187 21.1297 24.0026 3337.0280 .0027 .0107 ~~-20.5039~~ ~~-45.6120~~

-.0067
63.2858
1.7103
65.0028
20.3703
~~-44.6125~~
-53.3744

+.0092
13.1550
7.2261
+20.3903

dd	de	de	df	df	ds	ds
.0534 14.6536 122.2130 406.1838 .0019 .0004 .0137 .0023 543.1221	37.3327 0002 .0014 0009	.5271 3.5332 ~~37.3327~~ 68.4228 0015 -35.1494	10284 43.0287 0052 0038 +30.2903	11.4998 22773 ~~46.0154~~ 0020 0002 ~~.0002~~ ~~00~~ ~~-48.9057~~ ~~59.2549~~	.0326 1386618 ~~2515018~~ 3410.4416 .0136 .0257 .0467 ~~+385.3696~~ +474.8881 9148	47812 .1205

+543.1221
0567

-35.1494
59.2549
63.2858
.0097
-157.8088
+543.1788
385.3696

ee	ef	ef	es	es
5.2075 0.8519 11.4041 11.5260 0012 0001 0001 0004 +28.9913	27727 ~~7.8357~~ .0016 0008 0015 -15.3270	10.1595 6957 8.2483 ~~0004~~ 0001 ~~-0.2434~~	1.1528 42.3543 .0136 .0180 ~~+0.8276~~ -14.2559	.3218 57.4502 ~~42.3662~~ .0107 .0124

+28.9913
7.2261
29
36.2466
35.4191
+.8275

-2434
-35.1494
263
35.4191

ff	fs	fs
19.8203 9.0240 0424 ~~5.3282~~ 4.2022 0048 .0064 0064 ~~34.2239~~ 33.4583	.62771 3.7520 36.1284 ~~45.5560~~ 0778 +37.9028	.25836 ~~26.1254~~ ~~25.5075~~ .0148 0122 .0721 ~~-27.0574~~ ~~-34.3536~~

sin Ω' 8.7919357
cos i' 9.9550757
cos Ω 9.9991655
sin i' 9.6357840

-cos Ω' 9.9991655
cos i' sin Ω' 8.7470114
tang A 1.2521541
A 86 47 50.29
log a 9.9998444

-sin Ω' 8.7919357
-cos i' cos Ω' 9.9542412
tang B 8.8837694
B − 3 56 12.74
B 356 03 47.86
log b 9.9552671

A+ω' 67 54 06.9
B+ω' 337 12 58.26
ω' 341 9 10.40
log a 9.9998444
log b 9.9552671
log c 9.6357840

log sin φ = log e
e
1+e
1−ε
log √1+ε
log (1−ε)
log √1+ε
log √a
log √1−ε
log √a(1+ε)
log √a(1−ε)

log tan φ
45 − ½φ
tan(45 − ½φ)
log Do.
log e
log b
log e''

	a	b	c	d	e	f	g	n
(aa)	+4.9615	−7.1472	−.0067	−.1191	+.0292	−.0203	+3.7974	−.9504
log(aa)	0.6956130	0.0200296n	7.8260748n	9.0759118n	8.4653829	8.3074960n	0.5794463	0.9954106n
ab bb1	~~0.6956130~~	+1.2280	+.0092	+.0567	−.0263	−.0464	+.1740	+13.143
ab		+0.2210	+.0014	+.0251	−.0062	+.0043	−.8015	+20.904
bb1		+1.0070	+.0078	+.0316	−.0201	−.0507	+.9756	−7.761
log bb1		.0030295	7.8920946	8.4996871	8.3031961n	8.7050080n	9.9892718	0.8899107n
ee			+13.1550	−63.2858	+7.2261	−1.7103	−44.6125	+2225.695
ae ae			.0000	+.0002	−.0000	+.0000	−.0051	+0.018
aa ee			+13.1550	−63.2860	+7.2261	−1.7103	−44.6074	+2225.682
be, be1			+.0001	+.0002	−.0002	−.0004	+.0076	−.060
bb1 ee2			+13.1549	−63.2862	+7.2263	−1.7099	−44.6150	+2225.742
log ee2			1.1190875	1.8013090n	0.8589160	0.2329970n	1.6494800n	~~3.3475971~~ 3.3474745
dd				+543.1221	−35.1494	−59.2549	+385.3696	−22643.780
ad ad				+.0029	−.0007	+.0005	−.0912	+.238
aa dd1				+543.1192	−35.1487	−59.2554	+385.4608	−22644.018
bd1 bd1				+.0010	−.0006	−.0016	+.0306	−.244
bb1 dd2				+543.1182	−35.1481	−59.2538	+385.4302	−22643.774
ed2 ed2				+304.4602	−34.7646	+8.2261	+214.6355	−10707.780
ee2 dd3				+238.6580	−0.3835	−67.4799	+170.7947	−11936.084
log dd3				2.3777759	9.5837654n	1.8291744n	2.2324743	~~3.8…~~ 4.0768615n

	ds	dna		e	f	g	n
ee	+14024.098	1260353		+2.89913	−.2434	+.8276	+3814.969
eaea	−7.580	+20		+.0002	−.0001	+.0223	−.058
aa ee1 / aua au	+14016.518	1260333		+2.89911	−.2433	+.8053	+3815.027
be be1 / da nu1	−7.519	+60		+.0004	+.0010	−.0195	+.155
bb1 ee2 / bu1 bs1 bu1	+14008.999	+1260273		+2.89907	−.2443	+.8248	+3814.872
ee ae / ss Snz nnn	−10939.300	790573		+3.9696	−.9393	−24.5080	+1225.474
ee ee3 / en zes zenz	−3069.699	469400		+25.0211	+.6950	+25.3328	+2589.398
de de3 / ez snnu3	−5099.972	21796		+.0006	+.1084	−.2744	+9.136
dd3 ee4 / dn3 ds3 dn3	+2030.273	256604		+25.0205	+.5866	+25.6072	+2580.262
log ee4 / ds snunu4	2079.255	164963		1.3982960	9.7683421	1.4083621	~~3.2078446~~ 3.4099774
en4 es4 en4	48.982	9641					

e4 snsnu5
fn5 fs5 fn5
ff5 nn4

					f	g	n
ff					+34.2235	−27.0514	−2575.778
af af					+.0001	−.0155	+.040
aa ff1					+34.2238	−27.0359	−2575.818
bf bf1					+.0026	−.0491	+.391
bb1 ff2	−14024.098	+1260353	−14024.098	1260353	+34.2212	−26.9868	−2576.129
cf cf	−7.580	20	−7.580	20	+.2223	+.7991	−419.257
ee2 ff3	−14016.518	1260353	−14016.518	1260333	+33.9989	−32.7859	−2156.872
df3 df3	−7.519	60	+10.708	121	+19.0498	−48.2918	+2019.967
dd3 ff4	−14008.999	1260253	−14027.226	1260212	+14.9491	+15.5059	−4176.839
ef4 ef4	7548.616	376584	−7548.125	376535	+.0137	+.6009	+47.631
ee4 ff5	−6460.383	883709	−6479.101	883677	14.9054	+14.9038	−4218.470
log ff5	−8542.007	596963	−8542.929	597091	1.1733437		
	+2081.624	286746	+2063.828	286586			
	+2630.548	264038	+2633.838	264699			
	−548.916	22713	−570.012	21887			
				21798			
				89			

+2575.778	+2575.778
+.040	+.040
+2575.738	−2575.818
+.390	+.390
+2575.348	−2576.208
−289.307	−289.307
+2864.655	−2286.901
+3374.890	+3374.890
−510.235	−5661.791
+60.260	+60.260
−570.495	−5722.051

log fn5 2.7558870
−log ff5 1.1733437
log dx 1.5825433
70 dx 38.242
dx +382.42

dx ef4 +22.433
70 en4 +2573.492
sum +2595.925
log s 3.4142940
−log ee4 1.3982960
log dfn 2.0159980n
dfn −103.75
dff
2.0159946n

dx df3 −2580.846
70 dx de3 +35.788
dn3 −11937.360
s −14478.118
log s 4.1607121n
log dd3 2.3777759n
log dn 1.7829362
log [illegible] +60.67
d log w

dx cf2 −65.390
70 dx ee2 −149.725
d log aed2 3839.240
en2 +2225.597
s +3249.722
log s 3.7201353
−log ee2 1.1190875n
log f 2.6010478n
dL1 −399.27

−2428.758
3.3853843n
1.1190875n
2.2662968
dL1 +184.62

dx bb1 −.1939
70 dx be1 +.2085
d log ab d1 +.1917
dx be1 +.1440
log n1 +11.053
s +10.603 +14.556
log s 1.0041303 1.16304
−log bb1 .0030295n .00303n
log dΩ .9979008n 1.16001n
dΩ' − ~~993~~ − 14.46

dx ab +22.43 ~~32~~ 0.776 −.776
70 d log ab (25) −3.029 −3.029
d log ad −7.225 −7.225
dL ae +2.674 −1.237
d log ab +10.403 +15.137
an −9.904 −9.904
s +7.857 −7.034
log s 0.8952568n 0.84720n
−log aa 6956130n 69561n
log di'' .1996438 0.15159
di'' +1.58 +1.42

	1870 Sept. 24.5	1872 Mar 5.5	1873 May 25.5	1874 Nov 4.5
M	25° 09′ 22″.59	161° 46′ 11″.31	277 31 32.14	54 44 26.89
dM	0.00	− 3 37.73 − 3 17.80	− 6 41.65 − 3 17.80	− 10 17.73 − 3 17.80
M/K	~~25 09 22.59~~ 25 9 22.59	~~161 42 33.58~~ 161 39 15.78	~~277 24 50.49~~ 277 21 32.69	~~54 34 9.16~~ 54 30 51.36

9.904
9.958106n
+13.143
+ 2.090
+11.053
0.0434802
+2225.695
+ .013
+ 2225.682
+ .085
+2225.597
3.3474465
−22643.780
+ .238
−22644.018
+ .347
−22644.365
−10707.005
−11937.360
4.0769083n
+3814.969
− .058
+3815.027
− .221
+3815.248
+1222.574
+2592.674
+ 19.182
+2573.492
3.4105230
+ 2575.778
+ .40
+2575.738
− .556
+2576.294
− 289.287
+2865.581
+3375.255
− 509.674
+ 60.335
−570.009
2.7558810n

	1870 ~~Sept. 24.5~~	1872	1874 ~~Apr~~	1883
ω′		341 29 43.84	341 28 53.14	
Ω′	176 26 55.82	176 26 46.37	176 26 47.00	
i′	25 36 48.23	25 36 54.06	25 36 53.65	
l sin Ω′	8.7919357	8.7923152	8.7922688	
l cos i′	9.9551057	9.9550713	9.9550918	
l cos Ω′	9.9991655n	9.9991641n	9.9991642	
l sin i′	9.6357840	9.6358045 ~~9.9550713~~	9.6358057n	
−cos Ω′	9.9991655	9.9991641	9.9991642	
cos i′ sin Ω′	8.7470114	8.7473865	8.7473406	
l tg A	1.2521541	1.2517776	1.2518236	
A	86 47 59.29	86 47 40.31	86 47 41.58	
log a	9.9558444	9.9958442	9.9958441	
−l sin Ω′	8.7919357n	8.7923152n	8.7922688	
−cos i′ cos Ω′	9.9542412	9.9542354n	9.9542360	
tg B	8.8376945	8.8380798n	8.8380328	
B	−3 56 12.14	−3 56 24.68	−3 56 23.15	
B	356 03 47.86	356 03 35.32	356 03 36.85	
log b	9.9552671	9.9552631	9.9552635	
A+ω′	67 57 069	68 17 24.15	68 16 34.72	
B+ω′	337 12 58.36	337 33 19.16	337 32 29.99	
ω′	341 09 10.40	341 29 43.84	341 28 53.14	
log a	9.9958444	9.9958442	9.9958441	
log b	9.9552671	9.9552631	9.9552635	
log c	9.6357840	9.6358075	9.6358057	
log e	9.1009445	9.1073878	9.1076103	
e	.1261666	.1280524	.1281180	
(1+e)	1.1261666	1.1280524	1.1281180	
(1−e)	.8738334	.8719476	.8718820	
l(1+e)	.0516026	.0523293	.0523545	
l(1−e)	9.9414284	9.9404904	9.9404577	
l √(1+e)	.0258013	.0261646	.0261772	
log √a	~~9.9707143~~ 9.193[illegible]	.1931785	.1931702	
log √(1−e)	9.9707142	9.9702452	9.9702288	
log √a(1+e)	.2189720	.2193431	.2193474	
log √a(1−e)	.1638849	.1634237	.1633990	
φ	7 14 53.28	7 21 25.43	7 21 39.08	
½φ	3 37 26.64	3 40 42.71	3 40 49.54	
45−½φ	41 22 33.36	41 19 17.29	41 19 10.46	
l tg	9.9449129	9.9440805	9.9440516	
log e	9.1009445	9.1073878	9.1076103	
log C	5.3144251	5.3144251	5.3144251	
log e″	4.4153696	4.4218129	4.4220354	
μ		9.3432080		
φ₀		7° 14′ 53″.28		
dφ		+ 6 32.15		
φ		7 21 25.43		

nn	na	na	nb	vb	ne	ne	nd	nd	ne	ne	nf	nf	nb	ws
0.00	—		—		+0.07		+.00		.00		.00		.00	
2.06	—		—			−1.84	+6.12			−1.48		−4.81		−2.00
9.09	—		—		+0.50			−3.32		−1.01	+0.06			−3.76
~~11.56~~						~~−6.70~~	~~+68.52~~			~~−11.54~~	~~+7.26~~		~~+57.53~~	
11.56	+1.44		~~+1.??~~	−2.61		~~−2.61~~		~~−0.04~~ −0.15	+0.12	~~−0.11~~	~~+.17~~			−1.07
43.56		−5.27		−3.55	+0.01	−0.04		−.12		−.06	+.16 +.05			−8.94
9.61	+4.77			−0.98	+.03			−.36		−.04		−.22	+3.19	−4.18
~~18.49~~		~~−5.73~~	~~+2.13~~		~~+.05~~			~~−.21~~		~~−.08~~		~~−.34~~		
97.43	+6.21	−11.00		−7.14	+7.59	−8.58	+74.64	−4.16		+14.21	+7.53	−5.37	+60.72	−19.96
	−4.79		−6.01			−7.99	+70.48			~~14.08~~	~~+2.16~~		~~+40.76~~	
	+0.94		−7.14			−1.34	+2.17			−2.43	−4.76		−12.59	

1870 Sept. 24.5 — 1872 Mar. 5 — 1873 May 25.5 — 1874 Nov. 4.5

M . 28° 09′ 22″.59 . 161 39 15.78 . 277 21 32.65 54 30 57.36

	a	b	c	d	e	f	s	n	
(aa)	+4.9615	-1.0472	-.0067	-11.91	+.0292	+.0117	+3.8294	-9.904	~~-7.037~~ -4.79
lg(aa)	.6956130	0.0200296n	7.8260748n	9.0759118n	8.4653829	8.0681859	0.5831307	0.9958106n	0.6803355n
bb		+1.2280	+.0092	+.0567	-.0263	-.0583	+.0162	+13.143	~~-5.91~~ ~~5.270~~
ab ab/aa		+.2210	+.0014	+.0251	-.0062	-.0025	+.8082	+2.990	+1.01
bb1		1.0070	+.0078	+.0316	-.0201	-.0558	+.9705	+11.053	-6.02
lg bb1		.0030295	7.8920946	8.4996871	8.3031961n	8.7466342n	9.9869955	1.0434802	0.77960n
ce			+13.1550	-63.2858	+7.2261	-10.4722	-53.3744	+2225.695	-7.99 ~~-34.115~~
ac ac/aa			.000	+.002	+.000	-.000	-.0052	+.013	
ce1			+13.1550	-63.2860	+7.2261	-10.4722	-53.3692	+2225.682	
bc1 bc1/bb1			+.0001	+.0002	-2	-.0004	+.0075	+.086	
ce2			+13.1549	-63.2862	+7.2263	-10.4718	-53.3617	+2225.596	
lg ce2			1.1190875	1.8013090n	.8589160	1.0200215n	1.7273525n	3.3474464	
dd				+543.1221	-35.1494	+30.2903	+474.9148	-22643.780	+70.48
ad ad/aa				+.0029	-.0007	-.0003	-.0919	+0.234	
dd1				+543.1192	-35.1487	+30.2906	+475.0067	-22644.014	
bd1 bd1/bb1				+.0010	-.0006	-.0017	+.0305	+.347	
dd2				+543.1182	-35.1481	+30.2923	+474.9762	-22644.361	
cd2 cd2/ce2				+304.46112	-34.7646	+50.3784	+256.7876	-10707.002	
dd3				+238.6580	-.3835	-20.0861	+218.1886	-11937.359	
lg dd3				2.3777759	~~.343811~~ 9.5837659n	1.3028800n	2.3388321	4.0769083n	
ee					+28.9913	-15.3270	-14.2559	+3814.969	-14.09
ae ae/aa					+.0002	+.0001	+.0225	-.058	
ee1	+40.76	-19011.646	1260353	+97.4	+28.9911	-15.3271	-14.2784	+3815.027	
be1 be1/bb1		-7.644	+.720		+.0004	+.0011	-.0104	-.221	
ee2		-19004.002	1260333		+28.9907	-15.3282	-14.2680	+3815.248	
ce2 ce2/ce2		+10.653	121		+3.9696	-5.7525	-29.3212	+1222.570	
ee3		-19014.655	1260212		+25.0211	-9.5757	+15.0612	+3692.991	2592.678
de3 de3/dd3		-9030.490	376535		+.0006	+.0323	-.3506	+19.182	19.182
ee4		-9984.165	883677		+25.0205	-9.6080	+15.4126	+3673.809	+2573.492
lg ee4		-10913.507	597091		1.3982960	0.9826330n	1.1878131	3.4105930	
		+929.342	286586						
ff		+1585.075	264710			+33.4583	+37.9028	-2411.778	+2.16
af af/aa		-655.733	21875			.0000	+.0090	-.023	
ff1			21795			+33.4583	+37.8938	-2411.755	
bf1 bf1/bb1			80			+.0031	+.0538	+.612	
ff2						+33.4552	+37.8400	-2411.143	
cf2 cf2/ce2						+8.3359	+42.4900	-1771.660	
ff3						+25.1193	-4.6500	-640.707	
df3 df3/dd3						+1.6905	-18.3634	+1004.679	
ff4						+23.4288	+13.7134	-1645.386	
ef4 ef4/ee4						+3.6896	-5.9187	-988.257	
ff5						+19.7454	+19.6311		

	f	s	n
	33.4552	+37.9476	-2411.143
	8.3359	42.4500	-1771.660
ff3	25.1193	-4.5024	-639.483
	+1.6905	-18.3634	+1004.679
	+23.4288	+13.8210	-1644.162
	+3.6896	-5.9177	-988.257
	+19.7392	+19.7387	-655.905
	1.2953295		2.8168409n

log fn5 2.8168409n
-lg ff1 1.2953295n
lg dχ/10 1.5215114
dχ/10 +33.229
dχ +332.29

dχ/10 ef4 -319.260
en4 +2573.492
s +2254.232
log s 3.3529986
-lg ee4 1.3982960
lg dφ 1.9547026n
dφ -90.10

dχ/10 df3 -667.432
dφ de3 + 34.551
dn3 -11937.359
s -12570.24
log s 4.0993433n
-lg dd3 2.3777759
l dlgu 1.7215674n
dlgu + 52.67

dχ cf2 -347.963
dφ ce2 -651.050
dlgu cd2 -3333.316
cn2 +2225.596
s -2106.732
log s 3.3236095n
-lg ce2 1.1190875n
lg dΩ 2.2045220
dL, + +164.15

dχ/10 bf1 -1.854
dφ be1 +1.811
dlgu bd1 +1.664
dΩ bc1 +1.249
bn1 +11.053
s
~~log s~~ +13.923
-lg bb 1.1437300
lg dΩ′ 0.0030295n
l dΩ′ 1.1407005n
dΩ′ - 13″.83

dχ ab + 0.389
dφ ac - 2.681
dlgu ad - 6.273
dΩ ae - 1.073
dΩ′ ab +14.479
an -9.904
s -5.013
log s
-lg aa 0.70010n
lg di″ .69561n
di″ .00449
di +1.01

lg(1-cos i′) 8.99238
lg dΩ′ 1.14070n
lg dΩ′(1-cos i′) 0.13308n
dΩ′(1-cos i′) 1.36″
dχ +5 32.29
dπ′ +5 30.93
dΩ′ - 13.83
dω′ +5 44.76

log cos i′ 9.95508
lg dΩ′ 1.14070n
lg dΩ cos i′ 1.09578n
-dΩ cos i′ + 12.48
dχ +5 32.29
dω +5 44.77

log b 7.83235n
lg dlgu 1.72157
lg du 9.55392n
du .35803
w 9.3472991
w0 9.3437188
lg u2 9.7051??
lg b 3.5500066
.5794876
1931624
log a 3863246

dL, +2′ 40″.15
(1-cos i′)dΩ′ - 1.36
dL′ +2 38.79
dπ′ +5 30.93
dM -2 52.14

lg M 4.82335
lg dlgu 1.72157
lg dlgu 6.04492
dlga 4.0001109
3862137
3863246

	1870	1872	1873	1874
	Sept. 24.5	Mar. 5.5	May 25.5	Nov. 4.5
M	25° ~~12 40~~ 39	161° 46′ 11″31	277° 31′ 32″14	54° 44′ 26″89
dM	− 2 52.14	− 2 52.14	− 2 52.14	− 2 52.14
	0.00			− 8 56.33
	25 9 48.25			(54 32 38.42)

Conversion to Ecliptic Elements.

Ω′	176 26 56.45	sin ½ Ω′	9.9997914	cos ½ Ω′	8.4911272	sin ½ Ω′	9.9997914	cos ½ Ω′	8.4911272 ~~8.4911272~~
½ Ω′	88 13 28.22	cos ½ (i′ − ε)	9.9999230	cos ½ (i′ + ε)	9.9589027	sin ½ (i′ − ε)	8.2747311	sin ½ (i′ + ε)	9.6183049
i′	25 36 48.32		9.9997144		8.4500299		8.2745225		8.1094321
ε	23 27 22.16		8.4500299				8.1094321		
i′ + ε	49 04 10.38		1.5496845				0.1650904		
i′ − ε	2 09 26.26	½ (Ω − n + a)	88 23 03.99						
½ (i′ + ε)	24 32 5.19	½ (Ω − n) − a	55 38 12.76						
½ (i′ − ε)	1 4 43.13	Ω − n	144 01 16.75						
		Ω	324 01 16.75						
		a	32 44 51.23						
		ω′	341 08 19.70						
		ω − ω′ + a	13 53 10.93						
		Ω	324 01 16.75						
		π	337 54 27.68						

1872 1873 1874

8.3578175

½ i 1 18 21.97
i 2 36 43.94

New Ecliptic Elements

Epoch. Sept. 24.5 B.M.T. 1870

M = 25° 9′ 48″25
Ω = 324 01 16.45
π = 337 54 27.68
ω = 13 53 10.93
i = 2 36 43.94
φ = 7 15 6.93
μ = 934″37188
log a = .8863246

1870

Ω	~~324 01~~ 324 01 16.75
Ω − n	144 01 16.75
½ (Ω − n)	72 00 38.37
i	2 36 43.94
ε	23 27 22.06
i + ε	26 04 06.00
(i − ε)	−20 50 38.12
½ (i + ε)	13 02 3.00
½ (i − ε)	−10 25 19.06
sin ½ (Ω − n)	9.9782326
sin ½ (i + ε)	9.3532083
	9.3314409
cos ½ (Ω − n)	9.4897336
sin ½ (i − ε)	9.2574293 n
	8.7471629 n
sin ½ (Ω − n)	9.9782326
cos ½ (i + ε)	9.9886641
	9.9668967
cos ½ (Ω − n)	9.4897336
cos ½ (i − ε)	9.9927754
	9.4825090
tan ½ (Ω′ + a)	.5842780
tan ½ (Ω′ − a)	.4843877
½ (Ω′ + a)	75 24 06.16
½ (Ω′ + a)	104 35 53.84
½ (Ω′ − a)	71 51 2.61
Ω′	176 26 56.45
a	32 44 51.23
ω	13 53 10.93
ω′	341 08 19.70
sin ½ i′	9.8456927
~~cos ½~~ ½ i′	12 48 24.16
i′	25 36 48.32

sin Ω′
cos i′
cos Ω′
sin i′

− sin Ω′
− cos i′ sin Ω′
tan a
A
log a

− sin Ω′
− cos i′ cos Ω′
tan β
β
log b

Date	F	1877 Jul 4.5
	Feb. 23 1876	
T	1978	2476
log T	3.29623n	3.39375n
−3/2 log ...	7.83238	7.83192
log k ×	1.12865n	1.22567n
log r	.43860	.35680
r	2.7453	2.2740
p	~~2.4905~~ 2.3936	2.3953
r + p	5.1389	4.6693
log (r + p)	0.71087	.66925
E	198 26 23	30 09 28
log sin E	9.43495	9.93284n
Comp log a e cos φ	9.61736	9.61707
log ...	8.76318	.21866n
log 2r	87720	.71360
log a a cos φ	.76887	.76943
log 2r/(a a cos φ)	.10833	9.94417
2r/(a a cos φ)	1.2833	.87937
2r/(a a cos φ) − 1	.2833	−.12063
	9.45225	9.08146n
log	.45225	.08146n
log tan φ	9.11153	9.10989
log cos E	9.99984n	9.71382
cos E	−.99964	+.51739
e	.12822	+.12774
e + cos E	−.87142	+.64513
− log (e + cos E)	9.94023	9.80965n
log cos φ	9.99641	9.99643
log ...	9.94382	9.81322n
log ...	8.54648n	8.04223
log cot ψ	8.54648	9.04223n
ψ	~~90 10 00~~	96 17 23
log sin ψ	9.99999	9.99738
log r	43860	35680
log a a cos φ	.76887	.76943
log r sin ψ	.43859	.35418
log e'	.33028	.41525
	33028	5.−265848
a	159 14 38	263 48 53
Ω_0	356 26 51	356 26 40
a − Ω_0	162 48	267 22 13
log cos i	~~9.47086~~ 9.94889	9.95010
log sin (a − Ω')	9.47086	9.99954n
log m cos θ	9.46685	9.99964n
log tan = log m sin θ	9.13109	9.65623n
log tan θ	9.66424	9.70659
σ	24 46 40	~~163 11 50~~ 206 58 10
c'	25 36 56	25 36 62
log m	9.50879	9.99964
log cot (a − Ω_0)	9.98013n	8.66164n
σ − c	−0 50 16	181 2[illegible]
log tan (σ − c_0)	8.16528n	8.[illegible]n
log m	9.50879	9.99964
log cos σ − c'	9.99995	9.99988n
log sin θ	9.07407n	8.37[illegible]
log ... n cos θ	9.50874	7.55552
log ... h cos θ	9.97612n	8.61174n
log tan h	9.53262n	1.38778n
log cos θ	10.0000	9.99988
θ		87 39 21
n	161 10 34	267 39 20
u' = n + ω'	160 0 39	275 46 10
u' − n	358 50 05	8 06 50
ψ	89 49 54	96 17 23
u' + ψ − n	88 37 59	104 24 13
log e'	33028	.41525
log a	.24464	.11003
log r	.43860	.35680

	1876	1877
Date	Feb. 23)	~~1876~~
$\log c'$	.08564	.30522
$\log \sin(u+v-n)$	9.99988	9.98613
$\log M$	0.08552	.29135
$\log \sin \theta$	7.67407n	8.37342n
$-\log \frac{c'}{a}$	.08564	.30522n
$\log \cos(u+v-n)$	8.37759n	9.39577n
$\log M_0$	6.13730	8.07447n
$\log \frac{2}{a}$	.19396	.24677
$\log \sin(u-n)$	8.30828n	9.14965
$\log N$	8.50224n	9.39642
$-\log \frac{2}{a}$	.19396	.24677
$\log \sin \theta$	7.67407n	8.37342n
$\log \cos(u-n)$	9.99991	9.99563
$\log N_0$	7.86794	8.61582
$M = \frac{dx\cos\theta}{dL_1}$	+1.2476 ~~+1.2876~~	+1.9569 ~~−3.2887~~
$M f_x$	−16.3741	−32.8870
N	−.0318	+.2491
$\frac{dx\cos\theta}{d\log a}$	−16.4059	−32.6379
$M f_y$	+.0706 ~~+.1775~~	−3.2360
$N f_y$	−.0279	−.1620
$\frac{dx\cos\theta}{d\varphi}$	~~+.1496~~ +.0427	−3.3980
$M f_z$	+3.4496	−2.3594
$N f_z$	+.0011	+.2746
$10\frac{dx\cos\theta}{dx}$	+3.4507	−2.0848
$M = \frac{d\theta}{dL_1}$	+.0001	−.0119
$M^0 f_x$	+.0018	+.1996
N^0	+.0074	+.0413
$\frac{d\theta}{d\log a}$	+.0056	+.2409
$M^0 f_y$	+.0000	+.0196
$N^0 f_y$	+.0065	−.0338
$\frac{d\theta}{d\varphi}$	+.0065	−.0142
$M^0 f_z$	+.0004	+.0143
$N^0 f_z$	−.0003	+.0455
$10\frac{d\theta}{dx}$	+.0001	+.0598
$\log \frac{2}{a}$	.19396	.24677
$\log \sin u'$	9.53383	9.99779n
$\log \cos \theta$	10.00000	9.99988
$\log \frac{d\theta}{di'}$	9.72779	0.24444n
$\frac{d\theta}{di'}$	+.5343	−1.7556
$-\log \frac{2}{a}$	.19396	.24677n
$\log \cos u'$	9.97302n	9.00228
$\log \sin i'$	9.63582	9.63580
$\log \cos \theta$	10.00000	9.99988
$\log \frac{d\theta}{d\Omega'}$	9.80280	8.88473n
$\frac{d\theta}{d\Omega'}$	+0.6351	−.0767

Conditional equations for Feb. 23 1876

~~o = -279.1 + 1.218 dL~~

~~o = -127~~

	n	a	b	c	d	e	f	s
o =	-279.1	+ .000 di'	+ .000 dΩ'	+ 1.218 dL	- 16.406 dlog a	+ .043 dφ	+ 3.451 $\frac{d\chi}{10}$	-11.694
o =	-127	+ .534 di'	+ .635 dΩ'	+ .000 dL	+ .006 dlog a	+ .006 dφ	+ .000 $\frac{d\chi}{10}$	+1.181

log n	2.4457598$_n$	2.0888446$_n$
log a	∞	9.7275413
log b	∞	9.8027737
log c	0.0856473	∞
log d	1.2150027$_n$	7.7781500
log e	8.6334685	7.7781500
log f	0.5379450	∞
log s	1.0679631$_n$	0.0722499

nn	na	nb	nc	nd	ne	nf	ns
+~~1256679~~	—	—	-339.94	+4578.91	-12.00	-963.17	+3263.80
778968							
+1505530	-65.52	-77.91	-.00	-.74	-.74	.00	-144.91
929521							
+2107232	-65.52	-77.91	-339.94	+4578.17	-12.74	-963.17	+3118.89
+97.4	-4.79	-5.01	-7.79	+70.48	-14.09	+2.16	+40.76
2108206	-70.31	-82.92	-347.73	+4648.65	-26.83	-961.01	+3159.65
930419							

aa	ab	ac	ad	ae	af	as
+0.2852	+.3390	+.0000	+.0032	+.0032	+.0000	+.6307
+4.9615	-1.0472	-.0067	-.1191	+.0292	+.0117	+3.8294
+5.2467	~~.3862~~	-.0067	-.1159	+.0324	~~-.0203~~	~~+4.9280~~
	-0.7082				+.0117	+4.4600

bb	bc	bd	be	bf	bs
+.4032	+.0000	+.0038	+.0038	+.0000	+.7498
+1.2280	+.0092	+.0567	-.0263	-.0583	+.1621
+1.6312	+.0092	+.0605	-.0225	~~-.0464~~	~~+0.9238~~
				-.0583	+.9119

cc	cd	ce	cf	cs
+1.4835	-19.9825	+.0525	+4.2033	-14.2432
+13.1550	-63.2858	+7.2261	-10.4722	-53.3744
+14.6385	-83.2683	+7.2786	-6.2689	-67.6176

dd	de	df	ds
+269.1568	-0.7055	-56.6170	+191.8518
.0000	.0000	.0000	+ .0071
+269.1568	-0.7055	-56.6170	+191.8556
+543.1221	-35.1494	+30.2903	+474.9148
+812.2789	-35.8549	-26.3267	+666.7736

ee	ef	es
+.0018	+.1484	-.5028
+ 00	+ 00	+ 71
+.0018	+.1484	-.4957
+28.9913	-15.3270	-14.2559
+28.9931	-15.1786	~~-13.7601~~
		-14.7516

ff	fs
+11.9094	+ [illegible]3560
+33.4583	[illegible]37.9028
+45.3677	-24.5347

	a	b	c	d	e	f	s	n
(aa)	+5.2467	−0.7082	−.0067	−.1159	+.0324	+.0717	+4.4600	−70.31
log aa	0.7198862	9.8501559n	7.8260748n	9.0640834n	8.5105440	8.0681859	0.6493349	1.8470171n
bb		+1.6312	+.0092	+.0605	−.0225	−.0583	+.9119	−82.92
(ab) ab/aa		+.0956	+.0009	+.0156	−.0044	−.0016	−.6020	+9.49
bb₁		+1.5356	+.0083	+.0449	−.0181	−.0567	+1.5139	−92.41
log bb₁		0.1862781	7.9190781	8.6522463	8.2576286n	8.7535831n	0.1800972	1.9657190n
cc			+14.6385	−83.2683	+7.2786	−6.2689	−67.6176	−347.93
(ac) ac/aa			+ .0000	+ .0002	− .0000	− .0000	− .0057	+ .08
cc₁			+14.6385	−83.2685	+7.2786	−6.2689	−67.6119	−348.01
bc₁ bc₁/bb₁			.0000	+ .0002	− .0000	+ .0003	+ .0082	− 0.50
cc₂			+14.6385	−83.2687	+7.2786	−6.2686	−67.6201	−347.51
log cc₂			1.1654966	1.9204818n	0.8620479	0.7971706n	1.8300758n	2.5409673n
dd				+812.2789	−35.8549	−26.3267	+666.7736	+4648.65
ad ad/aa				+ .0026	− .0007	− .0003	− .0985	+ 1.55
dd₁				+812.2763	−35.8542	−26.3264	+666.8721	+4647.10
bd₁ bd₁/bb₁				+ .0013	− .0005	− .0016	+ .0443	− 2.70
dd₂				+812.2750	−35.8537	−26.3248	+666.8278	+4649.80
cd₂ cd₂/cc₂				+473.6603	−41.4031	+35.6579	+384.6459	+1976.75
dd₃				+338.6147	+5.5494	−61.9827	+282.1819	+2673.05
log dd₃				2.5297058	0.7442460	1.7922705n	2.4505269	3.4270071
ee					+28.9931	−15.1786	−14.7579	−26.83
(ea) ea/aa					+ .0002	+ .000[illegible]	+ .0275	− .43
ee₁					+28.9929	−15.1787	−14.7854	−26.40
be₁ be₁/bb₁					+ .0002	+ .0007	− .0178	+ 1.09
ee₂					+28.9927	−15.1794	−14.7616	−27.49
ce₂ ce₂/cc₂					+ 3.6190	− 3.1169	− 33.6223	−172.79
ee₃					+25.3737	−12.0625	+18.8607	+145.30
de₃ de₃/dd₃					+ .0910	− 1.0151	+ 4.6245	+ 43.81
ee₄					+25.2827	−11.0474	+14.2363	+101.49
log ee₄					1.4028234	1.0432602n	1.1533666	2.0064233
ff						+45.3677	−2.4531	−961.01
af af/aa						.0000	+ .0099	− .16
ff₁						+45.3677	− 2.4630	−960.85
bf₁ bf₁/bb₁						+ .0021	− .0559	+ 3.41
ff₂						+45.3656	− 2.4071	−964.26
cf₂ cf₂/cc₂						+ 2.6844	+28.9568	+148.81
ff₃						+42.6812	−31.3629	−1113.07
df₃ df₃/dd₃						+11.3461	−51.6526	−488.30
ff₄						+31.3351	+20.2897	−623.77
ef₄ ef₄/ee₄						+ 4.8271	− 6.2202	+ 44.35
ff₅						+26.5080	+ 26.5099	− ~~668.12~~ 579.42
log ff₅						1.4233770	2.4234097	2.9629935n

	~~ns~~ ns ‖	~~nn~~ nn ‖	
	+3159.65	+~~2108.21~~	93049
a n as an	− 13.40	+ 942	942
aa s n₁ nn₁	+3173.05	+209879	92107
b n₁ b s₁ b n₁	− 91.11	+ 5561	5561
bb₁ s n₂ nn₂	+3264.16	+204318	86546
c n₂ c s₂ c n₂	+1605.26	+ 8250	8250
cc₂ s n₃ nn₃	+1658.90	+196068	78296
d n₃ d s₃ d n₃	+2227.55	+21101	21101
dd₃ s n₄ nn₄	−568.65	+174967	57195
e n₄ e s₄ e n₄	+ 57.27	+ 407	408
ee₄ s n₅ nn₅	−625.92	+174560	56787
f n₅ f s₅ f n₅	+46.37		12665
ff₅ nn₆	579.55		44122

(bb₁)+(bc₁)+(bd₁)+(be₁)+(bf₁) = (bs₁)

cc₂+cd₂+ce₂+cf₂ = cs₂

dd₃+de₃+df₃ = ds₃

ee₄+ef₄ = es₄

ff₅ = fs₅

fn₅ = fs₅

(nn)

nn₆ = the sum of the squares of the residuals after the corrections derived from the equations have been applied.

(nn) = the sum of the squares of the original corrections

Equations of Condition (112) for Aug 4.5 1877

n a b c d e f s

4n = +1 0 = − 440.9" +.000 di' +.000 dΩ' +1.956 dℒ −.3288 dλ −3.398 dφ −2.085 dχ/10 −36.414

−3.93" 0 = + 10.0" −1.756 " −.077 " −.012 + .241 −.014 +.060 −1.558

log		
n	2.6443401n	1.000000
a	ℒ	0.2445245n
b	ℒ	8.8864907n
c	0.2913689	8.0791812n
d	1.5170243n	9.3820170
e	0.5312234n	8.1461280n
f	0.3191061n	8.7781513
s	1.5612684n	0.1925675n

nn	na	nb	nc	nd	ne	ns
~~1943928~~	−862.40	+1449.98	+1498.18	+919.28		

nn	na	nb	nc	nd	ne	nf	ns
+194392.8			−862.40	+1449.98	+1498.18	+919.28	+16055.04
100.0	−17.560	−.778	− .12	+ 2.41	− .14	+ .60	− 15.58
+194492.8	−17.56	−.877	−862.52	+1450.39	+1498.04	+919.88	+16039.46
+ 97.4	+4.79	−5.01	− 7.99	+ 7.48	−14.09	+2.16	+40.76
+194590.2	−12.35	−5.78	−870.51	+1457.87	+1483.95	+922.04	+16080.22

aa	ab	ac	ad	ae	af	as
+3.0835	+.1352	+.0211	−.4232	+.0246	−.1054	+2.7359
+4.9615	−1.0472	−.0067	−.1191	+.0292	+.0117	+3.8294
+8.0450	−.9120	+.0144	−.5423	+.0538	−.0937	+6.5653

bb	bc	bd	be	bf	bs
+.0059	+.0009	−.0186	+.0011	−.0046	+.1200
+1.2280	+.0092	+.0567	−.0263	−.0583	+.1621
+1.2339	+.0101	+.0381	−.0252	−.0629	+.2820

cc	cd	ce	cf	cs
+3.8260	−64.3270	−6.6465	−4.0783	−71.2258
+.0002	−.0029	+.0002	−.0007	+.0187
+3.8262	−64.3299	−6.6463	−4.0790	−71.2071
+13.1550	−63.2858	+7.2261	−10.4722	−53.3744
+16.9812	−127.6157	+0.5798	−14.5512	−124.5814

dd	de	df	ds
+1081.5552	+111.7501	+68.5694	+1197.5474
+ .0581	− .0034	+ .0144	− .3755
+1081.6133	+111.7467	+68.5838	+1197.1719
+ 543.1221	− 35.1494	+30.2903	+ 474.9148
+1624.7354	+76.5973	+98.8741	+1672.0865

ee	ef	es
+11.5464	+7.0848	+123.7348
+ .0002	− .0008	+ .0218
+11.5466	+7.0840	+123.7566
+28.9913	−15.3270	−14.2559
+40.5379	−8.2430	+109.5006

ff	fs
+4.3472	+75.9232
~~+75.9232~~	− .0935
+.0036	+75.8297
+4.3508	+37.9028
+33.4583	+113.7324
37.8091	

	a	b	c	d	e	f	s	n
	+8.0450							
(ac)	~~1.44902~~	−.9120	+.0144	−.5423	+.0538	−.0937	+6.1652	−.2235
lg(ac)	9.9055260	9.9599948n	8.1583625	9.7342396n	8.7307823	8.9717396n	0.8172480	1.3492775n
bb		+1.2339	+.0101	+.0381	−.0252	−.0629	+.2820	−3.78
abab		+.1034	−.0016	+.0615	−.0061	+.0106	−.7442	+2.53
aa bb1		+1.306	+.0117	−.023466	−.0191	−.0935	+1.0262	−5.84
lg bb1	×	.0532706	8.0681859	8.3692159n	8.2810334n	8.8002873n	0.8112320	0.9196010n
ce			+16.9812	−127.6157	+.5798	−14.5512	−124.5814	−870.51
aeae			.0000	−.0009	+.0001	−.0002	+.0117	−.04
aa ce1			+16.9812	−127.6148	+.5797	−14.5510	−124.5931	−870.47
be be1			+.0001	−.0002	−.0002	+.0009	+.0106	−.08
bb ce2			+16.9811	−127.6146	+.5799	−14.5503	−124.6037	−870.39
lg ce2	×		1.2299658	2.1059003n	9.7633531	1.1628720n	2.0955319n	2.9397139n
dd				+1624.7354	+76.5973	+98.8741	+1672.0869	+14572.87
adad				+.0366	−.0036	+.0063	−.4425	+1.51
aa dd1				+1624.6988	+76.6009	+98.8678	+1672.5294	+14571.36
bd1 bd1				+.0005	+.0004	+.0015	−.0212	+.17
bb dd2				+1624.6983	+76.6005	+98.8663	+1672.5506	+14571.19
cd2 cd2				+959.0359	−4.3580	+109.3468	+936.4110	+6541.07
cc dd3				+665.6624	+80.9585	−10.4805	+736.1404	+8030.12
lg dd3	×			2.8232531	1.9082624	1.0203821n	2.8669606	3.9047221
ee					+40.5379	−8.2430	+109.5006	+1483.95
eaea					+.0004	−.0006	+.0439	−0.15
aa ee1					+40.5375	−8.2424	+109.4567	+1484.10
be be1					+.0003	+.0012	−.0173	+0.14
bb ee2					+40.5372	−8.2436	+109.4740	+1483.96
ce2 ce2					+.0198	−.4970	−4.2552	−29.72
cc ee3					+40.5174	−7.7466	+113.7292	+1513.68
de3 de3					+9.8463	−1.2747	+89.5303	+976.63
dd ee4					+30.6711	−6.4719	+24.1992	+537.05
lg ee4	×				1.4867152	0.8110318n	1.3838010	2.7300147
ff						+37.8091	+113.7324	+922.04
fafa						+.0011	−.0765	+.26
aa ff1						+37.8080	+113.8089	+921.78
bf bf1						+.0048	−.0667	+.54
bb ff2						+37.8032	+113.8756	+921.24
cf2 cf2						+12.4674	+106.7672	+745.80
cc ff3						+25.3358	+7.1084	+175.44
df3 df3						+.1650	+11.5902	−126.43
dd ff4						+25.1708	~~+4.8888~~	+301.87
ef4 ef4						+1.3656	−5.1064	−113.33
ee ff5						+23.8052	+23.8050	+415.20
ff5	×					1.3766682		2.6182573

	ns	nn
	+16080.22	+194590.2
an as an	4.2062920	5.2891209
as sn1 nn1	+18.24 +16098.46	62 +194528.0
bn1 bs1 bn1	−7.84	+61.1
bb' sn2 nn2	+16106.00	+194466.9
en2 es2 en2 / ee2 sn3 nn3	+6386.77 +9719.23	44613.1 +149853.8
dn3 ds3 dn3 / dd2 sn4 nn4	+8880.34 +838.89	96870.4 +52983.4
en4 es4 en4	+423.74	+9404.0
ee4 sn5 nn5	+415.15	+43579.4
fn5 fn5		+7242.0
ff5 nn6		36337.4

lg ns 2.61826
−lg ff5 1.37667n
lg dy 1.24159n
$\frac{d\psi}{10}$ −17.442

$\frac{dy}{10}$ ef4 +112.88
en4 +537.05
s +649.93
log s 2.81287
−lg ee4 1.48672n
log dψ 1.32615n
dψ −21.19

dy df3 +18280
$\frac{1}{10}$ dψ de3 −171560
dn3 +80.3012
s +649.732
log s 3.81273
−log dd3 2.82325n
log dψ 0.98948n
dψ a −9.76

dy ef2 +25378
$\frac{1}{10}$ dψ ee2 −1229
dψ acd2 +124560
en2 −87039
s +61670
log s 2.79007
−lg ee ~~2.82325~~ 2.22556n
lg dy ~~9.9602~~
lg dL 1.5601n
(−36.32

dy bf1 +1.28
$\frac{1}{10}$ dψ be1 +.40
dψ abd1 +.23
dψ be1 −.42
bn1 +.88
s −6.82
log s 0.83378n
−lg bb1 .53241n
lg dΩ' .30107
dΩ' +2.00

dy ab +1.63
$\frac{1}{10}$ dψ ac −1.14
dψ aad +5.29
dψ ac −.52
dΩ' ab −1.82
an −22.35
s −18.51
log s 1.27669n
−lg aa ~~0.9999~~ 0.90555n
lg di'' 0.37114
di'' +2.35

lg(1−cos i') 8.98238
lg dΩ' .30107
lg dΩ'(1−cos i') 9.28345
dΩ'(1−cos i') +0.20
dψ +2 54.42
dπ' +2 54.62
dΩ' +2.00
dω' +2 52.62

log cos i' 9.95508
lg dΩ' .30107
.25615
−cos i' dΩ' −1.80
dψ 2 54.42
dω −2 52.62

dL −36.32
(1−cos i') dΩ' +.20
dψ' −36.12
dπ' +2 54.62
dL ~~+2 30.74~~
+2 18.50

log 6.7.83230n
lg dψ/ω 9.8948n
lg dω 8.82183
dω +.066349
ω 934.37188
ω +934.43823
log ω 2.9705504
log C 3.5500066
0.5794562
.1931520
log a .3863040

lg M 4.82335
9.8948n
5.31283n
−.0000205
.3863246
.3863041

(109)

Perturbations for 1476.

From the Berlin Elements.

Mean Eq. 1880.

$d\pi = +50.24''$
$d\Omega = +44.19$
$di = +0.46$
$d\omega = +0.75$

	π	Ω	i	ω
1875 ~~Red. to 1880~~	56° 1' 0"	4° 58' 28"	8° 2' 48"	51° 2' 32"
" " "	+4 11	+4 7	+2	+4
Ω 1880	56 5 11	5 02 35	8 2 50	51 2 36

♃ $\Omega' = 99° 7' 15'' + 4' 16'' = 99° 11' 31''$
$i' = 1 18 35 - 0 2 = 1 18 33$

♄ $\Omega' = 112° 30' 53'' + 3' 48'' = 112° 34' 41''$
$i' = 2 29 20 - 0 1 = 2 29 19$

	♃	♄
i	8 2 50	8° 2' 50"
i'	1 18 33	2 29 19
$i'+i$	9 21 23	10 32 09
$i'-i$	6 44 17	5 33 31
$\frac{1}{2}(i'+i)$	4 40 42	5 16 04
$\frac{1}{2}(i'-i)$	−3 22 08	−2 46 45

	♃	♄
Ω'	99° 11' 31"	112 34 41
Ω	5 2 35	5 2 35
$\Omega'-\Omega$	94 8 56	107 32 06
$\frac{1}{2}(\Omega'-\Omega)$	47 4 28	53 46 03

	♃	♄
$\sin\frac{1}{2}(\Omega'-\Omega)$	9.86465	9.90667
$\sin\frac{1}{2}(i'+i)$	8.91149	8.96289
$\sin\frac{1}{2}I \sin\frac{1}{2}(N+N')$	8.77614	8.86956
$\sin\frac{1}{2}I \cos\frac{1}{2}(N+N')$	8.60229n	8.45725n
$\tan\frac{1}{2}(N+N')$	0.17385n	0.41231n
$\frac{1}{2}(N+N')$	−56 10 25	−68 50 41
$\frac{1}{2}(N+N')$	123 49 35	111 09 19
$\frac{1}{2}(N-N')$	47 01 41	53 41 04
N	170 51 16	164 50 23
ω	51 2 36	51 2 36
ω'	240 11 20	246 12 13
N'	76 47 54	57 28 15
Ω'	99 11 31	112 34 41
$N+\Omega'$	175 59 25	170 02 56

$\sin\frac{1}{2}I$ 8.85668 ♃
8.89987 ♄
$\frac{1}{2}I$ 4° 7' 22"
$\frac{1}{2}I$ 4 33 17
I 8 14 44
I 9 06 34

♄
$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.83318
$\cos\frac{1}{2}(i'-i)$ ~~9.77163~~
8.76911n
8.60229n
$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.77163
8.68562n
8.45725n

	♃	♄
$\sin\frac{1}{2}(\Omega'-\Omega)$	9.86465	9.90667
$\cos\frac{1}{2}(i'+i)$	9.99855	9.99816
$\cos\frac{1}{2}I \sin\frac{1}{2}(N-N')$	9.86320	9.90483
$\cos\frac{1}{2}I \cos\frac{1}{2}(N-N')$	9.83243	9.77112
$\tan\frac{1}{2}(N-N')$	.03077	0.13371
$\frac{1}{2}(N-N')$	47 01 41	53 41 04
$\frac{1}{2}(N-N')$		

♄
$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.83318
$\cos\frac{1}{2}(i'-i)$ 9.99925
9.83243
$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.77163
9.99949
9.77112

	♃	♄
ω'	~~76° 47' 54"~~ 240 11 20	~~57° 28' 15"~~ 246 12 13
$N+\Omega'$	175 59 25	170 02 56

sin

$\sqrt{a(1+e)} = 27207$
~~tan~~ $\sqrt{a(1-e)} = 13821$
$\log e'' = 4.78983$

$\varphi = 17° 23' 12''$
$\log\cos\varphi$ 9.97969
$\log\cos 2\varphi$ 9.95938
$\log a$ .43059
$\log p$ .38997
$\log\sqrt{p}$ .19499
$\log e$ 9.47541
i 8 2 50
$\frac{1}{2}i$ 4 1 25
$\frac{1}{2}\varphi$ 8 41 36
$\tan\frac{1}{2}\varphi$ 9.18441
$\cot\varphi$ 0.50427

	♃	♄
log (1)	1.93677	1.41280
(2)	.85391	
(3)	.41026	
(4)	.91456	
(5)	.52459	
(6)	8.84721	
(7)	9.57487	
(8)	.48943	
(9)	9.57438	
(10)	.28072	
(11)	9.18441	
(12)	.89424	
(13)	.50427	

4

Checks.

(4) − (9) = (12)

(5) − 11 = (13)

Perturbations of 109 (Continued.)

	π	☊	i	ω
1880	56 00 54	4 56 06	8 02 58	51 04 49
Red to Day 25 11 =	+ 2 9	+ 2 7	+ 1	+ 3
	56 03 03	4 58 13	8 2 59	51 4 52

☊′♃	i′♃	☊′♄	i′♄
99 7 16	1 18 35	112 30 56	2 29 19

	♃	♄
i″	8 2 59	8 2 59
i′	1 18 35	2 29 19
i′+i″	9 21 34	10 32 18
i′−i″	−6 44 24	−5 33 40
½(i″+i′)	4 40 47	5 16 09
½(i′−i″)	−3 22 12	−2 46 50

	♃	♄
☊′	99 07 16	112 30 56
☊	4 58 13	4 58 13
☊′−☊	94 09 03	107 32 43
½(☊′−☊)	47 04 32	53 46 21

	♃	♄
sin ½(☊′−☊)	9.86466	9.90670
sin ½(i′+i″)	8.91161	8.96301
sin ½ I sin ½(N+N′)	8.77627	8.86971
sin ½ I cos ½ N+N′	8.60228	8.45742ₙ
tg ½(N+N′)	.17399	.41229
½(N+N′)	56 10 55	68 50 37
N+N′	123 49 05	111 09 23
N−N′	47 2 23	53 41 21
N	170 51 28	164 50 44
ω	51 04 52	51 04 52
ω′	240 13 24	246 14 08

cos ½(☊′−☊) 9.83302
sin ½(i′−i″) 8.76926ₙ
8.60228
9.77158
8.68584ₙ
8.45742ₙ

	♃	♄
sin ½(☊′−☊)	9.86466	9.90670
cos ½(i′+i″)	9.98855	9.98816
cos ½ I sin ½(N−N′)	9.86321	9.90986
cos ½ I cos ½(N−N′)	9.83227	9.77107
tg ½(N−N′)	0.03094	0.13879
½(N−N′)	47 02 23	53 41 21

cos ½(☊′−☊) 9.83302
cos ½(i′−i″) 9.98925
9.83227
9.77158
9.99949
9.77107

8.85677 8.90002
4 7 25 4 33 22
I 8 14 50 9 06 44 I
sin I 9.19967
cos I 9.99448

	♃	♄
N′	76 46 42	57 28 02
☊′	99 7 16	112 30 56
N′+☊′	175 53 58	169 58 58

	♃	♄
ω′	240 13 24	246 14 08
N′+☊′	175 53 58	169 58 58
log 40 mk	2.13176	1.60779

log 120k .31476

φ 17 24 02
log cos φ 9.97941 9.97966
log tg φ 9.49791 9.49609
log cos² φ 9.95888 9.95932
log a .43068 .42068
log p .38966 .38999
log √p .19483 .19499
log e 9.47576 9.47576
i 8 2 58
½i 4 1 29
½φ 8 44 0 58 42 01
log tg ½φ 9.18651 9.18477

	♃		♄
log (1)	~~1.93700~~	1.93677	1.41280
(2)	.85380		.48902
(3)	~~.41017~~ 331	41033	9.57
(4)	~~.91370~~	.91423	
(5)	~~.52424~~	52424	
(6)	~~8.84433~~	8.84733	
(7)	~~9.57518~~	9.57519	
(8)	~~0.48908~~	.48942	
(9)	~~9.57617~~	9.57476	
(10)	~~28052~~	28069	
(11)	~~9.18651~~	9.18477	
(12)	~~89135~~	89390	
(13)	~~50209~~	.50391	

log √a(1+e) .28215
√a(1−e) .13818
log e″ 4.79017

sin I 9.15668
cos I 9.88548

4

	1873 Sept. 18	Oct. 28	Dec 7	1874 Jan 16	Feb. 25	Apr 6	May 16	June 25	Aug 4	Sept 13
L	175 53 57 163 09 31	166 12 57	169 15 56	172 18 29	175 20 42	178 22 36	181 24 15	184 25 41	187 26 58	190 28 09
u'	347 15 33	350 18 59	353 21 58	356 24 31	359 26 44	2 28 38	5 30 17	8 31 43	11 33 0	14 34 11
log sin u'	9.34349n	9.22584n	9.06268n	8.79686n	7.98573n	8.63571	8.98194	9.17113	9.30151	9.40064
log tan u'	9.35490n	9.23208n	9.06559n	8.79771n	7.98575n	8.63611	8.98395	9.17598	9.31040	9.41483
log tan λ'	9.35039	9.22757	9.06108	8.79320	7.98124	8.63160	8.97944	9.17148	9.30589	9.41032
λ'	347 22 12	350 24 52	353 26 03	356 26 44	359 27 04	2 27 06	5 26 54	8 26 31	11 26 02	14 25 32
λ+ω'	145 58 20	156 19 12	167 51 54	180 45 42	195 05 30	~~210 46~~ 210 46 54	227 31 56	244 47 20	261 51 36	278 05 48
λ'−(λ+ω')	201 23 52	194 05 40	185 34 09	175 41 02	164 21 34	151 40 12	137 54 58	123 39 11	109 34 26	96 19 44
log sin β'	8.50017n	8.38252n	8.21536n	7.95354n	7.14241n	7.79239	8.13862	8.32783	8.45819	8.55732
log r'	73380	73437	73489	73534	73574	73607	73635	73657	73673	73682
log cos β'	9.99978	9.99987	9.99994	9.99998	10.00000	9.99999	9.99996	9.99990	9.99982	9.99972
log z'	9.23397n	9.11689n	8.95425n	8.68888n	7.87815n	8.52846	8.87497	9.06440	9.19452	9.29414
log sin(λ'−ω)	9.56210n	9.38654n	8.98698n	8.87656	9.43072	9.67628	9.82622	9.92034	9.97415	9.99733
log r' cos β'	.73358	.73424	.73483	.73532	73574	73606	73631	73647	73655	73659
log cos(λ'−ω)	9.96898n	9.98673n	9.99795n	9.99877n	9.98361n	9.94460n	9.87050n	9.74364n	9.52507n	9.04232n
log cos γ'	9.96876n	9.98660n	9.99789n	9.99875n	9.98361	9.94599	9.87046n	9.74354	9.52489	9.04204
log r'	73380	73437	73489	73534	.73574	73607	73635	.73657	73673	.73682
sin γ'	9.56352	9.38848	8.99260	8.87831	9.43074	9.67192	9.82626	9.92038	9.97417	9.99735
log r' cos γ'	.70256	.72097	.73278	.73409	.71935	.68206	.60681	.48011	.26162	9.77886
−r' cos γ'	+.50417	+.52599	+.54049	+.54212	+.52403	+.48091	+.40440	+.30208	+.18265	+.6010
R	+2.5103	2.3791	2.2507	2.1309	2.0269	1.9474	1.9003	1.8909	1.9207	+1.9858
R − r' cos γ'	.75520	+.76390	+.76556	+.75521	+.72662	+.67565	+.59443	+.49117	+.37472	+.25868
log r' sin γ' = log ρ sin l'	.29732	.12285	9.72749	9.61365	.16648	.40749	.56261	.65695	.71090	.73415
log ρ cos l'	0.87806	.88304	.88398	.87807	.86137	.82972	.77410	.69123	.57371	.41276
log tan l'	9.41926	9.23981	8.84351	8.73558	9.30511	9.57700	9.78851	9.96572	.13719	.32139
log Q	.89254	.88950	.88503	.87871	.87004	.85876	.84367	.82529	.80348	.77868
log 1/Q	9.10746	9.11050	9.11497	9.12129	9.12996	9.14124	9.15633	9.17471	9.19652	9.22132
log 1/Q³	7.32238	7.33150	7.34491	7.36387	7.38988	7.42372	7.46899	7.52413	7.58956	7.66396
log 1/2 r	9.26620	9.26563	9.26511	9.26466	9.26426	9.26393	9.26365	9.26343	9.26327	9.26318
log 1/r'³	7.79860	7.79689	7.79533	7.79398	7.79278	7.79179	7.79095	7.79029	7.78981	7.78954
+ 1/Q³	+.0021008	.0021454	.0022126	+.23114	+.0024541	.0026529	.0029444	.0033430	.0038866	~~.0061595~~ 46128
− 1/r'³	−.0062893	.0062646	62421	.62228	62056	61916	61795	.0061702	61633	61595
	−.0041886	−.0041192	−.0040295	−.0039114	−.0037515	−.0035387	−.0032357	−.0028272	−.0022767	−.0015467
log a	7.62206n	7.61481n	7.60525	7.59233	7.57421	7.54884	7.50989	7.45136	7.35731n	7.18941n
log z'	9.23397n	9.11689n	8.95425n	8.68888n	7.87815n	8.52846	8.87497	9.06440	9.19452	9.29414n
log 1	1.93700									
−.00083 log W₀	8.79303 280	8.86870	8.49650	8.21821	7.38936	8.01430	8.32186	8.45276	8.48923	8.42560
log a	7.62206	7.61481	7.60525	7.59233	7.57421n	7.54884n	7.50989	7.45736	7.35731	7.18941
log γ'	29568n	12078n	9.72187n	9.61188	16646	41234	56253	65681	71070	.73385
−.00023 log δ₀	9.85474 51	9.67259	9.26406	9.54121	9.67767	9.89818	.00942	.04517	.00501	9.86029
log 2	39972	37642	35230	32856	30684	.28946	27882	27666	28346	29794
log 1/Q³	7.32238	7.33150	7.34491	7.36387	7.38988	7.42372	7.46899	7.52413	7.58956	7.66396
log 2/Q³	7.72210	7.70792	7.69721	7.69243	7.69672	7.71318	7.74781	7.80079	7.87302	7.96190
log a	7.62206	7.61481	7.60525	7.59233	7.57421	7.54884	7.50989	7.45136	7.35731	7.18941
log x'	70256	72097	73278	73409	71935	68066	60681	48011	26162	9.77886
log a x'	8.32462	8.33578	8.33803	8.32642	8.29356	8.22950	8.11670	7.93145	7.61893	6.96827
a x'	+.021116	+.021666	.021779	.021204	.019659	.016963	.013083	.008540	.004158	+.000930
2/Q³	−.005273	−.005104	−.004980	−.004925	−.004974	.005166	−.005595	−.006321	−.007465	−.009160
a x' − 2/Q³	+.015843	+.016562	+.016799	+.016279	+.014685	+.011797	+.007488	+.002219	−.003307	−.008230
log(a x' − 2/Q³)	8.19984	8.21911	8.22528	8.21163	8.16687	8.07177	7.87437	7.34616	7.51943n	7.91540n
−.00023 log ρ₀	0.13684 61	0.15611	0.16228	.14863	.10387	0.00877	9.81137	9.28316	9.45643n	9.85240n

1875 Wash'n mltr

1876 BMT

log sin I 9.15660
log cos I 9.99549

1876

Oct 23	Dec 2	Jan 11	Jan 15	Feb 24	Apr 5	May 15	June 24	Aug 3	Sept. 12	Oct 22	Dec 1 ~~Jan 10~~
193 29 17	196 30 24	199 31 34	199 54 45	202 56 02	205 57 29	208 59 08	212 01 03	215 03 17	218 05 52	221 08 51	224 12 19
17 35 19	20 36 26	23 37 36	23 55 30	26 56 37	29 58 04	32 59 48	36 01 38	39 03 52	42 06 27	45 09 26	48 12 54
9.44027	9.54649	9.60290	~~9.6[illegible]~~	9.65621	9.69888	9.43605	9.76950	9.79947	9.82641	9.85067	9.87252
9.50106	9.57521	9.64092	9.64699	~~9.70614~~ 9.90610	9.76088	9.81244	9.86169	9.90937	9.95604	.00257	.04874
	9.57090		9.60855		9.75637					9.99786	
9.49655	~~9.54640~~	9.63641	9.64248	9.70160	~~9.74164~~	9.80793	9.85718	9.90486	9.95156	~~.01051~~	.04433
17 25 05	20 24 44	23 24 32	23 42 08	26 42 15	29 42 46	32 43 28	35 44 40	38 46 27	41 48 42	44 51 30	47 55 10
293 05 56	306 40 10	318 50 10	319 47 56	330 85 02	340 16 42	349 3 08	357 3 32	4 25 52	11 16 52	19 42 06	23 46 04
84 19 09	73 44 34	64 34 22	63 54 12	56 07 13	49 25 59	43 40 20	38 41 08	34 20 35	30 31 50	27 09 24	24 09 06
8.63695	8.70317	8.75958	8.76559	8.81281	8.85518	8.89268	8.92610	8.95601	8.98301	9.00743	9.02914
.73686	.73683	.73674	.73673	.73657	.73636	.73608	.73574	.73534	.73488	.73436	.73379
9.99959	9.99945	9.99925	9.99926	9.99908	9.99888	9.99868	9.99845	9.99822	9.99798	9.99768	9.99750
9.37381	9.44000	9.49632	9.50232	9.54938	9.59154	9.62873	9.66184	9.69141	9.71789	~~9.74782~~ 9.74163	9.76293
9.99786	9.98228	9.95575	9.95330	9.91919	9.88061	9.83918	9.79591	9.75139	9.70586	9.65937	9.61189
.73645	.73628	.73602	.73599	.73565	.73524	.73476	.73419	.73356	.73286	.73204	.73129
8.99508	9.44709	9.68283	9.64334	9.74621	9.81314	9.85932	9.89242	9.91681	9.93518	9.94927	9.96022
8.99517	9.44654	9.63211	9.64260	9.74529	9.81202	9.85800	9.89087	9.91503	9.93316	9.94685	9.95772
.73686	.73683	.73674	9.95348	9.91960	9.88142	9.84062	9.79830	9.75516	9.71156	9.66796	9.62388
9.99786	9.98232	9.95591	.73673	.73657	.73636	.73608	.73574	.73534	.73488	.73436	.73379
9.73203	.18337	.36885	.37933	.48186	.54838	.59408	.62661	.65037	.66804	.68131	.69151
+.5395	~~+.15254~~	+.23880	+.23952	+.30829	+.35349	+.39272	+.42327	+.44707	+.46563	~~.48008~~	+.49149
2.0794	2.1926	+2.3178	+2.3291	2.4596	2.5901	2.7170	2.8378	2.9507	3.0545	3.1482	3.2316
+1.5399	+0.6671	−.0202	+.0661	−.05733	−0.9448	+1.2102	1.3949	−1.5260	−1.6018	~~−1.6162~~	−1.6833
.73475	.71915	.68265	.69021	.65617	.61978	.57690	.53404	.49050	.44644	~~.4031~~	.35767 40232
.18799	9.82419	8.30535	8.82020 n	9.75838 n	9.97534	0.08286	0.14454	0.18184	0.20461	0.21817	0.22616 n
.54726	.89496	2.38730 n	1.87001	.89775 n	.64244 n	.49384 n	.38950 n	.30866 n	.24183 n	~~.17700~~	.13151
.75155	.72264	.69265	.69025	.65962	.62877	.59796	.56745	.53745	.50810	~~.48915~~ .47992	.45224
9.24845	9.27736	9.30735	9.30975	9.34038	9.37123	9.40204	9.43255	9.46255	9.49190	9.52028	9.54776
7.74535	7.83208	7.92205	7.92925	8.02114	8.11369	8.20612	8.29765	8.38765	8.47570	8.56084	8.64328
9.26314	9.26317	9.26326	~~9.62067~~	~~9.51814~~	~~9.64651~~	~~9.60728~~	~~9.57673~~	~~9.55293~~	~~9.53437~~	~~9.51592~~	~~9.50851~~
7.78942	7.78951	7.78978	7.78981	7.79029	7.79092	7.79176	7.79248	7.79398	7.79536	7.79652	7.79863
.0056687	.0067938	.0083570	+.0084957	+.010499	.012992	.016074	.019845	.024415	.029902	.036378	.043983
.0061578	61590	61629	.006163	.006170	.006179	.006191	.006206	.006223	.006243	.006265	.006290
−.0005941	+.0006343	+.0021941	+.002334	.004329	.006813	.009883	.013639	.018192	.023659	.030138	.037693
6.77386	6.80229	7.34126	7.36810	7.63639	7.83334	7.99489	8.13478	8.25988	8.37400	8.47904	8.57626
9.37381	9.44000	9.49632	9.50232 1.93677	9.54938	9.59154	9.62873	9.66184	9.69141	9.71789	9.74163	9.76293
8.08467 n	8.17929	8.77408 35	8.80719	9.12254	9.36165	9.56039	9.73339	9.88806	0.02866	.15744	.27596
6.77386	6.80229	7.34126	7.36810	7.63639	7.83334	7.99489	8.13478	8.25988	8.37400	8.47904	8.57626
.73431 n	.71856	.69177	.68929	.65484	.61580	.57394	.53010	.48495	.43872	.39141	.34318
9.44517 n	9.45785	9.97003 9.96980	9.99416	.22800	.38596	.50560	.60165	.68160	.74949	.80722	.85621
			7.92925	8.02114	8.11369	8.20612	8.29765	8.38765	8.47570	8.56084	8.64328
.31792	34096	36508	36718	39086	41332	43408	45298	46982	48494	49806	50942
7.74535	7.83208	7.92205	~~7.78981~~	~~7.79029~~	~~7.79092~~	~~7.79176~~	~~7.79278~~	~~7.79398~~	~~7.79536~~	~~7.79692~~	~~7.79863~~
8.06327	8.17304	8.28713	~~8.15699~~ 8.29643	8.41200	8.52901	8.64020	8.75063	8.85757	8.96064	9.05890	9.15270
6.77386	6.80229	7.34126	7.36810	7.63639	7.83334	7.99489	8.13478	8.25988	8.37400	8.47904	8.57626
9.73203 n	18337	.36885	37933	48186	54838	59408	62661	65037	66804	68131	69251
6.50589 n	6.98566	7.71011	7.74743	8.11825	8.38172	8.58897	8.76139	8.91025	9.04204	9.16035	9.26877
−.000320	+.000968	+.005130	.005590	.013130	.024084	.038813	.057729	.081330	.110165	.144662	.185685
−.011569	−.014895	−.019370	−.019789	−.025823	−.033652	−.043672	−.056316	−.072040	−.091336	−.114525	−.142135
−.011889	−.013927	−.014240	−.014199	−.012693	−.009568	−.004859	~~.0058~~ +.001413	+.009290	+.018829	+.030137	+.043250
8.07515 n	8.14386 n	8.15351 n	8.15229 n	8.10356 n	7.98082 n	7.68655 n	7.15014	7.96802	8.27483	8.47910	8.63599
0.01215 n	0.08086 n	.09051 n 28	0.08906 n	.04033 n	9.91759 n	9.62332 n	9.08691	9.90479	0.21160	0.41587	.57276

Nov 27

1876

	~~Feb 19~~ Jan 10	~~Mar 30~~ Feb. 19	Mar 31
	° ′ ″		
ℓ'	227 16 16	230 30 47	233 25 57
u'	51 16 51	54 24 22	57 26 29
log sin u'	9.89222	9.90991	9.92575
log tan u'	.09599	.14443	.19483
log tan λ'	.09148	.13992	.19032
λ'	50 59 26	54 04 28	57 10 16
$\ell+\omega'$	29 33 02	35 06 08	40 28 22
$\lambda'-(\ell+\omega')$	21 26 24	18 58 20	16 41 54
log sin β'	9.04882	9.06651	9.08235
log r'	.73317	.73248	.73175
log cos β'	9.99726	9.99703	9.99680
log z = log r' sin β	9.78199	9.79899	9.81410
log sin$(\lambda'-(\ell+\omega'))$	9.56292	9.51203	9.45838
log r' cos β'	.73043	.72951	.72855
log cos$(\lambda'-(\ell+\omega'))$	9.96886	9.97544	9.98129
log cos γ' = cos β' cos$(\lambda'-(\ell+\omega'))$	9.96612	9.97277	9.97809
log r'	.73317	.73248	.73175
log sin γ'	9.57986	9.53564	9.49104
log r' cos γ'	.69929	.70525	.70984
	50037	.50729	.51268
2	3.3040	3.3653	3.4153
$2-r'\cos\gamma'$	−1.6997	−1.7076	−1.7115
log r' sin γ' = log Q sin ℓ'	.23087	0.23239	0.23338
log Q cos ℓ'	0.31363 n	.26812 n	.22279 n
log tan ℓ'	.08266	.03573	9.98941
log Q	.42612	.40150	.37866
log $\frac{1}{Q}$	9.57388	9.59850	9.62134
log $\frac{1}{Q^3}$	8.72164	8.79550	8.86402
log $\frac{1}{a'}$	9.26683	9.26752	9.26825
log $\frac{1}{a'^3}$	7.80049	7.80256	7.80475
$\frac{1}{Q^3}$	.052680	.062446	.073118
$\frac{1}{a'^3}$	.006317	.006347	.006379
$\frac{1}{Q^3}-\frac{1}{a'^3}=A$	+.046363	.056099	.066739
log A	8.66617	8.74896	8.82438
log z'	9.78199	9.79899	9.81410
log (1)	1.93677		
log W_0	0.38493	0.48472	0.57525
log A	8.66617	8.74896	8.82438
log y'	29335	24154	.18693
log (1)			
log S_0	.89629	.92727	.94808
log 2	.51904	.52702	.53342
log $\frac{1}{Q^3}$	8.72164	8.79550	8.86402
log $\frac{2}{Q^3}$	9.24068	9.32252	9.39744
log A	8.66617	8.74896	8.82438
log x'	.69929	.70525	.70984
log Ax'	9.36546	9.45421	9.53422
Ax'	+.23199	.28459	.34215
$\frac{2}{Q^3}$	−.17405	−.21015	−.24971
$Ax'-\frac{2}{Q^3}$	+.05794	+.07444	+.09244
log$(Ax'-\frac{2}{Q^3})$	8.76298	8.87181	8.96586
log (1)			
log R_0	.69975	.80858	.90263

For h 1873

	Sept 18	Oct 28	Dec 7	74 Jan 16	Feb 25	Apr 6	May 16	June 25	Aug 4	Sept 13	Oct 23
l'	301 10 53	302 24 11	303 37 34	304 51 02	306 04 87	~~3071~~ 307 18 19	308 32 07	309 46 01	311 00 02	312 14 10	313 28 25
u'	131 11 58	132 25 13	133 38 36	134 52 04	136 05 39	137 19 21	138 33 05	139 47 03	141 01 04	142 15 12	143 29 24
log sin u'	9.87647	9.86818	9.85953	9.85048	9.84103	9.83115	9.82081	9.81001	9.79870	9.78687	9.77449
log tan u'	.05228	.03364	.01506	9.99648	9.97789	9.95923	9.94048	9.92161	9.90257	9.88333	9.86386
log tan λ'	0.05780	03916	02058n	00200	9.98341	9.96475	9.94600n	9.92713	9.90809	9.88885	9.86938
λ'	131 33 34	132 46 59	134 0 24	135 13 50	136 27 28	137 41 07	138 54 50	140 08 35	141 22 24	142 36 17	143 50 12
Ω+ω'	151 59 04	162 19 56	173 52 38	186 46 26	201 06 14	216 47 38	233 32 40	250 48 04	267 52 20	284 06 32	299 06 40
λ'−(Ω+ω')	339 34 30	330 27 03	320 07 46	308 27 27	295 21 14	280 53 29	265 22 10	249 20 31	233 30 04	218 29 45	204 43 32
log sin β'	9.07614	9.06785	9.05920	9.05015	9.04070	9.03082	9.02048	9.00968	8.99837	8.98654	8.97416
log z'	.99911	.99885	.99858	.99830	.99802	.99773	.99742	.99710	.99678	.99645	.99611
log cos β'	9.99689	9.99701	9.99713	9.99725	9.99737	9.99748	9.99760	9.99772	9.99783	9.99795	9.99806
log z₁' = log z' sin β'	.07525	.06670	.05778	.04845	.03872	.02855	.01790	00678	9.99515	9.98299	9.97027
sin(λ'−Ω+ω') y'	9.54250n	9.69300n	9.80690n	9.89350n	9.95601n	9.99211n	9.99858n	9.97114n	9.90579n	9.79411n	9.62145n
log z' cos β'	.99600	.99586	.99571	.99555	.99539	.99521	.99502	.99482	.99461	.99440	.99417
x' cos(λ'−Ω+ω')	9.97180	9.93949	9.88508	9.79374	9.63165	9.27634	8.90701n	9.54452n	9.77437n	9.89357n	9.95724n
log cos j' = cos β' cos(λ'…)	9.96869	9.93650	9.88221	9.79099	9.62902	9.27382	8.90461	9.54524	9.77220n	9.89152	9.95630
log z'	99911	99885	99858	99830	99802	99748	99760	99772	99783	99795	99806
log sin j'	9.56398	9.70202	9.81094	9.89552	9.95609	9.99220	9.99860	9.97146	9.90634	9.79731	9.63039
log z' cos j'	.96780	.93535	.88079	.78925	.62704	.27130	9.90221n	.54298	.77003	.88947	.95436
−2 z' cos j'	−.92855	−.86169	−.75996	−.61559	−.42369	−.18677	+0.7984	+.84973	+.58889	+.77531	+.90025
z'²	+2.5103	+2.3791	2.2507	2.1307	+2.0269	+1.9474	+1.9003	+1.8909	1.9207	1.9858	2.0794
1−2 z' cos j'	−.67752	−.62378	−.53489	−.40250	−.22190	+.07997	+.26987	+.53822	+.78096	+.97389	1.10819
log z' sin j'	.56309	.70087	.80952	.89382	.95462	.98968	.99620	.96918	.90417	.79526	.62845
log q cos k'	.83092	.77503	.72826	.60477	.34439	8.90146	0.43115	.73096	.89263	.98857	1.04423
log l'	9.73217	9.80584	.08126	.28905	.61023	2.08822	.56505	.23822	.01154	9.80675	9.58422
log ρ	.88643	.90553	.92318	.94472	.96731	.98969	1.01192	1.03174	1.04899	1.06323	1.07453
log 1/ρ	9.11357	9.09647	9.07682	9.05528	9.03269	9.01031	8.98858	8.96826	8.95101	8.93677	8.92547
log 1/ρ³	7.34071	7.28941	7.23046	7.16584	7.09807	7.03093	6.96574	6.90478	6.85303	6.81031	6.77641
log 1/z₁'	9.00089	9.00115	9.00142	0.00170	9.00198	9.00227	9.00258	9.00290	9.00322	9.00355	9.00389
log 1/z₁'³	7.00267	7.00345	7.00426	.00510	.00594	.00681	7.00774	.00870	.00966	.01065	.01167
1/ρ³	.0021913	.0019472	.0017001	.0014650	.0012584	.0010738	.0009242	.0008031	.0007129	.0006461	.0005976
−1/z₁'³	−.0010062	10080	10099	10118	10138	10158	10180	10203	10225	10248	.0010273
Δ	+.0011851	+.0009392	+.0006902	+.0004532	+.0002396	+.0000580	−.0000938	−.0002172	−.0003096	−.0003787	−.0004297
log Δ	7.07375	6.97276	6.83898	6.65629	6.37949	5.76343	5.97220n	6.33686n	6.49080n	6.57830n	6.63317
log z₁'	.07525	06670	05778	04845	03872	02855	01790	.00678	9.99515	9.98299	9.97027
log ζ	8.56203	8.45249	8.30979	8.11777	7.83124	7.20501	7.40313	7.75667	7.89898	7.97432	8.01647
log ζ₀	8.56180	8.45226	8.30976	8.11754	7.83102	7.20478	7.40290n	7.75694n	7.89875n	7.97409n	8.01624n
log Δ	7.07375	6.97276	6.83898	6.65629	6.37949	5.76343	5.97220n	6.33686n	6.49080n	6.57830	6.63317
log y'	53880n	68886	80261n	88935	95140	98782	99360	96596	89980	78851	.61562
log y₀	9.02552	9.07443	9.05487	8.95864	8.74367	8.16356	8.37860	8.71562	8.80340	8.77961	8.66157
log 2	39972	37642	35230	32856	30684	28946	27882	27666	28346	29794	31792
log 1/ρ³	7.34071	7.28941	7.23046	7.16584	7.09807	7.03093	6.96574	6.90478	6.85303	6.81031	6.77641
log 2/ρ³	7.74043	7.66583	7.58276	7.49440	7.40491	7.32039	7.24456	7.18144	7.13649	7.10825	7.09433
log Δ	7.07375	6.57276	6.83858	6.65629	6.37949	5.76343	5.97220	6.33686	6.49080	6.57830	6.63317
log x'	96780	93535	88079	78929	62704	27158	9.90203	54234	76898	88797	95241
log Δx'	8.04155	7.90811	7.71977	7.44558	7.00653	6.03498	5.87423	6.87920	7.25978	7.46627	7.58558
I Δx'	.0110040	.0080930	.0052453	.0027899	.0010151	.0001084	.0000748	.0007572	.0018188	.0029260	.0038511
−2/ρ³	.0055009	.0046326	.0038262	.0031218	.0025405	.0020912	.0017561	.0015186	.0013693	.0012831	.0012426
Δx − 2/ρ³	+.0055031	+.0034604	+.0014191	−.0003319 ~~6681~~	−.0015254	−.0019828	−.0016813	−.0007614	+.0004495	+.0016429	+.0026085
log ξ₀	7.74060	7.53913	7.15198	6.52101n	7.18338n	7.29728n	7.22565n	6.88161n	6.65273	7.21561	7.41639
log R₀	9.15340	8.85198	8.06598	7.93381	8.59647	8.71038	8.63846	8.29444	8.06558	8.62844	8.82549

1875 BMT l s. I 9.19554 l cos I 9.99449 — 1876

Dec 2	Jan 11	Jan 15 0	Feb 24	Apr 5	May 15	June 24	Aug 3	Sept 12	Oct 22	Dec 1	Jan 10
314 42 47	315 57	18 316 10 01	317 24 40	318 39 26	319 54 21	321 09 24	322 24 36	323 39 57	324 55 26	326 11 04	327 26 52
144 43 49	145 58 20	146 07 05 9 57 48	147 21 44	148 36 30	149 51 25	151 06 28	152 21 40	153 37 01	154 52 30	156 08 08	157 23 56
9.76150	9.74787	9.74623	9.73185	9.71674	9.70084	9.68409	9.66642	9.64774	9.62797	9.60700	9.58469
9.84405	9.82393	9.82705	9.80649	9.78547	9.76394	9.74182	9.71904	9.69551	9.67114	9.64581	9.61939
9.84957	9.82945	9.82154	9.80098	9.77996	9.75843	9.73631	9.71353	9.69000	9.66563	9.64030	9.61388
145 04 22	146 18 30	146 27 14	147 41 29	148 55 51	150 10 17	151 24 51	152 39 32	153 54 18	155 09 12	156 24 13	157 39 20
312 40 54	324 50 54	325 48 49	336 35 55	346 17 35	355 04 01	3 4 25	10 26 45	17 17 45	23 42 59	29 46 57	35 33 55
192 23 28	181 27 36	180 38 25	171 05 34	162 38 16	155 06 16	148 20 26	142 12 47	136 36 33	131 26 13	126 37 16	122 05 25
8.96118	8.94754	8.94577	8.93139	8.91628	8.90038	8.88363	8.86596	8.84728	8.82751	8.80654	8.78423
99575	99599	99537	99500	99462	99424	99385	99345	99304	99262	99220	99177
9.99818	9.99829	9.99830	9.99841	9.99852	9.99862	9.99873	9.99883	9.99892	9.99902	9.99911	9.99919
9.95693	9.94293	9.94114	9.92639	9.91090	9.89462	9.87748	9.85941	9.84032	9.82013	9.79874	9.77600
9.33160n	8.40618n	8.04824n	9.18987	9.47482	9.62424	9.72005	9.78727	9.83694	9.87488	9.90450	9.92799
.99393	.99368	.99367	.99347	.99314	.99286	.99258	.99228	.99156	.99164	.99131	.99096
9.98976n	9.99986n	9.99997n	9.99472n	9.97975n	9.95764n	9.93002n	9.89779n	9.86135n	9.82072n	9.77562n	9.72530n
9.98794	9.99815n	9.99827n	9.99314n	9.97827n	9.95626n	9.92875n	9.89662n	9.86027n	9.81974n	9.77473	9.72449n
.99816	.99829	99537	99500	99462	99424	99385	99345	99304	99262	99220	99177
9.36622	8.96417	8.94887	9.24616	9.48933	9.63056	9.72336	9.78921	9.83813	9.87564	9.90499	9.92831
.98612	.99644	.99364n	.98814n	.97289	.95050	.92260	.89007	.85331	.81236	.76653	.71626
+.96855	+.99152	+.98547	+.97307	+.93950	+.89229	+.83676	+.77638	+.71337	+.64918	+.58470	+.52081
2.1926	2.3178	+2.3291	2.4596	2.5901	2.7170	2.8378	2.9507	3.0545	3.1482	3.2316	3.3040
+1.18781	+1.22362	+1.21838	1.21903	+1.19851	+1.16395	+1.12054	1.07145	1.01882	.96400	.90786	.85071
.36440	9.96246	9.94424	.24116	.48395	.62480	.71721	.78266	.83117	.86826	.89719	.92008
1.07474	1.08764	1.08578	1.08602	1.07864	1.06595	1.04942	1.02997	1.00810	0.98408	.95802	.92908
9.28966	8.87482	~~9.94424~~ 8.85846	9.15514	9.40531	9.55885	9.66779	9.75269	9.82307	9.88418	9.93917	9.99030
1.08283	1.08886	1.08651	1.09041	1.09225	1.09271	1.09199	1.09029	1.08769	1.08432	1.08025	~~6580~~ 1.07550
			~~.03759~~	~~.03832~~	~~.03851~~	~~0.03877~~	~~.03755~~	~~.03651~~	~~.03515~~	~~.03352~~	~~.03160~~
8.91717	8.91114	8.91319	8.90969	8.90775	8.90729	8.90801	8.90991	8.91231	8.91568	8.91975	8.92480
6.75151	6.73342	~~8.96351~~ 6.73957	6.72877	6.72335	6.72187	6.72403	6.72913	6.73693	6.74704	6.75935	6.77350
9.00425	9.00461	9.00463	9.00500	9.00538	9.00576	9.00615	9.00655	9.00696	9.00738	9.00781	9.00823
7.01275	7.01383	7.01389	7.01500	7.01614	7.01728	7.01845	7.01965	7.02088	7.02214	00780 7.02340	7.02465
.0005643	.0005413	.0005490	.0005355	.0005289	.0005271	.0005297	.0005360	.0005457	.0005585	.0005746	.0005936
.10288	10324	.0010325	.0010352	.0010379	.0010406	.0010434	.0010463	.0010493	.0010523	.0010554	.0010585
		-.0004835	-.0004997	-.0005090	-.0005135	-.0005137	-.0005103	-.0005036	-.0004938	.0004808	-.0004649
-.0004655	-.0004911										
6.66792n	6.69117n	6.68440	6.69871n	6.70672	6.71054	6.71071	6.70783	6.70209	6.69355n	6.68196	6.66736
9.95693	9.94293n	9.94114n	9.92639n	9.91090n	9.89462n	9.87748n	9.85941n	9.84032n	9.82013	9.79874n	9.77600n
8.03788	8.04713										
8.03765n	8.04692n	8.03834n	8.03790n	8.03042n	8.01796n	8.00099n	7.98004n	7.95521n	7.92648n	7.89350n	7.85616n
6.66792	6.69117n	6.68440n	6.69871	6.70672	6.71054	6.71071n	6.70783	6.70209	6.69355	6.68196n	6.66736n
.32553n	9.39986n	9.04191n	18328	46796	61710	71263n	77955	82898n	86652n	89587n	91895n
8.40628n	7.50888	7.13911	8.29479n	8.58748n	8.74044n	8.88614n	8.90018n	8.94379n	8.97287n	8.99057n	8.99911n
84096	86508	36718	39086	41332	43408	45298	46992	48494	49806	50942	51904
6.75151	6.73342	6.73957	6.72877	6.72335	6.72187	6.72403	6.72913	6.73693	6.74704	6.75935	6.77350
7.09247	7.09850	7.10675	7.11963	7.13667	7.15595	7.17701	7.19905	7.22187	7.24510	7.26877	7.29254
6.66752	6.68117n	6.68440n	6.69871n	6.70672	6.71054	6.71071n	6.70783n	6.70209n	6.69355n	6.68196n	6.66736n
98369n	99354n	99364	98814	97289	95050n	92260	89007	85331	81236	76653	71626
7.65161n	7.68471	7.67804n	7.68685	7.67961	7.66104	7.63331n	7.59790	7.55540	7.50591	7.44889	7.38362
.0044836	.0048884	+.0012787	-.0013171	-.0013698	.0014320	.0015032	.0015814	.0016668	.0017584	.0018568	.0019613
-.0012373	-.0012546	+.0047648 -.0034861	.0048624	.0047821	.0045819	.0042984	.0039619	.0035925	.0032056	.0028112	.0024189
+.0032463	+.0035838	+.0034861	+.0035453	+.0034123	+.0031499	+.0027952	+.0023805	+.0019257	+.0014472	+.0009544	+.0004576
7.51139	7.55434	7.54233	7.54965	7.53305	7.49830	7.41641	7.37667	7.28459	7.16053	6.97973	6.66049
8.92442	8.96734	8.95573	8.96245	8.94585	8.91110	8.85921	8.78947	8.69739	8.57333	8.39253	8.07329

1876	Feb 19	Mar 30	May 9
☊	328 42 48	329 58 55	331 15 11
u	158 39 52	159 55 59	161 12 15
log sin u'	9.56090	9.53544	9.50812
log tang i'	9.59173	9.56264	9.53192
l tang λ'	9.58622	9.55913	9.52641
λ'	158 54 34	160 9 58	161 25 29
$☊+\omega'$	41 07 01	46 29 15	51 43 17
$\lambda'-(☊+\omega')$	117 47 33	113 40 43	109 42 12
l sin β'	8.76044	8.73498	8.70766
l r'	99183	99089	99044
l cos β'	9.99528	9.99936	9.99943
log $z' = r' \sin\beta'$	9.75177	9.72587	9.69810
l sin $(\lambda'-(☊+\omega'))$	9.94677	9.96181	9.97380
log $r' \cos\beta'$	.99061	.99025	.98987
l cos $(\lambda'-(☊+\omega'))$	9.66864 n	9.60380 n	9.52782 n
log cos γ' = cos b' cos l'	9.66792	9.60316	9.52725 n
log r'	99133	99089	99044
log sin γ'	9.94696	9.96193	9.97384
log $r' \cos\gamma'$	.65925 n	.59405	.51769 n
$2 r' \cos\gamma'$	+45630	+39269	+32938
r	3.36153	3.41153	3.4539
$r - r'\cos\gamma'$	79283	73422	67477
log $r' \sin\gamma'$	.93829	.95282	.96431
log $Q \cos l'$	.89918	.86583	.82916
log tang l'	.03911	.08699	.13515
log Q	.07013	.06417	.05760
log $\frac{1}{Q}$ =	8.92987 ~~.02943~~	8.93583 ~~.02702~~	8.94240 ~~.02432~~
log $\frac{1}{Q^2}$	~~9.97057~~	~~9.97298~~	~~9.97568~~
log $\frac{1}{Q^3}$	6.78961	6.80749	6.82720
l $\frac{1}{r'}$	9.00867	9.00911	9.00956
l $\frac{1}{r'^3}$	7.02601	7.02733	7.02866
$\frac{1}{Q^3}$	.0006160	.0006419	.0006717
$-\frac{1}{r'^3}$	−.0010617	−.0010650	−.0010683
Δ	−.0004457	−.0004231	−.0003966
log Δ	6.64904 n	6.62644 n	6.59835 n
log z'	9.75177	9.72587	9.69810
log $k W_0$	7.81361 n	7.76511 n	7.70925 n
log Δ	6.64904	6.62644 n	6.59835 n
log y'	93738 n	95206 n	96367 n
log S_0	8.99922 n	8.99130 n	8.97482 n
log z	52702	53342	53834
log $\frac{1}{Q^3}$	6.78961	6.80749	6.82720
log $\frac{z}{Q^3}$	7.31663	7.34091	7.36554
log Δ	6.64904 n	6.62644 n	6.59835 n
log x'	65925 n	59405 n	51769 n
log $\Delta x'$	7.30829	7.22049	7.11604
$\Delta x'$	+.0020337	+.0016615	+.0013063
$-\frac{z}{Q^3}$	−.0020731	−.0021923	−.0023200
$\Delta x' - \frac{z}{Q^3}$	−.0000394	−.0005308	~~.0010017~~ −.0010138
log ∂_0	5.59550 n	6.72493 n	7.00595 n
log R_0	7.00830 n	8.13773 n	8.41875 n

4

	1873 Sept. 18	Oct 28	Dec 7	1874 Jan 16	Feb 25	Apr 6	May 16	Jun 25	Aug 4	Sept 13
di −2 e cos u W₀	+.114	+.100	+.066	+.035	+.005	−.019	−.031	−.030	−.018	−.010
dΩ = 2R sin u W₀	−.462	−.430	−.183	−.036	+.004	−.053	−.177	−.316	−.404	−.378
(3) R₀ sin v	−3.513 +1	−3.663	−3.561	−3.117	−2.314	−1.289	−.366	+.039	−.271	−1.123
(3) (cos v + cos E) S₀	+.287	+.604	+.404	−.430	−1.879	−3.658	−5.155	−5.675	−4.917	−3.112
dφ	−3.229	−3.059	−3.157	−3.548	−4.194	−4.949	−5.528	−5.636	−5.190	−4.237
−(4) cos v R₀	+.833	−1.248	−3.611	−5.868	−7.350	−7.288	−5.188	−1.569	+2.181	+4.609
(+5) (p+1) sin v S₀	−11.843	−8.584	−2.752	+1.527	+5.053	+5.720	+3.268	−1.283	−5.454	−6.604
(6) 2 sin u W₀	−.068	−4	−2	−0	+0	−0	−2	−3	−4	−4
dπ	−11.018	−8.808	−6.366	−4.042	−2.298	−1.578	−1.918	−2.856	−3.270	−1.999
(−7) sin v R₀	+.5136	+.5354	+.5204	+.4568	+.3385	+.1886	+.0535	−.0057	+.0398	+.1640
−(8) ½ S₀	−.8797	−.6100	−.2516	+.2003	+.7243	+1.2529	+1.6588	+1.8101	+1.6246	+1.1287
dμ	−.3661	−.0746	+.2687	+.6561	+1.0626	+1.4412	+1.7123	+1.8044	+1.6644	+1.2930
(−9) cos v R₀	+.038	−.057	−.166	−.269	−.338	−.238 −.334	−.072 .238	+.100 −.072	+.212 +.100	+.234 +.212
(−10) 2 R₀	−6.562	−6.501	−6.238	−5.723	−4.911	−3.790	−2.348	−.692	+1.041	+2.696
(+11) (p+1) sin 2v S₀	−.548	−.346	−.126	+.084	+.231	+.263	+.150	−.059	−.250	−.302
(+6) 2 sin u W₀	−.008	−.004	−.000	−.000	−.00	−.00	−.002	−.003	−.004	−.004
dL	−7.074	−6.914	−6.530	−5.908	−5.018	−3.862	−2.438	−.826	+.889	+2.602
(+12) cos 2v R₀	−.791	+1.185	+3.431	+5.575	+6.982	+6.924	+4.923	+1.491	−2.072	−4.378
(−10) 2 R₀	−6.562	−6.501	−6.238	−5.723	−4.911	−3.790	−2.348	−.692	+1.041	+2.696
(−13) (p/2+1) sin 2v S₀	+11.254	+7.182	+2.616	−1.736	−4.802	−5.436	−3.105	+1.219	+5.183	+6.276
dM.	+3.900	+1.865								
+(12) cos 2v R₀	−.795	+1.191	+3.447	+5.601	+7.015	+6.957	+4.947	+1.498	−2.082	−4.399
(−10) 2 R₀	−6.562	−6.501	−6.238	−5.723	−4.911	−3.750	−2.348	−.652	+1.041	+2.696
(13) (p/2+1) 2 sin 2v S₀	+11.295	+7.208	+2.625	−1.743	−4.820	−5.455	−3.116	+1.223	+5.202	+6.299
	+3.938	+1 +1.898	−.166	−1.865	−2.716	−2.288	−.517	+2.029	+4.161	+4.596

	1875 Jan 15	Feb. 24	Apr 5	May 15	Jun 24	Aug 3	Sept 12	Oct 22	Dec 1	1876 Jan 10	Feb. 19
di	−.097	−.255	−.522	−.927	−1.502	−2.273	−3.261	−4.473	−5.903	−7.513	−9.238
dΩ	+.810	+1.452	+2.054	+2.423	+2.297	+1.339	−0.869	−4.808	−11.002	−19.965	−32.123
(3)	−3106	−2822	−2095	−1022	+0.280	+1.708	+3.155	+4.526	+5.710	6.565 ~~+14.323~~	+7.018 ~~+9223~~
(3)	+1.611	+1.242	−.280	−2.887	−6.465	−10.872	−15.989	−21.450	−27.164	−32.741	−37.801
dφ	~~.505~~ −1.495	−1.580	−2.375	−3.909	−6.185	−9.164	−12.784	−16.924	−21.454	~~−22.418~~ −26.176	~~−28.578~~ −30.783
−(4)	+.1819	−.062	−.1190	−.1116	+.0454	+.3712	+.8788	+15.782	+24.714	+35.401	+47.875
+(5)	+15.543	+27.795	+40.415	+52.451	+63.125	+71.824	+78.028	+81.231	+81.117	+77.331	+69.827
+(6)	+.008	+.014	+.020	+.024	+.020	+.013	−.008	−.047	−.108	−.197	−.316
dπ	+17.390	+29.757	+39.255	+51.369	+63.609	+75.566	+86.818	+96.996	+105.733	+112.595	+117.396
−(7)	+.4537	+.4123	+.3060	+.1494	−.0409	−.2495	−.4609	−.6612	−.8341	−.9591	−1.0252
−(8)	−1.3074	−2.1212	−2.8978	−3.6388	−4.3461	−5.0247	−5.6752	−6.2892	−6.8584	−7.3567	−7.7568
dμ	−.8537	−1.7089	−2.5918	−3.4894	−4.3870	−5.2742	−6.1361	−6.9504	−7.6925	−8.3158	−8.7820
−(9)	+.083	−.003	−.054	−.051	+.021	+.170	+.402	+.721	+1.129	+1.617	+2.187
−(10)	+5.470	+5.151	+4.089	+2.178	−.662	−4.523	−9.490	−15.673	−23.062	−31.587	−41.336
+(11)	+.710	+1.270	+1.847	+2.397	+2.885	+3.282	+3.566	+3.712	+3.707	+3.534	+3.191
+(6)	+8	+14	+20	+24	+20	+13	−8	−47	−108	−197	−316
dL	+6.271	+6.432	+5.902	+4.548	+2.264	−1.058	−5.530	−11.287	−18.334	−26.633	−36.274
+(12)	−1.735	+.059	+1.136	+1.065	−.433	−3.543	−8.387	−15.061	−23.584	−33.782	−45.687
−(10)	+5.470	+5.151	+4.089	+2.178	−.662	−4.523	−9.450	−15.673	−23.062	−31.587	−41.336
+(3)	+14.825	+26.529	+38.575	+50.063	+60.250	+68.550	+74.475	+77.532	+77.423	+73.810	+66.648
dM	~~+18.860~~	~~+31.239~~	~~+43.800~~	~~+53.306~~	~~+59.455~~	~~+60.444~~	~~+56.598~~	~~+46.748~~	~~+30.777~~	~~+8.441~~	~~−20.375~~
dM	−11.090	−21.319	−33.350	−46.820	−61.345	−76.616	−92.382	−108.266	−124.069	−139.179	−153.671

1875

Oct 23	Dec 2	Jan 11
-.005	-.015	-.088
-.170	+.210	+.158
-.2108	-.2889	-.3104
-.980	+.755	+1.600
-3.089	-2.085	-1.505
+5.081	+3.948	-1.996
-3.367	+4.086	+14.593
2	+ 2 +	9
+1.722	+8.036	+16.596
+.3089	+.4151	+.4599
+.4134	-.4037	-1.2416
+.7216	+.0114	-.7829
+.181 .234	+.181	+.091
+4.079	+5.038	+5.446
-.155	+.188	+.669
-.002	+.002	+.009
+4.155	+5.406	+6.214
-4.836	-3.701	-1.895
+4.079	+5.038	+5.446
+3.200	-3.882	+3.867
-4.859	-3.869	-1.904
+4.079	+5.038	+1.445
+3.212	-3.897	-13.918
+2.432	-2.628	-10.397

Ma 30 May 18

-10.971

-47.700

+6.934
+7.699
41.886
~~34187~~
-34952
+61.795
+58.780
-470
120.125

7.0130
-8.0185
-9.0315

+2823
-52092
+2687
-470

-47052

-58.970
-52.092
+56.113

-54.949

-167.175

l_2	Sept 11	Oct 28	Dec 7	Jan 16	Feb 25	Apr 6	May 16	Jun 25	Aug 4	Sept 13
di	+.067	+.057	+.043	+.028	+.014	+.003	−.003	−.005	−.004	−.000
dΩ (2) small	−.448	−.261	−.119	−.029	+.010	+.009	−.021	−.064	−.104	−.134
(3) [illegible]	−.365	−.229	−.090	+.019	+.072	+.065	+.024	−.004	+.011	+.067
(3) ([illegible]) δ₀	−.042	−.152	−.249	−.283	−.219	−.067	+.121	+.266	+.309	+.259
dφ	−.407	−.381	−.339	−.264	−.147	−.002	+.145 +.146	+.262	+.320	+.326
(−4) cos 2 R₀	+.087	−.078	−.091	+.036	+.228	+.367	+.348	+.161	−.089	−.275
(+5) (p+1)² sin 2δ₀	+1.754	+1.907	+1.698	+1.199	+.588	+.405	−.076	+.060	+.343	+.548
(6) sin ω₀	0									
dπ	+1.841	+1.829	+1.607	+1.235	+.811	+.472	+.272	+.221	+.254	+.273
(−7) sin 2 R₀	+.0534	+.0335	+.0132	−.0028	−.0105	−.0095	−.0036	+.0005	−.0016	−.0098
(+8) 1 80	+.1301	+.1540	+.1554	+.1316	+.0844	+.0231	−.0388	−.0848	−.1022	−.0936
dμ	+.1835	+.1875	+.1686	+.1288	+.0739	+.0136	−.0424	−.0843	−.1038	−.1034
(+9) cos 2 R₀	+.004	−.003	−.004	+.002	+.011	+.017	+.016	+.007	−.004	−.013
(−10) 2 R₀	−.682	−.406	−.158	+.035	+.153	+.191	+.158	+.071	−.043	−.161
(+11) (p+1) 2 sin 2δ₀	+.081	+.087	+.078	+.055	+.027	+.005	−.004	+.003	+.016	+.025
(6) 2 sin ω₀	~~+.367~~	~~+.490~~	~~+.232~~	~~+.022~~	~~−.115~~	~~−.268~~	~~−.156~~	~~−.061~~	~~+.055~~	~~+.173~~
dL	−.597	−.322	−.084	+.092	+.191	+.213	+.170	+.081	+.031	−.149 .523
(+12) cos 2 R₀	−.083	+.074	+.087	−.034	−.218	−.350	−.332	−.154	+.085	+.262
(−10) 2 R₀	−.682	−.406	−.158	+.035	+.153	+.191	+.158	+.071	−.043	−.161
(+13) (p+1) 2 sin 2δ₀	−1.675	−1.818	−1.621	−1.145	−.561	−.101	+.073	−.057	−.327	−[illegible]
	−2.440	−2.150	−1.692	−1.144	−.626	−.260	−.101	−.140	−.285	−.422

	1875 Jan 15	Feb 24	Apr 5	May 15	June 24	Aug 3	Sept 12	Oct 22	Dec 1	1876 Jan 10	Feb 19
di	+.017	+.021	+.024	+.027	+.028	+.028	+.027	+.026	+.024	+.022	+.020
dΩ	−.138	−.119	−.046	−.069	−.043	−.017	−.007	+.028	+.046	+.059	+.068
(3)	+.229	+.236	+.223	+.198	+.166	+.131	+.097	+.065	+.038	+.015	−.001
(3)	+.002	−.014	+.004	+.050	+.111	+.180	+.249	+.314	+.370	+.415	+.446
dφ	+.231	+.222	+.227	+.248	+.277	+.311	+.346	+.379	+.408	+.430	+.445
−(4)	−.134	+.005	+.127	+.216	+.269	+.285	+.269	+.227	+.163	+.084	−.008
+(5)	+.022	−.324	−.643	−.901	−1.083	−1.188	−1.221	−1.190	−1.106	−.980	−.824
+(6)	−.001	−.001	−.001	−.001	−.000	−.000	−.000	−.000	+.000	+.000	+.001
d_π	−.113	−.319	−.517	−.686	−.814	−.903	−.952	−.963	−.943	−.896	~~−.748~~ −.831 ~~−.899~~
−(7)	−.0334	−.0345	−.0326	−.0290	−.0242	−.0191	−.0141	−.0095	−.0055	−.0023	+.0002
−(8)	−.0018	+.0247	+.0461	+.0625	+.0746	+.0832	+.0888	+.0921	+.0934	+.0932	+.0915
dμ	−.0352	−.0098	+.0135	+.0335	+.0504	+.0641	+.0747	+.0826	+.0879	+.0909	+.0917
−(9)	−.006	+.000	+.005	+.009	+.012	+.013	+.012	+.010	+.007	+.004	−.000
−(10)	−.401	−.431	−.436	−.423	−.392	−.347	−.291	−.225	−.152	−.075	+.066
+(11)	+.001	−.015	−.029	−.041	−.049	−.054	−.056	−.055	−.050	−.045	−.038
+(6)	−.001	−.001	−.001	−.001	.000	.000	.000	.000	.000	.000	+.001
dL	−.406	−.447	−.461	−.456	−.429	−.389	−.335	−.270	−.195	−.116	+.029 ✓
+(12)	+.128	−.005	−.121	−.206	−.256	−.272	−.257	−.216	−.156	−.080	+.007
−(10)	−.401	−.431	−.436	−.423	−.392	−.347	−.291	−.225	−.152	−.075	+.006
−(13)	−.021	+.309	+.614	+.860	+1.034	~~+1.134~~ 1.133	~~+1.055~~ +1.165	~~+.938~~ +1.135	~~+.767~~ 1.055	~~+.620~~ +.934	+.787
dM	~~−.294~~ −.294	−.127	+.057	+.231	+.386	+.514	+.617	+.694	+.747	+.779	+.800

1875

Oct 28	Dec 2	Jan 11
+.005	+.010	+.016
-.150	-.152	-.142
+.138	+.198	+.234
+.161	+.067	+.000
+.278	+.265	+.235
-.334	-.275	-.150
+.554	+.363	+.050
+.220	+.088	-.100
-.0202	-.0289	-.0342
-.0681	-.0359	-.0042
-.0883	-.0648	-.0384
-.015	-.010	-.007
+.268	+.351	+.410
+.025	+.017	+.002
+.278	+.358	+.405
-.263	-.341	-.415
+.319	+.263	+.140
+.266	+.357	+.410
-.328	-.346	-.048
-.478	-.434	-.318

Mar 30	May 19
+.017	+.019
+.074	+.075
-.015	-.025
+.463	+.464
+.448	+.439
-.109	-.209
-.650	-.467
+.001	+.001
-.758	-.675
+.0017	+.0025
+.0886	+.0843
+.0903	+.0868
-.005	-.009
+.090	+.173
-.030	-.021
+.001	+.001
+.056	+.144
+.101	+.199
+.090	+.173
+.620	+.445
+.811	+.817

	$\frac{\omega^2 du}{dT^2}$	$'f$	$''f$	di	$'f$	$d\Omega$	$'f$	$d\varphi$	$'f$	$d\pi$	$'f$
1873		-13.3654	+157.4993		-12.967		-133.411		-235.555		~~-235.555~~
Sept. 18	-.3661		K 144.1339	+.114		-.762		-3.227		-11.018	-273.759
		-13.7315			-12.853		-134.173		-238.782		-284.277
Oct 28	-.0746		+130.4024	+.100		-.430		-3.059		-8.807	
		-13.8061			-12.753		-134.603		-241.841		-293.584
Dec 7	+.2687		+116.5963	+.066		-.183		-3.157		-6.366	
		-13.5374			-12.687		-134.786		-244.998		-299.950
1874 Jan 16	+.6561		+103.0589	+.035		-.036		-3.548		-4.042	
		-12.8813			-12.652		-134.822		-248.546		-303.992
Feb 25	+1.0626		+90.1776	+.005		+.004		-4.194		-2.298	
		-11.8187			-12.647		-134.818		-252.740		-306.290
Apr 6	+1.4412		+78.3589	-.019		-.053		-4.949		-1.570	
		-10.3775			-12.666		-134.871		-257.689		-307.860
May 16	+1.7123		+67.9814	-.031		-.177		-5.523		-1.918	
		-8.6652			-12.697		-135.048		-263.212		-309.778
June 25	+1.8044		+59.3162	-.030		-.316		-5.638		-2.856	
		-6.8608			-12.727		-135.364		-268.850		-312.634
Aug 4	+1.6644		+52.4554	-.018		-.404		-5.180		-3.277	
		-5.1964			-12.745		-135.768		-274.040		-315.911
Sept 13	+1.2930		+47.2590	-.010		-.378		-4.237		-1.999	
		-3.9034			-12.755		-136.146		-278.277		-317.910
Oct 23	+.7216		+43.3556	-.005		-.175		-3.089		+1.722	
		-3.1818			-12.760		-136.321		-281.366		-316.188
Dec 2	+.0114		+40.1738	-.015		+.210		-2.085		+8.036	
1875		-3.1704			-12.775		-136.111		-283.451		-308.152
Jan 11	-.7879		+37.0034	-.088		+.758		-1.500		+16.597	
		-3.9583			-12.863		-135.353		-284.956		~~-299.555~~ -291.555
Feb. 20			+33.0451								

		$'f$	$''f$	di	$'f$	$d\Omega$	$'f$	$d\varphi$	$'f$	$d\pi$	$'f$
1875 a-1 Jan 15	-.8537		~~-.0356~~ -.0356	-.097		+.810		-1.495		+17.370	
		+.0356			+.007		-.027		+.004		-.433
a Feb. 24	-1.7089		.0000 ~~-1.6733~~	-.255		+1.452		-1.580		+27.757	
		-1.6733	~~-1.6733~~		-.248		+1.425		-1.576		+27.324
a+1 Apr. 5	-2.5918		-1.6733	-.522		+2.054		-2.375		+39.255	
		-4.3651			-.770		+3.479		-3.951		+66.579
May 15	-3.4894		-6.0384	-.927		+2.423		-3.909		+51.369	
		-7.8545			-1.697		+5.902		-7.860		+117.948
June 24	-4.3870		-13.8929	-1.502		+2.297		-6.185		+63.609	
		-12.2415			-3.199		+8.199		-14.045		+181.557
Aug 3	-5.2742		-26.1344	-2.273		+1.339		-9.164		+75.556	
		-17.5157			-5.472		+9.538		-23.209		+257.113
Sept 12	-6.1361		-43.6501	-3.261		-0.869		-12.784		+86.818	
		-23.6518			-8.733		+8.669		-35.993		+343.931
Oct 22	-6.9504		-67.3019	-4.473		-4.808		-16.924		+96.976	
		-30.6022			-13.206		+3.861		-52.917		+440.907
Dec 1	-7.6925		-97.9041	-5.903		-11.002		-21.454		+105.733	
		-38.2947			-19.109		-7.141		-74.371		+546.640
1876 Jan 10	-8.3158		-136.1988	-7.573		-19.965		-26.176		+112.545	
		-46.6105			-26.622		-27.106		-100.547		+659.185
Feb 19	-8.7820		-182.8093	-9.238		-32.123		-30.783		+117.396	
		-55.3925			-35.860		-59.229		-131.330		+776.581
Mar 30	-9.0315		-238.1018	-10.971		-47.700		-34.952		+120.125	
		-64.4240			-46.831		-106.929		-166.282		+896.706
May 9	-9.0		-302.5258	-12.7		66 -66.6		-38.7		+120.7	
		-73.7									

Integration for Apr. 19 1876

	$\iint\frac{\omega^2 du}{dT^2}$	~~$\iint$~~ $\int du$	$\int di$		$\int d\Omega$	$\int d\varphi$	$\int d\pi$
		-64.4240					
	-270.3138	~~-102.3750~~	-46.831		-106.929	~~+~~-166.282	+896.706
$+\frac{1}{12}''$	+.3754	-.0092	-.072	$+\frac{1}{24}'$	-.719	-.165	+.067
	-269.9384	-64.4332	-46.903		-107.648	-166.447	+896.773
	+2.5797	+.6686	+.264		-.077	+3.755	-8.573
	-267.3587	-63.7646	-46.639		-107.725	-162.692	+888.200
		-1.594115	-46.64		-1′ 47.72″	-2′ 42.69″	+14′ 48.20″

Integration for Jan 31.5 1879

dL	f	dM	f	
	-53.667		+220.088	
-7.074		+3.938		
	-60.741		+224.026	
-6.914		+1.898		
	-67.655		+225.924	
-6.533		-.166		
	-74.188		+225.758	
-5.908		-1.865		
	-80.096		+223.893	
-5.018		-2.716		
	-85.114		+221.177	
-3.862		-2.288		
	-88.976		+218.889	
-2.438		-.517		
	-91.414		+218.372	
-.826		+2.029		
	-92.240		+220.401	
+.887		+4.161		
	-91.353		+224.562	
+2.602		+4.596		
	-88.751		+229.158	+49.49
+4.158		+2.432		
	-84.593		+231.590	
+5.409		-2.628		
	-79.184		+228.962	+0.46
+6.214		-10.377		
	-72.970		+218.585	
+6.271		-11.090		
	-.007		+.426	+50.24
+6.432		-21.319		
	+6.425		-21.745	-20.893
+5.902		-33.350		
	+12.327		-55.095	-54.243
+4.548		-46.820		
	+16.875		-101.915	-101.063
+2.264		-61.345		
	+19.139		-163.260	-162.408
-1.058		-76.616		
	+18.081		-239.876	-239.024
-5.530		-92.362		
	+12.551		-332.238	-331.386
-11.287		-108.266		
	+1.264		-440.504	-439.652
-18.334		-124.069		
	-17.070		-564.573	-563.721
-26.633		-139.179		
	-43.703		-703.752	-702.900
-36.274		-153.675		
	-79.977		-857.427	-856.575
-47.052		-167.175		
	-127.029		-1034.602	1023.750
-59.0		-179.7		

1879 Oct 31.5 B.M.T.

M 344° 01′ 20.18″ +3′ 38.26″ +3.50″ −4.91″ +14.09″ + 60° 22′ 55.45″

Ω 4 56 5.99 − 2′ 15.35″ −19.14 ~~−19.14~~ + 4′ 56.94″

ω 51 04 48.46 −2′ 35.85″ +14.40 +4.50

i 8 02 58.43 −12.86″ −.03 +2.76

φ 17 28 9.23 −4 44.94 −13.00

μ 802.00077 −.09986 +.00157

log μ .4305544

1880 ~~Dec 31.5~~ Jan. 31.5

M 44° 28′ 38.14″ ~~48 55 58.16~~ 51 23 00.16

Ω 4 58 28.44 }

ω 51 02 21.57 } Mean eq. 1875.0

i 8 2 48.30 }

φ 17 23 11.79

μ 801.90242 log 2.904121 3

~~3.55~~

~~.6458147~~ 6458853

~~2152911~~ 2152951

~~4305822~~ 4305902

π 56 00 59.95

L 107 24 00.11

∫ dL

−127.029
− ~~474~~
−127.503
−3.009
−130.512

∫ dM

−1023.750
− .542
−1024.292
+ 5.561
−1018.731
−267.359
−1286.090
−21° 26.09
+ 2.58
21 23.51

	$\omega^2\frac{du}{dt^2}$	$\int$	$\int\int$	$\frac{di}{dt}$	$\int$	$\frac{d\Omega}{dt}$	$\int$	$\frac{d\varphi}{dt}$	$\int$	$d\pi$	$\int$
1873		-.1655			-.262		-17.533		-13.320		-13.773
Sep. 18	+.1835		+9.5034	+.067		-.448		-.407		+1.841	
		+.0180			-.195		-17.981		-13.727		-11.932
Oct 28	+.1575		+9.9214	+.057		-.261		-.382		+1.829	
		+.2055			-.138		-18.242		-14.109		-10.103
Dec 7	+.1686		+10.1269	+.043		-.119		-.339		+1.607	
		+.3741			-.095		-18.361		-14.448		-8.496
Jan 16	+.1288		+10.5010	+.028		-.029		-.264		+1.235	
		+.5029			-.067		-18.390		-14.712		-7.261
Feb 25	+.0739		+11.0039	+.014		+.010		-.147	~~14859~~	+.811	
		+.5768			-.053		-18.380		-14859		-6450
Apr 6	+.0136		+11.5807	+.003		+.009		-.002	~~14861~~	+.472	
		+.5904			-.050		-18.371		-14.861		-5.978
May 16	-.0424		+12.1711	-.003		-.021		+.145		+.272	
		+.5480			-.053		-18.392		-14.716		-5.706
Jun 25	-.0843		+12.7191	-.005		-.064		+.262		+.221	
		+.4637			-.058		-18.456		-14.454		-5.485
Aug 4	-.1038		+13.1828	-.004		-.104		+.320		+.254	
		+.3599			-.062		-18.560		-14.134		-5.231
Sept 13	-.1034		+13.5427	-.000		-.134		+.326		+.273	
		+.2565			-.062		-18.694		-13.808		-4.958
Oct 23	-.0883		+13.7992	+.005		-.150		+.299		+.220	
		+.1685			-.057		-18.844		-13.509		-4.738
Dec 2	-.0688		+13.9677	+.010		-.152		+.265		+.088	
		+.0987			-.047		-18.996		-13.244		-4.650
1875 Jan 11	-.0394		+14.0664	+.016		-.142		+.239		-.100	
		+.0593			-.031		-19.138		-13.005		-4.750
			+14.1257								

Epoch = Feb 4 1875

1875											
Jan 15	-.0352		-.0088	+.017		-.138		+.231		-.113	
		-.0111			.000		-.001		+.000		+.009
Feb 24	-.0098		-.0099	+.021		-.119		+.222		-.319	
		-.0109			+.021		-.120		+.222		-.310
Apr 5	+.0135		-.0208	+.024		-.096		+.227		-.517	
		+.0026			+.045		-.216		+.449		-.827
May 15	+.0335		-.0182	+.027		-.069		+.248		-.686	
		+.0361			+.072		-.285		+.697		-1.513
June 24	+.0504		+.0179	+.028		-.043		+.277		-.814	
		+.0865			+.100		-.328		+.974		-2.327
Aug 3	+.0641		+.1044	+.028		-.017		+.311		-.903	
		+.1506			+.128		-.345		+1.285		-3.230
Sept 12	+.0747		+.2550	+.027		-.007		+.346		-.952	
		+.2253			+.155		-.352		+1.631		-4.182
Oct 22	+.0826		+.4803	+.026		+.028		+.379		-.963	
		+.3079			+.181		-.324		+2.010		-5.145
Dec 1	+.0879		+.7882	+.024		+.046		+.408		-.943	
		+.3958			+.205		-.278		+2.418		-6.088
1876 Jan 10	+.0909		+1.1840	+.022		+.059		+.430		-.896	
		+.4867			+.227		-.219		+2.848		-6.984
Feb 19	+.0917		+1.6707	+.020		+.068		+.445		-.831	
		+.5784			+.247		-.151		+3.293		-7.815
Mar 30	+.0903		+2.2491	+.017		+.074		+.462		-.758	
		+.6688			+.264		-.077		+3.755		-8.573
May 9	+.0868		+2.9178	+.014		+.075		+.462		-.675	
		+.7555			+.278		-.002		+4.217		-9.248
			+3.6733								

$\int\int\frac{d^2u}{dt^2}dt^2$	$\int du$	$\int di$	$\int d\Omega$	$\int d\varphi$	$\int d\pi$
+2.5834 -.0037	+.6687 -.0001	+.264 .000	-.077 .000	+3.755 .000	-8.573 +.003
+2.5797	+.6686	+.264	-.077	+3.755	-8.573

$d\mathcal{L}$	$\int$	dM	$\int$
	-8.187		+6.581
-.597		-2.440	
	-8.784		+3.141
-.322		-2.150	
	-9.106		+0.991
-.084		-1.692	
	-9.190		-0.701
+.092		-1.144	
	-9.098		-1.845
+.191		-.626	
	-8.907		-2.971
+.213		-.260	
	-8.694		-2.731
+.170		-.101	
	-8.524		-2.833
+.081		-.140	
	-8.443		-2.973
-.031		-.285	
	-8.474		-3.258
-.149		-.422	
	-8.623		-3.680
-.263		-.478	
	-8.886		-4.158
-.341		-.434	
	-9.227		-4.592
-.415		-.318	
	-9.642		-4.910

-.406		-.294	
	+.002		-.007
-.447		-.127	
	-.445		-.134
-.461		+.057	
	-.906		-.077
-.456		+.231	
	-1.362		+.154
-.429		+.386	
	-1.791		+.540
-.389		+.514	
	-2.180		+1.054
-.335		+.617	
	-2.515		+1.671
-.270		+.694	
	-2.785		+2.365
-.195		+.747	
	-2.980		+3.112
-.116		+.779	
	-3.096		+3.891
+.029		+.860	
	-3.067		+4.751
+.056		+.811	
	-3.011		+5.562
+.144		+.817	
	-2.867		+6.379

$\int d\mathcal{L}$	$\int dM$
-3.011	+5.562
+.002	-.001
-3.009	+5.561
	~~2.578~~
	~~+8.139~~

Elements for new Epoch of perturbations

Epoch. Feb. 4.5 1875

M Eq. 1875.0

M = 52° 16′ 27″.77 − 2′ 26″.09 + ~~2.58~~
Ω = 4 58 28.44 − 1 47.72 + 49″.49
ω = 51 02 31.57 + 16 35.92 + 0.75
i = 8 2 48.30 − 46.64 + 0.46
φ = 17 23 11.79 − 2 42.69
μ = 801.80242 − 1.59411
π = 56 00 59.95 + 14 48.20 + 50.24
ℒ = 107 24 0.17
log a = .4305822

Integration for Ap. 19.5 1876

Mean Eq. 1876.0

(~~+2″.28~~)
M 51° 55′ 1″.68 + 98° 00′ 37″.06 = 149° 55′ 38″.74
Ω 4 57 30.21
ω 51 19 8.18
i 8 2 21.2
φ 17 20 29.10
μ 800.30831
π 56 16 38.39

log 2.9032543
3.5500066
.6467493
2155831
log a .4311662

1874 Yearly ephemeris

	Jan 0	20	Feb 9	Mar 1	21	Apr 10	May 0	20	Jun 9	Jun 29	Jul 19
M	323 04 29 326 38 16	327 31 42	331 58 55	336 26 08	340 53 21	345 20 34	349 47 47	354 15 00	358 42 13	3 09 26	7 36 39
E	309 56 13	315 31 23	321 15 34	327 08 18	333 09 03	339 16 57	345 30 32	351 48 32	358 09 02	4 30 07	10 49 50
	9.88465	9.84548	9.79643	9.734 8	9.65480	9.54874	9.39834	9.15374	8.50884	8.89483	9.27394
	4.79017	4.79017	4.79017	4.79017	4.79017	4.79017	4.79017	4.79017	4.79017	4.79017	4.79017
	4.67482	4.63565	4.58660	4.52465	4.44497	4.33891	4.18851	3.94391	3.29901	3.68500	4.06411
	-43 08 16	12 0 17	10 43 27	3 17 56	-7 44 19	-6 03 43	-4 17 15	-2 26 28	-0 33 11	+1 20 42	+3 13 11
E	309 56 13	315 31 25	321 15 34	327 08 18	333 09 02	339 16 51	345 30 32	351 48 32	358 09 02	4 30 08	10 49 50
½ E	154 58 06	157 45 42	160 37 47	163 34 09	166 34 31	169 38 2	172 45 16	175 54 16	179 04 31	2 15 04	5 24 55
sin ½ E	9.62646	9.57802	9.52071	9.45157	9.36580	9.25487	9.10079	8.85582	8.20786	8.59416	8.97485
cos ½ E	9.95716	9.96643	9.97469	9.98189	9.98797	9.99286	9.99652	9.99889	9.99995	9.99966	9.99806
	9.89861	9.85017	9.79286	9.72372	9.63795	9.52702	9.37294	9.12597	8.48001	8.86631	9.24700
	.09534	.10461	.11287	.12007	.12615	.13104	.13470	.13707	.13813	.13784	.13624
tan ½ v	9.80327	9.74536	9.67999	9.60365	9.51180	9.39598	9.23824	8.98890	8.24188	8.72847	9.11076
½ v	32 26 44	29 06 05	25 34 36	21 52 26	18 02 04	13 58 32	9 49 10	5 34 03	1 0 00	3 03 48	7 21 12
½ v	147 33 16	150 53 55	154 25 24	158 07 34	161 59 56	166 01 28	170 10 50	174 25 57	357 25 58	6 7 36	14 42 24
v	295 06 32	301 47 50	308 50 48	316 15 08	323 59 52	332 02 56	340 21 40	348 51 54	358 00 00		
log r	.16905	.16322	.15766	.15242	.14795	.14409	.14111	.13912	.13822	.13846	.13983
	.33810	.32644	.31522	.30494	.29590	.28818	.28222	.27824	.27648	.27692	.27966
v+ω+α	81 03 11	87 44 29	94 47 27	102 11 47	109 56 31	117 59 35	126 18 19	134 48 33	143 25 37	152 04 15	160 39 03
v+ω+ω'	351 28 35	358 09 53	5 12 51	12 37 11	20 21 55	28 24 59	36 43 43	45 13 57	53 51 01	62 29 39	71 04 27
v+ω'	349 55 23	356 36 41	3 39 39	11 03 59	18 48 43	26 57 47	35 10 31	43 40 45	52 17 49	60 56 27	69 31 15
log r a	9.99468	9.99566	9.99848	9.99009	9.97315	9.94596	9.90627	9.85073	9.77513	9.67060	9.52025
	.33807	.32641	.31519	.30491	.29587	.28815	.28219	.27821	.27645	.27689	.27963
log r b	9.17080	8.50550	8.95846	9.33941	9.54198	9.67750	9.77672	9.85124	9.90713	9.94791	9.97586
	.26985	.25784	.24612	.23564	.22680	.21908	.21312	.20914	.20738	.20762	.21066
log r c	9.24297	8.77147	8.80516	9.28318	9.50847	9.65500	9.76048	9.83927	9.89828	9.94157	9.97165
	.05593	.04427	.03305	.02297	.01373	.00601	.00005	9.99607	9.99431	9.99475	9.99749
x	+2.1516	+2.1187	+2.0591	+1.9724	+1.8579	+1.7144	+1.5434	1.3463	1.1261	.8861	.6308
X	+.1695	+.4966	.7626	+.9359	+.9968	+.9396	+.7731	+.5181	+.2045	-.1322	-.4541
x'	+2.3211	2.6163	2.8217	2.9083	2.8547	2.6540	2.3165	1.8644	1.3306	.7539	+.1767
y	-.2754	-.0579	+.1602	+.3761	+.5867	+.7881	+.9768	+1.1498	+1.3017	+1.4308	+1.5366
Y	-.8885	-.7795	-.5749	-.3000	+.0110	+.3207	+.5932	+.7980	+.9125	+.9248	+.8339
y'	-1.1639	-.8374	-.4147	+.0761	+.6252 .5977	1.1088	+1.5701	+1.9478	+2.2142	+2.3561	+2.3700
z	-.1990	-.0654	+.0689	+.2022	+.3328	+.4582	+.5762	+.6844	+.7809	+.8636	+.9314
Z	-.3855	-.3382	-.2494	-.1302	+.0048	+.1391	+.2574	+.3462	+.3959	+.4012	+.3618
z'	-.5845	-.4036	-.1805	+.0720	+.3376	+.5973	+.8336	~~+1.0629~~ 1.0306	+1.1768	+1.2648	+1.2932
log a cos δ cos α	36569	41752	45051	46364	45556	42390	.36483	.27054	.12405	9.87731	9.24724
log a cos δ sin α	.06594	9.92293	9.61778	8.88138	9.79602	0.04489	.19590	.28947	.34529	.37216	.37496
log tg α	9.70022	9.50591	9.16742	8.41994	9.34096	9.62095	9.83187	.01898	.22119	.49488	1.12752
α	-26 37 59	-17 45 16	-8 21 54	+1 29 56		22 40 28	34 08 01	46 18 06	68 59 44	92 15 24	85 44 10
α	333 22 08	342 14 44	351 38 06		11 49 30						
α	22 13 28	22 49.0	23 26.5	0 6.0	0 47.8	1 30.7	2 16.5	3 5.0	3 56.0	4 49.1	5 42.9
log a cos δ	.41440	.43871	.45516	.46375	.46488	.45883	.44686	.43064	.41217	.39335	.37586
log tg δ	9.76678	9.60595	9.25648	8.85733	9.52840	9.77619	9.92096	0.1809	.07070	.10202	.11167
log tg δ	9.35281	9.16724	8.80132	8.39354	9.06352	9.31736	9.47400	9.58245	9.65853	9.70867	9.73501
δ	-12 41 03	-8 21 40	-3 37 17	+1 25 04	+6 36 09	11 43 54	16 35 11	20 55 26	24 29 29	27 04 50	28 33 10
log a	.42513	.44335	.45603	.46392	.46777	.46800	.46542	.46027	.45313	.44378	.43228

Aug 8	Aug 28	Sept 17	Oct 7	27	Nov 16	Dec 6	Dec 26
12 03 52	16 31 05	20 58 18	25 25 31	29 52 44	34 18 57	38 47 10	43 14 23
17 06 11	23 17 37	29 22 37	35 20 07	41 09 18	46 49 43	52 21 10	57 43 38
9.46848	9.59708	9.68068	9.76220	9.81829	9.86291	9.89861	9.92712
4.79017	4.79017	4.79017	4.79017	4.79017	4.79017	4.79017	4.79017
4.25865	4.38725	4.48085	4.55237	4.60846	4.65308	4.68878	4.71729
+5 02 21	+6 46 32	+8 24 19	+9 54 36	11 16 34	12 29 47	13 34 01	14 25 15
17 06 13	23 17 37	29 22 37	35 20 07	41 09 18	46 49 44	52 21 11	57 43 38
8 33 06	11 38 48	14 41 18	17 40 03	20 34 39	23 24 5	26 10 25	28 51 49
9.17231	9.30508	9.40408	9.48215	9.54589	9.59921	9.64457	9.68370
9.99574	9.99097	9.98557	9.97902	9.97137	9.96268	9.95301	9.94239
9.44446	9.57723	9.67623	9.75430	9.81804	9.87136	9.91672	9.95585
.13332	.12915	.12378	.11720	.10955	.10086	.09119	.08057
9.31114	9.44808	9.55248	9.63710	9.70849	9.77050	9.82553	9.87528
11 34 09	15 40 26	19 38 20	23 26 32	27 04 15	30 31 14	33 44 20	36 53 02
23 08 18	31 20 52	39 16 40	46 53 04	54 8 30	61 02 28	67 34 40	73 46 04
.14224	.14561	.14978	.15461	.15994	.16563	.17154	.17756
.28448	.29122	.29956	.30922	.31988	.33126	.34308	.35512
168 04 57	177 17 31	185 13 19	192 49 43	200 5 09	206 57 07	213 31 19	219 42 43
79 30 21	87 42 55	95 38 43	103 15 7	110 30 33	117 24 31	123 56 43	130 08 07
77 57 09	86 09 43	94 05 31	101 41 55	108 57 21	115 51 19	122 23 31	128 34 55
9.27787	8.67437	8.95911n	9.34640n	9.53584n	9.65683n	9.74214n	9.80545n
.28445	.29119	.29953	.30919	.31985	.33123	.34305	.35509
9.99267	9.99965	9.99789	9.98828	9.97156	9.94829	9.91885	9.88339
.21538	.22212	.23046	.24012	.25078	.26216	.27398	.28602
9.99033	9.99902	9.99889	9.99088	9.97378	9.95419	9.92655	9.89305
.00231	.00905	.01739	.02705	.03771	.04909	.06091	.07295
.3646	+.0924	−.1814	−.4525	−.4173	−.9729	−1.2167	−1.4443
−.7251	−.9144	−.9996	−.9691	−.8245	−.5815	−.2680	+.0783
−.3605	−.8220	−1.1810	−1.4216	−1.5418	−1.5544	−1.4847	−1.3660
1.6146	1.6664	+1.6918	+1.6920	+1.6666	+1.6235	+1.5590	+1.4776
+.6498	+.3925	+.0905	−.2217	−.5079	−.7332	−.8695	−.8992
+2.2644	+2.0589	+1.7828	+1.4703	+1.1607	+.8903	+.6895	+.5779
+.9832	.10188	10382	10422	10316	10046	.9716	+.9247
+.2819	+.1703	+.0393	−.0962	−.2203	−.3182	−.3773	−.3802
+1.2651	+1.1891	+1.0775	+.9460	+.8113	+.6894	+.5943	+.5345
9.85690n	9.91487n	0.07225n	.15278	.18806n	.19156n	.17164n	.13545
.35494n	.31364n	.25401n	.16748n	.06470n	9.94954n	9.83850n	9.76188n
.79804	.39891	.19896	.01465	9.87607	9.75798	9.66687	9.62643
−50 57 65	68 14 18	56 28 22	45 57 54	36 58 24	−29 48 10	24 54 37	22 50 58
99 02 48	111 45 49	123 37 35	134 02 06	143 07 36	150 17 50	156 06 23	157 04 02
6 36.2	7 27.1	8 14.7	8 56.7	9 32.7	10 0.8	10 20.4	10 28.3
.36038	.34585	.33004	.31084	.28558	.25317	.21408	.17121
.10212	.07522	.03242	9.97589	9.90918	9.83844	9.77401	9.72795
9.74174	9.72947	9.70238	9.66515	9.62365	9.58530	9.55996	9.55674
28 53 16	28 12 30	26 44 44	24 49 22	22 48 05	21 03 00	19 57 12	19 49 03
.41809	.40066	.37918	.35284	.32087	.28316	.24054	.19772

F26 4
52 08 49
~~34~~ 14 57

	h ~		
	22 13.5	35.5	
	22 48.0	37.5	2.0
	23 26.5	39.5	2.0
	0 6.0	41.3	1.8
	0 49.3	43.4	2.1
	1 30.7	45.8	2.4
	2 16.5	48.5	2.7
	3 5.0	51.0	2.5
	3 56.0	53.1	2.1
	4 49.1	53.8	+0.7
	5 42.9	53.3	−.5
	6 36.2	50.9	2.4
	7 27.1	47.0	3.9
	8 14.7	42.0	5.0
	8 56.7	36.0	6.0
	9 32.7	28.7	7.3
	10 0.8	19.6	9.1
	10 20.4	7.8	11.8
Dec 26	10 28.3	−.6	15
Jan 15	10 20.0	−28	20
Feb. 4	9 58		

δ Short Feb. 19 1475

° ′	° ′	
−12 41		
−8 22	+4 19	
−3 37	4 45	+26
+1 25	5 02	+17
+6 36	5 11	+9
+11 44	5 08	−3
16 85	4 51	17
20 55	4 20	31
√ 24 30	3 35	45
27 08	2 38	57
1 28 53	1 46	
28 13	40	
26 45	1 28	
24 49	1 56	
22 48	2 01	
21 03	1 45	
19 57	1 06	
19 49	08	

.425	
.443	18
.456	13
.464	8
.468	4
.468	0
.465	3
.460	5
.453	7
.444	9
.432	12
.418	14
.401	17
.379	22
.353	26
.321	32
.283	38
.241	42
.198	43

Ω 4 58 28.44
$\Omega - n$ 175 01 31.56
$\frac{1}{2}(\Omega - n)$ 87 30 45.78
$\frac{1}{2}(\Omega - n)$ 92 29 14.22
i' 8 02 48.30
ε 23 27 19.93
$i + \varepsilon$ 31 30 8.20
$i' - \varepsilon$ −15 24 31.63
$\frac{1}{2}(i + \varepsilon)$ 15 45 4.11
$\frac{1}{2}(i' - \varepsilon)$ −7 42 15.81

$\sin \frac{1}{2}(\Omega - n)$ 9.9995907
$\sin \frac{1}{2}(i' + \varepsilon)$ 9.4337050
$\sin \frac{1}{2} i'' \sin \frac{1}{2}(\Omega' + a)$ 9.4332957
$\sin \frac{1}{2} i'' \cos \frac{1}{2}(\Omega' + a)$ 7.7647723
$\tan \frac{1}{2}(\Omega' + a)$ 1.6685234 n
$\frac{1}{2}(\Omega' + a)$ 88 46 15.80
~~1 13 44.20~~

$\cos \frac{1}{2}(\Omega - n)$ 8.6374662 n
$\sin \frac{1}{2}(i' - \varepsilon)$ 9.1273061 n
7.7647723
9.4333916
i'' 15 44 22.64
i' 31 28 45.28

$\sin \frac{1}{2}(\Omega - n)$ 9.9995907
$\cos \frac{1}{2}(i' + \varepsilon)$ 9.9833781
$\cos \frac{1}{2} i'' \sin \frac{1}{2}(\Omega' - a)$ 9.9829688
$\cos \frac{1}{2} i'' \cos \frac{1}{2}(\Omega' - a)$ 8.6335280 n
$\tan \frac{1}{2}(\Omega' - a)$ 1.3494608 n
$\frac{1}{2}(\Omega' - a)$ −~~87~~ 26 21.18
$\frac{1}{2}(\Omega' + a)$ 92 28 38.82
88 46 15.80
Ω' 181 14 54.62
a 356 12 36.98
ω 51 02 31.51
ω' ~~347 15 8.49~~
54 49 54.53

$\cos \frac{1}{2}(\Omega - n)$ 8.6374662
$\cos \frac{1}{2}(i' - \varepsilon)$ 9.9960618 n
8.6335280 n

$\sin \Omega'$ 8.3662900 n — $\cos \Omega'$ 9.9998826 — $\sin \Omega'$ 8.3662900
$\cos i''$ 9.9308622
$\cos \Omega'$ 9.9998826 n
$\sin i''$ 9.7178283

$\cos i'' \sin \Omega$ 8.2971522 — $\cos i'' \cos \Omega$ 9.9307448
$\tan A$ 1.7027304 n
A −88 51 50.81
$\log a$ 9.9999679
A 91 08 9.19

$\log B$ 8.4355452
B 1° 33 41.64
$\log b$ 9.9309061

$A + \omega'$ 145 58 37.2
$B + \omega'$ 56 23 36.17
ω' 54 49 54.53

$\log a$ 9.9999679
$\log b$ 9.9309061
$\log c$ 9.7178283

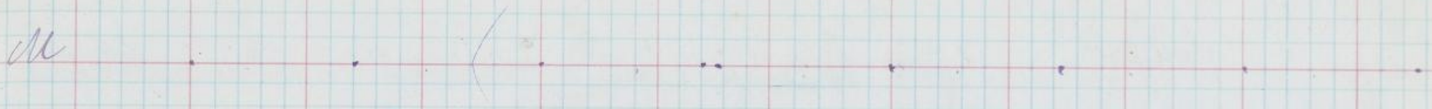
$\log c = \log \sin \varphi$ 9.4754064
e .2988177
$1 + e$
$1 - \varepsilon$ 7011823
$\log(1 + \varepsilon)$ .1135482
$\log(1 - \varepsilon)$ 9.8458309

$\log \sqrt{1 + \varepsilon}$ 0.0567741
$\log \sqrt{a}$ 2152950
$\log \sqrt{1 - \varepsilon}$ 9.9229155
$\log \sqrt{(1 + \varepsilon) a}$ 0.2720651
$\log \sqrt{(1 - \varepsilon) a}$ .1382105

φ 17 23 11.79
$\frac{1}{2}\varphi$ 8 41 35.90
$45° - \frac{1}{2}\varphi$ 36 18 24.10
$\tan(45 - \frac{1}{2}\varphi)$ 9.8661413

$\log e$ 9.4754064
$\log e$ 5.3144251
9.7898315
$\log e''$

μ 801.90242
$\cos \varphi$
$\log \mu$ 2.9041215
f 3.5500066
.6458851
2152950
4305900


M

	Jan 23.5	27.5	Jan 31.5	Feb. 4.5	8.5	12.5	16.5
M	47 09 29.4	48 02 30.55	48 55 58.16	49 49 25.77	50 42 53.38	51 36 20.99	52 29 48.60
E	62 18 40.30	63 20 34.98	64 22 8.78	65 23 22.48	66 24 15.50	67 24 49.24	68 25 2.84
	9.9471809	9.9511958	9.9550136	9.9586405	9.9620819	9.9653437	9.9684310
	4.7898315	4.7898315	4.7898315	4.7898315	4.7898315	4.7898315	4.7898315
	4.7370124	4.7410273	4.7448457	4.7484720	4.7519134	4.7551752	4.7582625
	15 09 37.34	15 18 4.22	15 26 10.60	15 33 56.62	15 41 22.44	15 48 28.25	15 55 14.20
E	62 18 40.28	63 20 34.77	64 22 8.76	65 23 22.39	66 24 15.82	67 24 48.24	68 25 2.83
½E	31 09 20.14	31 40 17.38	32 11 4.38	32 41 41.20	33 12 7.91	33 42 24.62	34 12 31.42
sin ½E	9.7137962	9.7201993	9.7264404	9.7325254	9.7384597	9.7442480	9.7498981
cos ½E	9.9323547	9.9299665	9.9275432	9.9250855	9.9225922	9.9200647	9.9175029
√r sin ½v	9.9858653	9.9922684	9.9985095	.0045550	.0105288	.0163181	.0219672
√r cos ½v	.0705652	.0681770	.0657537	.0632956	.0608027	.0582753	.0557134
tan ½v	9.9153001	9.9240914	9.9327558	9.9412587	9.9497261	9.9580428	9.9617885 9.9662538
½v	39 26 52.53	40 01 04.98	40 34 54.86	41 08 22.45	41 41 27.98	42 14 11.88	42 46 34.31
v	78 53 45.07	80 02 9.96	81 09 49.72	82 16 44.90	83 22 56.00	84 28 23.76	85 33 8.62
log √r	~~.0981342~~	.1840379	.1852391	.1864390	.1876325	.1888236	.1900102
log r	~~.1962684~~ .3656681	.3680758	.3704782	.3728750	.3752650	.3776470	.3800204
v+A+Θ'	224 51 48.79	226 00 13.68	227 07 53.44	228 14 48.62	229 20 59.72	230 26 27.48	231 31 12.34
v+B+Θ'	135 17 21.24	136 25 46.18	137 33 25.89	138 40 21.07	139 46 32.17	140 51 59.93	141 56 44.79
v+Θ'	133 43 39.57	134 52 4.49	135 59 44.25	137 06 39.43	138 12 50.53	139 18 18.29	140 23 3.15
log sin(v+A+Θ')	9.8484482n	9.8569619n	9.8650549n	9.8727509n	9.8800714n	9.8870368n	9.8936685n
log r a	.3656861	.3680437	.3704461	.3728429	.3752329	.3776149	.3799883
log sin(v+B+Θ')	9.8472816	9.8388748	9.8292098	9.8197820	9.8100865	9.8001161	9.7898676
log r b	.2965743	.2989819	.3013843	.3037811	.3061711	.3085531	.3109263
log sin(v+Θ')	9.8589181	9.8504839	9.8418056	9.8328797	9.8237023	9.8142684	9.8045730
log r c	.0834966	.0859041	.0883065	.0907033	.0930933	.0954753	.0978487
x	~~9.8484482~~ -1.6371343	-1.6788257	-1.7198913	-1.7603288	-1.8001318	-1.8392962	-1.8778194
x'	+.5449786	+.6020200	.6561021	.7069491	.7542958	.7979030	.8375734
	-1.0921557						
y	~~9.8472816~~ +1.3526945	+1.3720080	+1.3508094	+1.3298166	+1.3069457	+1.2843180	-1.2612288
y'	-.7521427	-.7151850	-.6746780	.6308162	-.5838230	.5339529	.4814783
	+.6405518						
z	+.8558194	+.8637498	+.8513580	.8386543	+.8256492	+.8123510	.7987700
z'	-.3263445	-.3103112	-.2927378	-.2737076	-.2533161	-.2316754	.2089057
	+.5494749						
log Δ cos δ cos α	.0382846n	.0321373	0.0268556	0.0225849	.0194636	.0176448 ~~.0171360~~	.0171360 ~~.0180982~~
log Δ cos δ sin α	9.8065542	9.8174483	9.8300311	9.8440423	9.8592120	9.8752692	9.8919557
log tan α	9.7682696n	9.7853112	9.8031755	9.8214594	9.8397484	9.8576544	9.8748197
α	-30 23 30.29	-31 22 55.54	-32 26 22.35	33 32 27.48	34 39 40.16	35 46 26.49	36 51 16.57
α	149 36 29.71	148 37 04.46	147 33 37.65	146 27 32.52	145 20 19.84	144 13 33.51	143 08 43.43
log Δ cos δ	.1024820	.1008251	.1005347	.1016840	.1043119	.1084148	.1139591
log Δ sin δ	9.7299479	9.7430694	9.7471167	9.7520074	9.7576489	9.7639336	9.7707521
log tan δ	9.6374659	9.6422443	9.6465820	9.6503234	9.6533370	9.6555158	9.6567930
δ	23 27 34.90	23 41 26.83	23 54 07.39	24 05 07.55	24 14 01.98	24 20 29.98	24 24 18.00
log Δ	.1399515	.1390589	.1394747	.1412427	.1443754	.1488500	.1546087
l	265 15	267 08	268 55	270 36	272 11	273 40	275 02
a	148 36	148 37	147 34	146 28	145 20	144 14	143 09
l+a	54 51	55 45	56 29	57 04	57 31	57 54	58 11
log cos(l+a)	9.7602	9.7504	9.7421	9.7353	9.7300	9.7254	9.7220
	9206	9242	9283	9328	9376	9425	9475
log sin l+a	9.9125	9.9173	9.9210	9.9239	9.9261	9.9279	9.9293
log Δ	9.6375	9.6422	9.6466	9.6503	9.6533	9.6555	9.6568
log I	0.4706	.4837	0.4959	.5070	.5170	.5259	.5336
	-1.60	-0.98	-0.38	+0.20	+.74	+1.26	1.77
	+2.96	+3.05	+3.18	+3.21	+3.29	+3.36	+3.42
α'-α	+1.36	+2.07	+2.75	+3.41	+4.03	+4.62	+5.19
α	149 36 29.71	148 37 4.46	147 33 37.65	146 27 32.52	145 20 19.84	144 13 33.51	143 08 43.43
	149 36 31.07	148 37 6.53	147 33 40.40	146 27 35.93	145 20 23.87	144 13 38.13	143 08 48.62
log I	.6808	.6746	.6704	.6681	.6676	.6679	.6695
δ'-δ	+4.80	4.73	+4.68	+4.66	4.65	4.65	+4.67
δ	23 27 34.90	23 41 26.83	23 54 7.39	24 05 7.55	24 14 1.98	24 20 29.98	24 24 18.00
	23 27 39.70	23 41 31.56	23 54 12.07	24 05 12.21	24 14 6.63	24 20 34.63	24 24 22.67

20.5 .	24.5.	28.5 .	Mar 4.5.
58 23 16.21	54 16 43.82	55 10 11.43	56 03 39.04
68 24 56.76	70 24 31.21	71 23 46.39	
9.9713484	9.9741008	9.9766926	
4.7898315	4.7898315	4.7898315	
4.7611799	4.7639323	4.7665241	
16 01 40.55	16 07 47.39	16 13 34.86	16 19 8.46
68 24 56.76	70 24 31.21	71 23 46.39	72 22 42.50
84 42 28.85	8 12 15.60	35 41 63.20	36 11 21.25
9.7554115	9.7607949	9.7660516	9.7711861
9.9149065	9.9122759	9.9096110	9.9069120
.0274809	.0328640	.0381207	.0432552
.0531170	.0500864	.0478215	.0431225
9.8617895	9.8617895	9.8617895	9.8617895
9.9743639	9.9823776	9.9902951	9.9981327
43 18 35.68	43 50 16.33	44 21 36.57	44 52 36.57
86 37 11.36	87 40 32.66	88 43 13.02	89 45 13.14
.1911920	.1923689	.1935402	.1947058
.3823844	.3847378	.3870804	.3894116
232 35 15.08	233 38 36.38	234 41 16.74	235 43 16.86
143 00 47.53	144 04 8.83	145 06 49.19	146 08 49.31
141 27 5.89	142 30 23.19	143 33 7.55	144 35 07.67
9.8992749	9.9059812	9.9116989	9.9171421
.3823523	.3847057	.3870483	.3893785
9.7793302	9.7684967	9.7573582	9.7459048
.3132905	.3156439	.3179865	.3203177
9.7946100	9.7843720	9.7738259	9.7630444
.1002127	.1025661	.1049087	.1072399
−1.9156987	−1.9529311	−1.9895751	−2.0254458
.8781458	.9044730	.9314114	.9538297
+1.2377151	+1.2137818	+1.1894463	+1.1647225
.4266651	.3697742	−.3110707	.2508357
.7849151	.7707944	+.7564184	+.7417956
.1851239	.1604417	+.1349780	−.1088378
.0180983 ~~.0205510~~	.0205510	.0245282	.0300392
9.9090476	9.9263463	9.9436802	9.9608829
9.8909494	9.9057953	9.9191520	9.9308537
37 52 51.56	38 50 02.51	39 41 ~~47.68~~ 50.86	40 27 28.63
142 07 8.44	141 09 52.49	140 18 9.14	139 32 31.32
.1208627	.1290327	.1383603	.1487216
9.7780001	9.7855808	9.7934030	9.8013447
9.6571374	9.6565481	9.6550427	9.6526531
24 25 19.56	24 23 34.23	24 19 05.63	24 12 00.50
.1615711	.1696406	.1787120	.1886702
276 20 2.26	277 33	278 42	279 47
142 07	141 10	140 18	139 33
58 27	58 43	59 00	59 20
9.7187	9.7157	9.7118	9.7076
.9523	.9570	.9614	.9654
9.9305	9.9318	9.9331	9.9346
9.6571	9.6565	9.6550	9.6527
.5399	.5453	.5495	.5527
+2.26	+272	317	360
+347	+351	354	357
+573	+623	+671	+717
142 07 8.44	141 09 57.49	140 18 9.14	139 32 31.02
142 07 14.17	141 10 3.72	140 18 16.85	139 32 38.48
.6710	.6724	.6732	.6730
469	470	471	471
24 25 19.56	24 23 34.23	24 19 5.63	24 12 0.50
24 25 24.25	24 23 38.93	24 19 10.34	24 12 5.21

	α	4_1	4_2	4_3	4_4
Jan 23.5	149 36 31.07	° ″	− 5 1.2		
		−59 24.54	′ ″	′ ″″	
27	148 37 6.53		−4 01.59		+ 12
		1 3 26.13		+1 23.25	
31	147 33 40.40		−2 38 34		+ 7.50
		6 04.47		+1 30.75	
4	146 27 35.23		−1 7.59		+3.16
		7 12.06		+1 33.91	
8	145 20 23.87		+ 26.32		−4.00
		6 45.74		+1 29.91	
12	144 13 38.13		+1 56.23		−11.08
		4 49.51		+1 18.83	
16	143 08 48.62		+3 15.06		+9.89
		1 34.45		+1 8.94	
20	142 07 14.17		+4 24.00		−10.36
		57 10.45		+ 58.58	
24	141 10 3.72		+5 22.58		−10.65
		51 47.87		+ 47.93	
28	140 18 15.85		+6 10.51		
		−45 37.36			
4.5	139 32 38.49				

1

23 27 39.70		·0 44		
	+13 51.86		38	
23 41 31.56		−1 11.35		
	+12 40.51		−29.02	
23 54 12.07		−1 40.37		+3.68
	+11 00 14		−25.35	
24 05 12.21		−2 05.72		+4.65
	+8 54.42		−20.70	
24 14 6.63		−2 26.42		+7.16
	+6 28.00		−13.54	
24 20 34.63		−2 39.96		+7.04
	+3 48.04		−6.50	
24 24 22.67		−2 46.46		+6.06
	+1 01.58		−0.44	
24 25 24.25		−2 46.90		+4.07
	−1 45.32		+ 3.63	
24 23 38.93		−2 43.27		+3.10
	−4 28.59		+ 6.73	
24 19 10.34		2 36.54		
	−7 5.13			
24 12 5.21				

1398515				
	−8926	+ 12354	7·30	
1390589		+13084		
	+4158		+438	
1394747		13522		−313
	17680		+125	
1412427		13647		353
	31327		−228	
1443754		13419		350
	44746		578	
1488500		12841		226
	57587		804	
1546087		12037		162
	69624		966	
1615711		11071		− 86
	80695		1052	
1696406		10019		+ 1
	90714		1151	
1787120				
1886702	+99582	+ 8868		

B.M.O.T

I_r + 1

Jan 23.5	–19.59			149 36 3107	9/8 58 26.07			–2.50			+ 23 27 2970	3590		
24.5	18.52	14	24.47	149 22 660	9 57 28.44	57.63	1.23	3.00 +	3	3 2007 +	23 31 1007	12.7	3 32.8	
– 25	17.47	– 14	42.95	149 07 2365	9 56 29.58	58.86	1.17	– 3.50	3	39.97	23 34 4266	4.26	29.9	2.9
26	16.35	15	0.39	148 52 23.26	9 55 29.55	1 0003	1.08	3.98	3	26.47	23 38 0911	9.1	26.5	3.4
27	15.16	15	16.72	148 37 653	9 54 28.44	1 1.11	1.03	4.48	3	24.49	23 41 3156	3.16	22.5	4.0
28	13.89	15	32.00	148 21 3453	9 53 26.30	1 2.14	.902	4.95	3	18.01	23 44 4957	4.66	18.0	4.5
– 29	12.60	15	45.89	148 05 4864	9 52 23.24	3.06	84 –	5.41	3	13.06	23 48 0263	2.6	13.0	5.0
30	11.29	15	58.47	147 49 5017	9 51 19.34	3.90	75	5.86	3	7.66	23 51 1029	10.3	7.7	5.3
31	9.93	16	09.76	147 33 4040	9 50 14.69	4.65	66	6.29	3	01.60	23 54 1207	12.1	1.8	5.9
Feb 1	8.54	16	19.74	147 17 20.66	9 49 09.38	5.31	58	6.71	2	55.50	23 57 0757	7.6	55.5	6.3
– 2	7.12	16	28.78	147 00 5238	9 48 03.49	5.89	47 –	7.12	2	48.79	23 59 5636	56.4	48.8	6.7
3	5.69	16	35.39	146 44 16.99	9 46 57.13	6.36	37	7.52	2	41.68	24 02 3804	38.0	41.6	7.2
4	4.24	16	41.08	146 27 3593	9 45 50.40	6.83	30	7.88	2	34.16	24 05 1221	12.2	34.2	7.4
5	2.76	16	45.36	146 10 5057	9 44 43.37	7.03	18	8.24	2	26.27	24 07 3848	38.5	26.3	7.9
– 6	– 1.27	16	48.12	145 54 2.45	9 43 36.16	7.21	8 –	8.55	2	18.03	24 09 5651	56.5	18.0	8.3
7	+ 20	16	49.40	145 37 18.05	9 42 28.87	7.29	1	8.87	2	9.48	24 12 0599	6.0	9.5	8.5
8	1.67	16	49.20	145 20 2387	9 41 21.59	7.28	1	9.12	2	0.61	24 14 663	6.6	0.6	8.9
9	3.14	16	47.58	145 03 3629	9 40 14.42	7.17	20	9.33	1	51.25	24 15 5788	57.9	51.3	9.3
– 10	4.62	16	44.44	144 47 5185	9 39 07.45	6.97	32 –	9.65	1	41.92	24 17 3980	39.8	41.9	9.4
11	6.02	16	39.86	144 30 1199	9 38 00.80	6.65	39	9.85	1	32.22	24 19 1212	12.1	32.3	9.6
12	7.32	16	33.84	144 13 3813	9 36 54.54	6.26	50	10.03	1	22.49	24 20 3463	34.6	22.5	9.8
13	8.61	16	26.50	143 57 1163	9 35 48.78	5.76	56	10.17	1	12.36	24 21 4695	47.0	12.4	10.1
– 14	9.86	16	17.91	143 40 5372	9 34 43.58	5.20	66 –	10.28	1	2.19	24 22 4918	44.7	2.2	10.2
15	11.07	16	8.08	143 24 4564	9 33 39.04	4.54	74	10.36	0	51.93	24 23 4111	41.1	51.9	10.3
16	12.24	15	57.01	143 08 4462	9 32 35.24	3.80	82	10.43	0	41.57	24 24 2267	22.7	41.6	10.3
17	13.38	15	44.75	142 53 387	9 31 32.26	2.58	89	10.46	0	31.08	24 24 5375	53.7	31.0	10.6
– 18	14.47	15	31.37	142 37 3250	9 30 30.17	2.09	96 –	10.48	0	20.62	24 25 1437	14.4	20.7	10.3
19	15.53	15	16.92	142 22 15.58	9 29 29.04	1.13	103	10.47 +	0	10.16	24 25 2453	24.5 +	10.1	10.6
20	16.55	15	1.39	142 07 1407	9 28 28.94	0.10	111	10.45 –		00.31	24 25 2425	24.2 –	.3	10.4
21	17.54	14	44.83	141 52 2924	9 27 29.95	58.99	114	10.40		10.98	24 25 1347	13.5	10.7	10.4
– 22	18.50	14	27.29	141 38 1.95	9 26 32.10	57.85	1.29 –	10.34 –	0	21.16	24 24 5229	52.3	21.2	10.5
23	19.37	14	8.84	141 23 5311	9 25 35.54	56.56	1.27	10.29	0	31.53	24 24 2076	20.8	31.5	10.3
24	20.21	13	49.47	141 10 3.72	9 24 40.25	55.29	1.34	10.22		41.82	24 23 3883	38.9	41.5	10.4
25	20.96	13	29.18	140 56 3454	9 23 46.30	53.95	1.40	10.13		52.06	24 22 4687	46.4	52.0	10.1
– 26	21.70	13	8.22	140 43 2632	9 22 53.75	52.55	1.46 –	10.02	1	02.19	24 21 4468	44.7	1 02.2	10.2
27	22.57	12	46.49	140 30 3983	9 22 02.66	51.09	1.49	9.92	1	12.21	24 20 3247	32.5	12.2	[illegible]
28	23.21	2	23.98	140 18 1585	9 21 13.06	49.60		9.80	1	22.13	24 19 1034	10.3	22.2	

3096	+774		1399175
	786	–3412	1396103
	–799	–2635	1393467
	809	–1899	1391628
3279	820	–1030	1390589
	827	–188	1390401
	835	+619	1391020
	841	1452	1392472
3387	847	2293	1394747
	850	3143	1397890
–	853	3993	1401883
	854	4845	1406728
3415	855	5699	1412427
	852	6557	1418984
–	850	7409	1426393
	846	8258	1434651
3362	841	9104	1443754
	833	9946	1453700
–	825	10779	1464479
	816	11603	1476082
3219	804	12419	1488500
	790	13221	1501721
–	781	14014	1515735
	7.67	14793	1530528
3012	753	15560	1546087
	7.43	16309	1562396
–	723	17052	1579448 –
	7.08	17777	1597225
2769	692	18485	1615711 –
	6.75	19179	1634890
–	658	19854	1654744
	6.41	20511	1675255
2505 +	624	21152	1696406
–	6.07	21776	1718182
–	590	22383	1740565
			1763555
		22950	1787120

Yearly Ephemeris of (107)

1874 B.M.T.

~~Dec 24 Jan 15 Feb. 24 Apr 5 May 15 Jun 24 Aug 3 Sept. 12 Oct 22 Dec 1 Dec 4~~

	Dec 26.0	Jan 15.0	Feb. 4	Feb. 24	Mar 16	Apr 5	Apr. 25	May 15	Jun 4	Jun 24	Jul 14	
M		47 42 29	52 09 47	56 37 05	61 04 23	65 31 41	69 58 59	74 26 17	78 53 35	83 20 53	87 48 11	
E		62 57 30	68 2 31	72 59 20	77 48 27	82 30 11	87 04 34	91 33 03	95 54 25	100 12 08	104 23 91	
log sin E		9.94972	9.96729	9.98057	9.99019	9.99627	9.99949	9.99984	9.99769	9.99308	9.98616	
log e″		4.78983	4.78983	4.78983	4.78983	4.78983	4.78983	4.78983	4.78983	4.78983	4.78983	
e sin E″		+15 14 58	15 52 44	16 22 19	16 44 5	16 58 29	17 05 56	17 06 53	17 01 49	16 51 02	16 35 08	
E		62 57 27	68 02 31	72 59 24	77 48 28	82 30 10	87 04 55	91 33 10	95 55 24	100 11 55	104 23 17	
½E		31 28 43	34 01 15	36 29 42	38 54 14	41 15 05	43 32 27	45 46 35	47 57 42	50 05 57	52 11 37	
sin ½E		9.71782	9.74780	9.77434	9.79797	9.81913	9.83814	9.85529	9.87081	9.88488	9.90345	9.89767
cos ½E		9.93087	9.91847	9.90521	9.89109	9.87612	9.86027	9.84382	9.82583	9.80717	9.77751	78746
log √r sin ½v		9.98989	.01989	.04641	.07004	.09120	11021	12736	14288	15695	.17552	.16974
log √r cos ½v		.06908	.05668	.04342	.02930	.01433	9.99848	9.98173	9.96404	9.94088	991572	.92567
log tan ½v		9.92081	996319	.00299	.04074	.07687	.11173	.14563	17884	21157	25980	.24407
½v		39 48 18	42 34 31	45 11 51	47 41 02	50 2 41	52 17 25	54 25 54	56 28 38	58 26 06	61 11 55	60 1 51
v		79 36 36	85 09 02	90 23 42	95 22 4	100 5 22	104 34 50	108 51 48	112 57 16	116 52 12	122 23 50	120 37 42
log √r		.18359	18957	.19543	.20114	.20666	.21197	.21704	22189	22649	.23287	23084
log r		.36718	37914	.39086	.40228	41332	.42394	.43408	44378	45298	.46574	46168
											286 35 46	
v+A+ω′		225 34 49	231 07 6	236 21 46	241 20 8	246 03 26	250 32 54	254 49 52	258 55 20	262 50 16	~~268 21 54~~	
v+B+ω′		136 00 12	141 32 38	146 47 18	151 45 40	156 28 58	160 58 26	165 15 24	169 20 52	173 15 48	177 01 18	
v+ω′		134 26 31	139 58 57	145 13 37	150 11 59	154 55 17	159 24 45	163 41 43	167 48 11	171 42 07	175 27 37	
sin g		9.85382n	9.89123n	9.92042n	9.94322n	9.96692n	9.97448n	9.98460n	9.99183n	9.99660n	9.99923n	
log ra		36715	37911	39083	40225	41329	42391	43405	44375	45297	46165	
		9.84175	9.79376	9.73857	9.67400	9.60099	9.51322	9.40567	9.26681	9.06932	8.71565	
log 2b		.29869	.31005	.32177	.33319	.34423	.35485	.36499	.37465	.38389	.39259	
		9.85367	9.80823	9.75612	9.69634	9.62722	9.54610	9.44831	9.32543	9.15933	8.89845	
log 2c		.08501	.09697	.10869	.12011	.13115	.14177	.15191	.16161	.17081	.17951	
X		+.4158	+.7008	+.9008	+.9922	+.9657	+.8263	+.5918	+.2903	−.0439	−.3733	
		−1.6633	−1.5636	−2.0476	−2.2155	−2.3671	−2.5026	−2.6221	−2.7264	−2.8155	−2.8889	
		−0.8181	−.6365	−.3770	−.0719	+.24180	+.52728	+.75232	+.89210	+.93171	+.86431	
y		+1.3399	+1.2700	−1.1490	−1.0167	+.88150	+.73803	+.58974	+.43803	+.28393	+.12831	
		−.35500	−27616	−16357	−.03120	+.10490	+.22878	+.32642	+.38707	+.40426	+.37631	
z		+.86833	+80380	+.73251	+.65532	+.57329	+.48739	+.39831	+.30693	+.21387	+.11966	
log Δ cos δ sin a		.09625	.06550n	.05949	.08753	.14656n	.22435	.30456	.38670	.45627n	.51364	
log Δ cos δ cos a		9.74958n	9.80175n	9.88762n	9.95537n	.05053n	.10219n	.12778n	.12388n	.08479	9.99808n	
log tan a		9.65333n	9.73625n	9.82813n	9.88781n	9.90397n	9.87784n	9.82022n	9.73718n	9.62852n	9.48444n	
a		−24 14 01	−28 34 57	−33 56 52	−37 40 50	−38 43 00	−37 02 46	−33 27 56	−28 38 02	−23 1 55	−16 58 01	
log Δ sin δ		9.71040	9.72242	9.75407	9.79527	9.88135	9.85502	9.86018	9.84136	9.79108	9.69546	
log Δ cos δ		.13631	.12194	.14065	.18912	.25433	.32226	.38628	.44836	.49235	.53298	
log tan δ		9.57409	9.60048	9.61342	9.60615	9.57702	9.53276	9.47390	9.39800	9.29873	9.16249	
δ												
log Δ		.16487	.15395	.17448	.22192	.28327	.34615	.40473	.41117 .45653	.50078	.53751	

					h	m		
Dec 26	157 04 02	1 18 03			10	28.3	+12.1	17.3
a	155 45 59	4 20 56	3 2 53	2 41 504	10	23.1	−5.2	12.2
	161 25 03	5 21 55	+1 0 59	2 38 56	10	5.9	17.4	+4.1
	146 08 08	3 43 58	−1 37 57		9	44.2	21.5	−6.6
	142 19 10	+1 2 10	2 41 48		9	29.3	14.9	10.7
	141 17 00	−1 40 14	2 42 24		9	25.1	−4.2	10.9
	142 57 14	3 34 50	1 54 36		9	31.8	+6.7	7.6
	146 32 04	4 49 54	1 15 04		9	46.1	14.3	5.1
	151 21 58	5 36 07	46 13		10	5.5	19.4	3.0
	156 58 5	6 03 54	27 47		10	27.9	22.4	1.8
	163 1 59	6 19 53	15 59		10	52.1	24.2	1.2
	169 21 52	6 28 40	8 47		11	17.5	25.4	.5
	175 50 32	6 32 28	−3 47		11	43.4	25.9	.2
	182 22 59	6 32 13	+ 4		12	9.5	26.1	− .1
	188 55 12	6 28 1	4 12		12	35.7	26.2	+ 3
	195 23 13	6 18 16	9 45		13	1.6	25.9	.7
	201 41 29	6 1 05	17 11		13	26.8	25.2	1.2
	207 42 34	5 35 38	31 27		13	50.8	24.0	1.9
	213 13 12	4 46 05	44 33		14	12.9	22.1	2.8
	217 59 17	3 39 16	1 6 49		14	32.2	19.3	
	221 38 33	2 01 47						
	223 40 20							

1875

Aug 3	Aug 23	Sept 12	Oct 2	Oct 22	Nov. 11	Dec 1	Dec 21	Dec 41
92 15 29	96 42 47	101 10 05	105 37 23	110 04 41	114 31 59	118 59 17	123 26 35	
108 29 46	112 31 38	116 29 35	120 23 26	124 14 15	128 01 12	131 45 41	135 27 02	
9.97697	9.96553	9.95182	9.93581	9.91738	9.89642	9.87270	9.84604	
4.78983	4.78983	4.78983	4.78983	4.78983	4.78983	4.78983	4.78983	
16 14 12	15 48 53	15 19 24	14 46 07	14 09 18	13 29 17	~~466203~~	12 09 39	
108 29 41	112 31 40	116 29 29	120 23 30	124 13 59	128 01 16	12 46 16 131 45 33	135 27 14	
54 14 50	56 15 50	58 14 44	60 11 45	62 06 59	64 00 38	65 52 46	67 43 37	
9.90931	9.91992	9.92958	9.93838	9.94640	9.95370	9.96032	9.96632	
9.76663	9.74458	9.72122	9.69640	[illegible]	9.64168	9.61136	9.57867	
.18138	.19199	.20165	.21045	.21840	.22577	.23235	.23835	
9.90484	9.88279	9.85943	9.83461	9.80815	9.77989	9.74957	9.71688	
.27654	.30920	.34222	.37584	.41032	.44588	.48282	.52157	
62 7 16	63 51 50	65 32 46	67 10 29	68 48 28	70 17 35	71 47 22	73 15 4	
124 14 32	127 43 40	131 05 32	134 20 58	137 30 46	140 35 10	143 34 44	146 30 8	
.23496	.23883	.24247	.24586	.24903	.25198	.25471	.25722	
.46992	.47766	.48494	.49172	.49806	.50396	.50942	.51444	
270 12 36	273 41 44	277 03 36	280 19 02	283 28 50	286 33 14	289 32 48	292 28 12	
180 38 08	184 07 16	187 29 08	190 44 34	193 54 22	196 58 46	199 58 20	202 53 44	
179 04 28	182 33 35	185 55 27	189 10 53	192 20 41	195 25 05	198 24 39	201 20 03	
10.00000n	9.99910n	9.99669n	9.99292n	9.98787n	9.98162n	9.97422n	9.96571n	
.46989	.47763	.48491	.49169	.49803	.50393	.50939	.51441	
8.04502n ~~.16887~~	8.85652n	9.11487n	9.27045	9.38081n	9.46543	9.53347n	9.59001n	
.40083	.40857	.41585	.42263	.42897	.43487	.44033	.44535	
8.20839	8.64993n	9.01373n	9.20292	9.32999n	9.42465n	9.49945	9.56057n	
.18775	.19549	.20277	.20955	.21589	.22179	.22725	.23227	
-.6609	-.8742	-.9882	-.9885	-.8729	-.6534	-.3550	-.0134	
-2.9505	-2.9973	-3.0311	-3.0522	-3.0613	-3.0588	-3.0452	-3.0208	
+.70608	+.46554	+.17215	-.14093	-.43737	-.68169	-.84356	-.90221	
-1.02791	-.18412	-.33941	-.49327	-.64533	-.79488	-.94146	-1.08480	
+.30636	+.20199	+.07469	-.06115	-.18977	-.29577	-.36601	-.39146	
+.02490	-.07005	-.16463	-.25851	-.35147	-.44304	-.53297	-.62099	
55768	58788	60415	60646	59486	56963	53150	48204	
9.83184	9.44936	9.22339n	9.80223n	0.03457n	0.16926n	0.25184n	0.29820n	
9.27366	8.86148n	8.61924	9.19557	9.43965	9.59963	9.72034	9.81616	
-10 38 08n	-4 9 28	+2 22 59	+8 55 12	+15 23 13	+21 41 29	+27 42 34	+33 13 12	
9.52017	9.12038	8.95395	9.50469	9.73338	9.86482	9.95375	0.00535	
.56521	.58902	.60453	.61174	.61077	.60153	.58440	.55953	
8.95496	8.53136	8.34942n	8.89295n	9.12267n	9.26700n	9.36935	9.44582n	
~~.56672~~ .56697	.58927	.60464	.61306	.61450	.60883	.59598	.57582	

19 48 11	0 44 w	36 17	
δ +20 38 31	+1 10 17		
21 43 48	+ 35 36	34 31	
22 19 24	−	55 42	
21 59 18	− 20 06	58 2	
20 41 10	1 18 8	33 15	
18 49 47	1 51 23	23 26	
16 34 58	2 14 49	18 51	
14 02 18	2 32 40	14 31	
11 15 07	2 47 11	11 38	
8 16 28	2 58 49	8 24	
5 9 5	3 07 13	5 04	
+1 56 48	3 12 17	+ 1 22	
−1 16 57	3 13 39	− 2 22	
4 28 8	3 11 17	6 5	349
7 33 20	3 5 12	9 54	
10 28 38	2 55 18	13 28	324
13 10 28	2 41 50	16 30	302
15 35 48	2 25 20	19 08	238
17 42 17	2 06 29	21 23	
19 27 23	1 45 06	24 08	
20 48 21	1 20 58		

lg a		
1649	−110	
1539	+206	316
1745	+474	268
2219	614	140
2833		+.14
3461	628	−42
4047	586	68
4565	518	75
5008	443	76
5375	368	72
5670	295	72
5893	223	70
6046	153	68
6131	85	71
6145	+ 14	71
6088	− 57	71
5960	− 128	74
5758	− 202	
5481	277	

lg a = .43055
a 2.695
a−1 1.695
lg(a+1) .22917
lg a² .86110
lg (a−1)² .45834
lg a²(a+1)² 1.31944
lg 2² a² 1.07040
lg $h = \frac{a^2(a-1)^2}{2^2 a^2} =$ .24904

lg 2 .3005
lg 4 1.547
~~.2352~~
lg 2² 7610
lg 4² 3094
1.0704

Intensity = 1.77

m for opp. 1873 = 12.0
m for opp 1872 = 11.5

m = 11.7 − .6 = 11.1

Opposition Ephemeris of (109)

1875

~~Jan 24 28 Feb 1 5 9 13 17 21 25 Mar 1 5~~ Jan 23.5

	Jan 27.5	Feb 0.5	Feb 4.5	Feb 8.5	Feb 12.5	Feb 16.5	Feb 20.5	
M	50 29 32.55	51 23 6.16	52 16 27.77	53 09 55.38	54 03 22.99	54 56 50.60	55 50 18.21	49 36 4.94
	66 9 5.60	67 09 44.00	68 10 2.46	69 10 1.29	70 9 40.60	71 9 0.60	72 8 1.41	65 8 7.11
	9.9612398	9.9645460	9.9676762	9.9706356	9.9734288	9.9760603	9.9785344	9.9577525
	4.7898315	4.7898315	7898315	4.7898315	4.7898315	4.7898315	4.7898315	4.7898315
	4.7510713	4.7543775	4.7575077	4.7604671	4.7632603	4.7658918	4.7683659	4.7475840
	15 39 33.63	15 46 43.82	+15 53 84.71	16 0 5.91	16 6 17.62	16 12 9.99	16 17 43.22	15 32 21.7
E	66 9 5.58	67 9 43.98	68 10 2.48	69 10 1.29	70 9 40.61	71 09 0.59	72 8 1.43	65 8 7.11
½E	33 4 32.79	33 34 51.99	34 05 1.24	34 35 0.66	35 4 50.30	35 34 30.30	36 4 0.71	32 34 3.55
log sin ½E	9.7369919	9.7428169	9.7485005	9.7540477	4.7594629	9.7647508	9.7699154	9.7310203
log cos ½E	9.9232178	9.9206990	9.9181458	9.9155580	9.9129359	9.9102796	9.9075896	9.9257021
log √r sin ½v	.0090610	.0148860	.0205696	.0261168	.0315320	.0368199	.0419845	.0030894
log √r cos ½v	.0614283	.0589095	.0563563	.0537685	.0511464	.0484901	.0458001	.0639126
log tan ½v	9.9476327	9.9559765	9.9642133	9.9723483	9.9803856	9.9883298	9.9961844	9.9391768
½v	41 33 14.21	42 06 03.55	42 38 31.28	43 10 37.95	43 42 23.74	44 13 49.00	44 44 9.03	41 10 03.29
v	83 06 28.42	84 12 7.10	85 17 2.56	86 21 15.90	87 24 47.48	88 27 38.00	89 28 48.06	82 0 6.58
log r	.3746686	.3770528	3794286	.3817952	.3841512	3864968	3888308	3727[illegible]
v+A+ω'	229 04 32.14	230 10 10.82	231 15 6.28	232 19 19.62	233 22 51.20	234 25 41.72	235 27 51.78	227 58 10.20
v+B+ω'	139 30 4.59	140 35 43.27	141 40 38.73	142 44 52.07	143 48 23.65	144 51 14.17	145 53 24.23	138 23 42.65
v+ω'	137 56 22.55	139 02 1.63	140 06 57.09	141 11 10.43	142 14 42.01	143 17 32.53	144 19 42.59	136 50 1.01
log sin(v+A+ω')	9.8782773n	9.8853299n	9.8920409n	9.8984287n	9.9045092n	9.9102976n	9.9158081n	9.8708652
log ra	.3746365	.3770267	.3793965	.3817631	.3841191	.3864647	.3887987	3722455
log sin(v+B+ω')	9.8125341	9.8026322	9.7924534	9.7819883	9.7712296	9.7601682	9.7487945	9.8221609
log rb	.3055747	.3079589	.3103347	.3127013	.3150573	.3174029	.3197369	30 31837
log sin(v+ω')	9.8260179	9.8166481	9.8070188	9.7971228	9.7868545	9.7765064	9.7657708	9.8351314
log rc	.0924969	.0948811	.0972569	.0996235	.1019795	.1043251	.1066591	.0901059
x	-1.7902504	-1.8295764	-1.8682604	-1.9063026	-1.9436909	-1.9804430	-2.0165378	-1.7502928
X	+.6020200	+.6561021	+.7069491	+.7542958	+.7979030	+.8375734	+.8731458	+.5449786
y	+1.3120287	+1.2900042	+1.2670335	+1.2436255	+1.2197952	+1.1955592	+1.1709313	+1.3345800
Y	-.7151850	-.6746780	-.6308162	-.5838230	-.5339529	+.4814783	+.4266651	-.7521427
z	+.8289242	+.8156977	+.8021872	+.7883953	+.7743441	+.7600314	+.7454697	+.8418556
Z	-.3103112	-.2927378	-.2737076	-.2533161	-.2316754	-.2089059	-.1851239	-.3263445
log Δ cos δ cos α	.0744019n	.0694736n	.0649486n	.0614551n	.0591061n	.0579966n	.0581959n	.0811003n
log Δ cos δ sin α	9.7762243	9.7891054	9.8036062	9.8194139	9.8362242	9.8537475	9.8717283	9.7652492
log tang α	9.7013224	9.7196318	9.7386576	9.7579588	9.7771181	9.7957509	9.8135324	9.6841489
α	-26 41 21.83	-27 40 15.02	-28 42 57.26	-29 48 5.65	-30 54 13.04	-31 59 51.87	-33 03 40.30	-25 47 27.4
α	153 18 38.17	152 19 44.98	151 17 2.74	150 11 54.35	149 05 46.96	148 00 8.19	146 56 19.70	154 12 32.52
	+1.87	+2.55	+3.22	+3.83	+4.42	+5.00	+5.55	1.19
α'	153 18 40.04	152 19 47.53	151 17 5.96	150 11 58.18	149 5 51.38	148 00 13.19	146 56 25.25	154 12 33.71
log Δ sin δ	9.7148434	9.7184684	9.7230283	9.7284212	9.7345338	9.7412517	9.7484561	9.7122380
log Δ cos δ	0.1238294	0.1222212	0.1219427	0.1230596	0.1256024	0.1295654	0.1349061	.1266709
log tang δ	9.5910140	9.5962472	9.6010856	9.6053616	9.6089314	9.6116863	9.6135500	9.5855671
δ	+21 18 12.69	+21 32 17.72	+21 ~~37 16.32~~ 45 25.63	+21 57 07.28	+22 06 56.88	+22 14 34.27	+22 19 44.87	+21 03 41.08
	+4.14	+4.06	4.04	4.02	4.01	4.02	4.03	4.4
δ'	21 18 16.83	21 32 21.78	+21 45 29.67	+21 57 11.30	+22 7 0.89	+22 14 38.29	+22 19 48.90	+21 03 45.22
log Δ	.1545678	.1536516	~~.1536278~~ 1540376	.1557469	.1587922	.1631478	.1681576	

l	153 19	152 20	151 17	150 12	149 06	148 00	146 56
b	267 8	268 05	270 36	272 11	273 40	275 2	276 20
	60 27	61 15	61 53	62 23	62 46	63 2	63 16
log	9.5910	9.5962	9.6011	9.6054	9.6089	9.6117	9.6135
log sin(l+a)	9.9395	9.9429	9.9455	9.9475	9.9490	9.9500	9.9509
log	9242	9283	9.9328	9376	.9425	9470	9523
log cos(l+a)	9.6931	9.6821	9.6733	9.6661	9.6605	9.6566	9.6531
log g sin(l+a)	.4547	.4674	.4794	.4905	.5004	.5092	.5167
log g cos(l+a)	.6173	.6084	.6061	.6037	.6030	.6041	.6054
x	-0.98	-0.38	+0.20	+0.74	+1.26	+1.77	+2.26
y	+2.85	+2.93	3.02	3.09	3.16	3.23	3.29
α'−α	+1.87	+2.55	+3.22	+3.83	+4.42	+5.00	+5.50

68 67 61 59 58 55 57

Berlin Mean Time.

Feb. 24.5	Mar. 0.5	Mar. 4.5
56 43 45.82	57 37 13.43	58 30 41.04
73 6 43.33	74 5 6.54	75 3 11.25
9.9808550	9.9830262	9.9850515
4.7898315	4.7898315	4.7898315
4.7706865	4.7728577	4.7748830
.1622 5752	.1627 5311	.1632 3017
73 06 43.34	74 5 6.54	75 3 11.21
36 38 21.67	37 2 33.27	37 31 35.60
9.7749608	9.7798910	9.7847093
9.9048642	9.9021053	9.8993121
.0470299	.0519601	.0567784
.0430747	.0403158	.0375226
.0039552	.0116443	.0192558
45 15 39.24	45 46 04.86	46 16 11.19
90 31 18.48	91 32 9.72	92 32 22.38
.3911526	3934620	.3957578
236 29 22.20	237 30 13.44	238 30 26.10
146 54 54.65	147 55 45.89	148 55 58.55
145 21 13.01	146 22 4.25	147 22 16.91
9.9210539	9.9260472	9.9307994
.3911205	.3934299	.3957257
9.7370974	9.7250649	9.7126843
.3220587	.3243681	.3266639
9.7547381	9.7433991	9.7317433
.1089809	.1112903	.1135861
−2051 9859	−2086 7822	−2120 9239
+.9044730	+.9314114	+.9538297
+1.1459251	+1.1205546	+1.0948244
−.3697742	−.3110707	−.2508354
+.7306662	+.7156314	+.7008731
−1604417	−1349730	−.1088378
9.0597576	.0627213	.0671059
9.8899462	9.9082082	9.9263369
9.8301886	9.8454869	9.8592310
−34 04 24.62	−35 00 58.04	−35 52 21.86
145 55 35.38	144 59 1.96	144 07 38.14
+6.06	+6.55	+ + 7.01
145 55 41.44	144 59 8.51	144 7 45.15
9.7560459	9.7639207	9.7719807
9.1415597	9.1494423	9.1584507
9.6144862	9.6144784	9.6135300
+22 22 21.25	+22 22 19.93	+22 19 41.53
4.05	4.06	+ 4.07
+22 22 25.30	+22 22 23.99	+22 19 45.60
.1755455	.1834270	.1922983
145 16	144 59	144 08
277 33	278 42	279 47
63 29	63 41	64 55
9.6145	9.6145	9.6135
9.9518	9.9525	9.9584
.9570	.9614	.9657
9.6498	9.6467	9.6431
.5233	.5284	.5303
.6068	.6081	.6085
+2.72	+3.17	+3.60
3.34	+3.38	+3.41
+6.06	+6.55	+7.01

48 46

L

23.5 154° 12′ 33.71″

−53 53.67 5 48

Jan. 27.5 153 18 40.04 −4 58.84 50 19

−58 52.51 1 9.78

Feb. 0.5 152 19 47.53 −3 49.06 +1 30.7

−1 02 41.57 +1 22.85

4.5 151 17 5.96 −2 26.21 +4.34

1 5 7.78 1 27.19

8.5 150 11 58.18 − 59.02 +0.44

1 6 6.80 1 27.63

12.5 149 5 51.38 + 28.61 −5.99

1 5 38.19 1 21.64

16.5 148 00 13.19 +1 50.25 −7.76

1 3 47.94 1 13.88

20.5 146 56 25.25 +3 4.13 −7.13

1 0 43.81 1 6.75

24.5 145 55 41.44 +4 10.88 −8.06

56 32.93 +0 58.69

Mar. 0.5 144 59 8.51 +5 9.57

51 23.36

4.5 144 7 45.15

δ

21° 8′ 45.22 + 2.0 −3

Jan. 27.5 +21 18 16.83 +14 31.61 2.667 −1

+14 4.95 − ~~29.134~~ − 30.40

21 32 21.78 − 57.06 +1.20

13 7.89 − 29.20

21 45 29.67 1 26.26 +3.92

11 41.63 − 25.78

21 57 11.30 1 52.04 5.63

9 45.59 − 20.15

22 7 0.89 2 12.19 5.55

7 37.40 − 16.60

22 14 38.29 2 26.79 7.18

5 10.61 − 7.42

22 19 48.90 2 34.21 3.52

+2 36.40 − 3.50

22 22 25.30 2 37.71 +4.13

− ~~58.69~~ 1.31 +0.63

22 22 23.99 −2 37.08

−2 38.39

22 19 45.60

log r

3746686	+23842		
3770528	23758	−84	−8
3794286	23666	92	14
3817952	23560	106	+2
3841512	23456	104	+12
3864968	23340	116	−6
3888308	23218	122	−2
3911526	23094	124	−12
3934620	+22958	−136	
3957578			

log q

1566982	−21304			
1545678		12202		
1536576	−9102	+12902	700	309
1540376	+3800	+13293	+351	−324
1554469	+17093	+13360	+67	−324
1587922	+30453	+13103	−257	−314
1631478	+43556	+12532	−571	−160
1687566	+56088	+11801	−731	−144
1755455	+67889	+10926	−875	−153
1834270	+78815	+9898	−1028	
1922983	+88713			

Berlin Mean Midnight Opposition Ephemeris of (109)

23	11	−21.88	21.88			154	12	33.71	3.71	12.87	45	+15			21	8	45 22	45.2				
24			21.23	12	58.33	153	59	36.38	6.38	2.13	43.	+5.29	+3	38.78	21	7	24 00	24.0	31.2	38.8	3	
25	5 2/7 4 X	21.55	20.80	12	18 56	153	46	12.82	2.84	9.5	18	+4.73 +4	3.	38 49	21	11	2.49	2.5	24.5	38.5	8	
26			19.73	13	39.08	153	32	38.81	8.41	2.94 3.35	5.9	1.19	3	37.68	21	14	40 17	40.2	22.3	39.7	8	
27	Jan. 23	−18.78	14.78	13	58.88	153	18	40 04	10.04 3.35		67 67	−1.65	+3	36.68	+21	18	16.83	16.8	23.4	36.6	11	
28	24	−17.95	17.78	14	19.56	153	4	22.48	7.45	2.5	2.55 51	2.05	+3	34.83	21	21	51.66	51.7	23.1	34.9	17	
29	25	−16.78	16.68	14	35.34	152	49	47.34	2.34	.71	.77 15	+2.68	+3	32 78	21	25	24.44	24.8	27.3	32.8	27	
30	26	−15.56	15.52	14	52 02	152	34	55 42	10.21	34	340 68	3.09	3	30.22	21	28	59 66	54.7		30.3	2	
31	27	−14.35	14.31	15	8.68	152	19	47.53	2.53	84	84 17	−3.58	3	27.13	21	32	21.78	21.8		27.1	3	
1	Feb 28	−13.08	13.06	15	22 07	152	04	25.46	10.46		349 40	+4.06	8	23.52	21	35	45.30	45.3		23.5	3.6	
2	29	−11.79	11.78	15	35.15	151	48	50.31	5.31		177 17	X 4.52	3	19.46	21	39	4.76					
3	30	−10.49	10.49	15	46.83	151	33	3 38	3.38		113 23	4.97	3	14 95	21	42	19.71					
4	31	−9.16	9.16	15	57 42	151	17	5 96	5.96		199 40	−5.41	3	9.98	21	45	29 61					
5	Feb 1	−7.81		16.	6.61	151	00	59.35	14 35		498 96	5.83	3	4.56	21	48	34.23					
6	2	6.43		16	14 42	150	44	44.93	14.93		498 99	* 6.25	2	58.73	21	51	32 96					
7	3	−5.07		16	20.85	150	28	24 08	9.08		303 61	6.64	2	52.50	21	54	25 46					
8	4	−3.69	−3.69	16	25 92	150	11	58 18	13.18		439 88	−7.02	2	45.86	21	57	11 30					
9	5	2.28		16	29.65	149	55	28.53	13.53		451 90	7.36	2	38.74	21	59	50.04					
10	6	−0.89		16	31.93	149	38	56 60	11.60		387 77	X 7.68	2	31.38	22	02	21.42					
11	7	+0.47		16	32 84	149	22	23.76	8.76		292 58	7.97	2	23.72	22	04	45 14					
12	8	+1.82		16	32.37	149	5	51.38	6.38		213 43	−8.25	2	15.75	22	7	0.89					
13	9	+3.14		16	30 53	148	49	20.85	5.85		195 39	8.52	2	7.36	22	9	8.25					
14	10	+4.43		16.	27.39	148	32	53.46	8.46		282 56	X 8.77	1	58.84	22	11	7.09					
15	11	+5.68		16	22.98	148	16	30.48	0.48		16 03	8.99	1	50.09	22	12	57.18					
16	12	+6.82		16	17.30	148	0.	18.19	13.19		440 88	−9.18	1	41.10	22	14	38 29					
17	13	+8.12		16	10.32	147	44	02 87	2.87		96 19	9.34	1	31 77	22	16	10.06					
18	14	+9.30		16	2.20	147	28	0.67	0.67		22 04	X 9.46	1	22.43	22	17	32.49					
19	15	+10.44		15	52 92	147	12	7.75	7.75		258 52	9.57	1	12.98	22	18	45.47					
20	16	+11.55		15	42.48	146	56	25.25	10 25		342 68	−9.66	1	3.41	22	19	48 90					
21	17	12.64		15	30.95	146	40	54.30	9 30		310 62	9.74	0	53.76	22	20	42.66					
22	18	+13.69		15	18.31	146	25	35.99	5.99		366 78	9 80	0	44.02	22	21	26 68					
23	19	14.72		15	4.63	146	10	31.36	X 1.36		45.09	9.85	0	34.23	22	22	0.91					
24	20	+15.72		14	49 91	145	55.	41.44	11.44		381 76	−9.88	0	24.38	22	22	25 30					
25	21	16.67		14	34 15	145	41	7.29	7.29		243 49	9.89	0	14.49	22	22	39.79					
26	22	+17.60		14	17.48	145	26	49.81	4.81		160 37	9.88	+0	4.60	22	22	44 35					
27	23	18.50		13	59.90	145	12	49.91	4.91		164 33	9.87	−	5.27	22	22	39.12					
28	24	+19.38		13	41 40	144	59	8.57	8.51		284 57	9.84	−	15.14	22	22	23 59					
Mar 1	25	20.21		13	21.95	144	45	46.56	1.56		52.10	9.80	0	24.98	22	21	59.01	Jan 23	16	50.25		
2	26	+21.01		13	1.74	144	32	44.82	14.82		494	9.73	−0	34.78	22	21	34.23	24	15	58.43		
3	27	21.80		12	40.74	144	20	4.08	4.08		136 27	9.64	−0	44.50	22	20	39.73	25	15	05.19		
4	28	+22.54		12	18.94	144	7	45.15	0.15		.05 41	−9.54	0	54.14	22	19	45.69	26	14	10.59		
					7.85													27	13	14.67		
		log ⊿			7.25		49 60		1549893									28	12	17.50		
					7.45													29	11	19.14		

Sid. time — α in time

Jan 23	27	+30 53	14	7 63	42 15	X 1545678	11	50.5	10 13	14.67			
24	28	31.06		7 77	−34 52	1542226		50	12	17.51	+59.16	+1.20	
25	29	X 31.53	−38.22	7 88	−26 75	1539551		49	11	19.15	58.36	1.11	9
26	30	31.94	−29.22	7 99	−18 87	1537664		49	10	19.68	59.47	1.04	7
27	31	32 32		8 08	−10 88	X 1536576		49	9	19.17	60.51	.96	8
28	1	32 52		8 13	− 2 77	1536299		49	8	17.90	61.47	.88	8
29	2	X 32 90	−7 95	8 22	+5 36	1536835		49	7	15.86	62.35	.77	11
30	3	33 10	+25 56	8 28	+13 56	1538191		50	6	12.23	63.12	.71	6
31	4	33 29		8 32	+21 84	X 1540376		50	5	8.40	63 83	.61	10
Feb. 1	5	33 38		8 35	+30 20	1543396		50	4	3 96	64.44	.53	8
2	6	X 33 46	+26.40	8 37	+38 55	1547251		50	2	58.99	64.97	.41	12
3	7	33 46		8 37	+46 90	1551941		51	1	53.61	65.38	.35	6
4	8	33 46		8 37	+55 27	X 1557469		52	0	47.88	65.73	.25	10
5	9	33.41		8 35	+63 64	1563833		53	9 59	41.90	65.98	.15	10
6	10	X 33.28		8 32	+71 99	1571032		54	58	35.77	66.13	+.06	9
7	11	33.10		8 28	+80 30	1579062		55	57	29.58	66.19	− 4	10
8	12	32 89		8 22	+88 58	X 1587922		57	56	23.43	66 15	11	7
9	13	32.54		8 13	+96 76	1597598	11	59	55	17.39	66.04	21	10
10	14	X 32.17		8 04	+104 89	1608087	12	1	54	11.52	65.83	30	9
11	15	31.77		7 99	+112 90	1619382		3	53	6.03	65.53	38	8
12	16	31 36		7 84	+120 94	X 1631478		5	52	0.88	65.15	46	8
13	17	30.94		7 73	128 74	1644352		7	50	56.19	64.69		8
14	18	X 30 49		7 62	+136 47	1657999		10	49	52 04	64.15	.54	9
15	19	30.02		7 51	+144 08	1672407		12	48	48.52	63.52	.63	6
16	20	29 53		7 38	151 59	X 1687566		15	47	45.68	62.83	.69	7
17	21	29.02		7 25	158 98	1703464		17	46	43.62	62.07	.76	4
18	22	X 28 49		7 12	+166 23	1720087		20	45	42.40	61.22	.85	6
19	23	27.93		6 98	+173 34	1737421		23	44	42.09	60.39	.91	7
20	24	27 34		6 83	180 32	X 1755455		26	43	42.76	59.33	.98	8
21	25	26 73		6 68	189 18	1774173		29	42	44.49	58.27	1.06	4
22	26	X 26 09		6 52	+193 86	1793555		32	41	47.32	57.17	1.10	8
23	27	25.45		6 36	+200 38	~~1813597~~		35	40	51.33	55.99	1.18	5
24	28	24.77		6 19	206 74	X 1834270		39	39	56.57	54.76	1.23	6
25	29	24.09		6 02	212 93	1855563		43	39	3.10	53.47	1.29	4
26	30	X 23 37		5 84	+218 85	1877458		43	38	10.98	52.12	1.35	6
27	31	22.62		5 66	+224 79	1899937		47	37	20.27	50.77	1.41	4
28	32	21 82		5 45	+230 45	1922983	12	51 55	36	31.01	49.26	1.45	4

Observations of (109)

To get – par for log par
diff. red. 4

Berlin Meridian Circle

1875 B.M.T.

				par. dis.	Δα(c–o)	Δδ(c–o)
Feb. 23	11 30 58	α = 9 44 35.22	δ = +22 22 45.5	+3.0	+8.59	–48.4
28	11 06 35	= 9 39 50.81	+22 23 11.2	+2.9	+8.24	–49.2

Berlin Equatorial

1875
Jan 30 11 11 13 α = 10 10 13.57 –0.16 +21 29 34.6 +3.4 + 8.79 – 52.1

Wien

1875
W.M.T.
Feb. 24 8 34 4.5
– 11 56.8
B.M.T. = 8 22 7.7
– 12 26.0
8 09 42
.34007
– 15993
log T 9.20393n

α = 9 43 43.93 +22 23 7.6
~~α = 9 43 43.93 – 1.02 +22 23 7.6 + 3.4~~

s ″
~~u = –47.98 +93.40 –.10~~
~~u′ = +.60~~
~~log u 1.68106n 1.97035~~
~~log u′ 9.77815 9.49 …n~~

α ″
u = –58.80 +19.40
u′ = + .53 – –

~~α δ″~~
~~ru –46.7 +14.94~~
~~r²u′ = + .02 .00~~
~~ru + r²u′ –76.5 +14.94~~

α δ
log u 1.76938 1.28780
log ru 9.72428n

ru +9.40 ~~+3.10~~
r²u′ + .01
+9.41 +3.10

f. 9 43 42.76 +22 22 20.3
f.(b) 9 43 52.17 +22 22 22.2
f.(o) 9 43 43.93 +22 23 11.0
f.(c–o) +8.24 – 48.8

		Δα(c–o) s	Δδ(c–o) ″
Feb. 23	Berlin	+ 8.59	– 48.4
28	Berlin	+ 8.24	– 49.2
24	Wien	+ 8.24	– 48.8
Feb. 25		+ 8.36	– 48.8

~~α₀ = 9 43 42.76~~

α(b) = 9 42 44.49 δ(b) = +22 22 39.8
Δα(c–o) + 8.36 – 47.7
α(c) 9 42 36.13 δ(b) +22 23 27.5

145 39 01.95

For Feb 24.5

α₀ = 145 55 41.44 δ₀ = +22 22 25.30
Δα(c–o) +2 5.40 Δδ(c–o) – 47.70
α(o) 145 53 36.04 δ(o) +22 23 13.00

Observations of (112) Iphigenia

Hamilton College.

1870

H.C. M.T.

		α h m s	log p″Δ	δ ° ′ ″	log p″Δ
Sept. 20	14 57 28	1 1 51.54	505	+10° 13 30.8	695
21	10 48 22	1 1 12.24	$.652_n$	10 10 58.9	.699
22	9 59 30	1 0 24.98	659_n	10 7 51.4	.711
26	11 22 8	0 56 55.80	311_n	9 53 18.4	.691
27	12 57 24	0 55 58.01	9.918	9 48 59.9	.688
		// 0 40 31.27	9.910_n	8	
Oct. 14	10 38 26	// 0 37 10.49	8.129	8 29 49.8	.703
18	10 47 57	// 0 34 51.31	9.156	8 10 16.4	.706
21	10 38 20	// 0 34 7.13	9.787	7 56 11.6	.705
22	10 49 57	// 0		7 51 32.6	.710
23	8 32 1	// 0 33 28.66	$.493_n$	7 47 24.3	.714

M.T. Berlin 1872

Feb. 5	13 9 47	9 25 33.33	8.875	+15 36 4.3	+.727
11	9 21 56	9 19 36.86	9.365_n	+15 58 22.8	+.747
Mar 5	10 47 44	8 59 39.35	8.851	+17 5 11.2	+.713
7	8 46 41	8 58 28.21	9.045_n	+17 8 36.0	+.716

M.T. Leipzig 1872

Feb. 28	10 23 2	9 3 57.13	8.146_n	+16 52 24.0	.700
Mar 4	8 46 7	9 0 21.62	9.140_n	17 3 5.9	.708
6	11 20 47	8 58 59.87	9.134	17 6 52.9	.723
8	9 49 6	8 57 51.25	9.301_n	17 10 1.3	.699

1872

Mean T. Lund

Mar 2	10 31 41	9 1 41.95	8.322	+16 59 11.2	.745
5	12 18 50	8 59 36.70	9.252	17 5 20.8	.763
7	10 8 27	8 58 26.18	8.114	17 8 40.0	.743
8	9 35 16	8 57 51.43	8.362_n	17 9 56.4	.743

1872

Mar 15 Hamburg M.T.

13 03 40	8 54 28.36	9.485	+17 18 10.1	.770

1870 M.T. Berlin

	Dec 20	8 33 59	0 40 24.75	9.228	+7 44 34.4	.801
	21	7 6 8	0 41 14.93	8.602	7 48 39.8	.794
1871	Feb. 5	13 9 47	9 25 33.33	8.877	15 36 4.3	.727
	11	9 21 56	9 19 36.86	9.365_n	15 58 22.8	.747

1873

M.T. Leipzig

May 29 11 ~~26 56~~ 22 29 15 (36) 26.92 8.447 −23 54 14.6 .935

May 29 11 6 26 15 (56) 26.92 —— −23 54 10.3 + 6.0″ = Meridian Obs.

1873

Wash. M.T.

							s	″
May 23	11 14 15	15 42 18.63	8.658_n	−24 15 6.8	.895	Corr. B.P.	+.71	+0.0
26	10 17 39	15 39 15.52	9.133_n	−24 4 37.4	.850		+.50	+2.5
28	10 46 21	15 37 18.15	8.718_n	−23 57 5.5	.894		+.13	−1.8

1873 Harvard College.

~~Corr~~ Δα(C−O) and Δδ(C−O) derived by comparison of the observations with the Ephemeris in the Jahrbuch for 1875 1

	Δa(C−O)	Δδ(C−O)		
May 18	$+.56^s$		+.56	− ~~.44~~
19	+.48	− 47	+.48	− 4.7
20	+.48	− 0.0	+.48	− 0.0
25	+.60	− 4.2	+.67	− 4.3
25	+.74	− 4.5		
29	+.70	− 5.3		
29	+.50	− 8.7		
29	+.58	− 6.4		
29	+.73	− 5.9		
29	+.75	—	+.69	− 5.3
29	+.70	—		
29	+.81	—		
29	+.76	—		
31	+.64	− 3.9		
31	+.57	− 0.7	+.53	− 2.3
31	+.49	− 2.0		
31	+.48	− 2.5		
			+.57	− 3.3

Normal for May 25.5 B.M.T.

$\alpha_0 = 15^h\ 40^m\ 28.19^s \quad -24^\circ\ 8'\ 48.8''$

$\Delta a(C-O) = +.57 \qquad -3.3 = \Delta\delta(C-O)$

$\alpha(O) \quad 15\ 40\ 27.62 \quad -24\ 8\ 45.5$

Hamilton Coll May 19 $+.50^s$ $-4.5''$

Yearly Ephemeris of (109) for 1876

	1875	1876								
	~~Dec. 21~~	~~Jan. 10~~	~~Feb. 19~~	~~Mar. 30~~	~~May 9~~	~~June 18~~	~~July 28~~	~~Sept. 6~~	~~Oct. 16~~	~~Nov. 25~~
	Jan. 10	30	Feb. 19	Mar. 10	Mar. 30	Apr. 19	May 9	May 29	June 18	July 8
M	127 53 53	132 21 11	136 48 29	141 15 47	145 43 05	150 10 23	154 37 41	159 05 59	163 32 17	167 59 35
E'	139 06 34	142 43 20	146 18 20	149 51 39	153 23 16	156 53 33	160 22 41	163 50 49	167 18 07	170 44 42
e sin E'	9.81599	9.78224	9.74411							
E'	139 06 24	142 43 22	146 18 22	149 51 34	153 23 15	156 53 32	160 22 39	163 50 47	167 18 05	170 44 48
½ E'	69 33 12	71 21 41	73 09 11	74 55 47	76 41 37	78 26 46	80 11 20	81 55 23	83 39 02	85 22 24
l sin ½ E'	9.97174	9.97660	9.98095	9.98480	9.98818	9.99111	9.99360	9.99567	9.99733	9.99858
l cos ½ E'	9.54324	9.50460	9.46212	9.41498	9.36203	9.30166	9.23147	9.14769	9.04512	8.90667
~~l tan ½ v~~	~~9.81531~~	~~9.77667~~	~~9.73419~~	~~9.68705~~	~~9.63410~~	~~9.57373~~	~~9.50354~~	~~9.41576~~	.26540	.27065
l cos ½ v	.124381	.124867	.125302	.125687	.126025	.126318	.126567	.126774	9.18[illegible]	9.04488
l tan ½ v	9.68145	9.64281	9.60033	9.55319	9.50024	9.43987	9.36968	9.28590	1.08[illegible]	1.22577
	.56236	.60586	.65269	.70368	.76001	.82331	.89599	.98184		
½ v	74 40 51	76 04 53	77 27 24	78 48 33	80 08 31	81 27 28	82 45 32	84 02 50	85 19 34	86 35 50
v	149 21 42	152 09 46	154 54 48	157 37 06	160 17 02	162 54 56	165 31 04	168 05 40	170 39 08	173 11 40
log √r	.25952	.26161	.26351	.26521	.26671	26802	.26915	27009	27085	27142
log r	.51904	.52322	.52702	.53042	.53342	.53604	.53830	.54018	.54170	.54284
		298 07 50	300 52 52	303 35 10	306 15 06	308 53 00	311 29 08	314 03 44	316 37 12	319 09 44
v + A + Ω'	295 19 46	~~222 02 57~~	~~223 25 28~~	~~224 46 37~~	~~226 06 35~~	~~227 25 32~~	~~228 43 36~~			
v + B + Ω'	205 45 18	208 33 22	211 18 24	214 00 42	216 40 38	219 18 32	221 54 40	224 29 16	227 02 44	229 35 16
v + Ω'	204 11 37	206 58 41	209 44 43	212 27 01	215 06 57	217 44 51	220 20 59	222 55 35	225 29 3	228 01 35
log sin (v + A + Ω')	9.95610$_n$	9.94541$_n$	9.93364$_n$	9.92067	9.90657	9.89122	9.87451	9.85648	9.83685	9.81552
log r a	51901	52319	52699	53039	53339	53601	53827	54015	54167	54281
log sin (v + B + Ω')	9.63801$_n$	9.67945$_n$	9.71568$_n$	9.74769$_n$	9.77620$_n$	9.80175$_n$	9.82476$_n$	~~9.8455~~$_n$	~~9.86341~~	9.88161$_n$
log r b	0.44995	.45413	.45793	.46133	.46433	.46695	.46921	47107	47261	47375
log sin (v + Ω')	9.61259$_n$	9.65697$_n$	9.69561$_n$	9.72962$_n$	9.75984$_n$	9.78688$_n$	9.81121$_n$	9.83318$_n$	9.85312$_n$	9.87125$_n$
log r c	.23687	.24105	.24485	.24825	.25125	.25387	.25613	.25801	.25953	.26067
x	+33023	+63276	+85817	+97950	+98402	+87300	+66109	+37394	+04474	-28953
X	~~+07404~~	~~+33023~~	~~+85817~~	~~+98402~~	~~+66109~~	~~+04474~~	~~-59157~~	~~+96897~~	~~-91396~~	~~-43899~~
x'	~~-.81236~~ -2.98620	-2.94170	2.88800	2.82580	2.75400	2.67440	2.58710	2.49250	2.39090	-2.28210
	-2.65597	-2.30874	-2.02983	-1.84580	-1.76998	-1.80140	-1.92601	-2.11856	-2.34596	-2.57163
y	-84974	-69272	-45085	-15425	+16085	+45711	+70073	+86473	+93146	+89405
Y	~~-89984~~	~~-84974~~	~~-45085~~	~~+16085~~	~~+70073~~	~~+93146~~	~~+75687~~	~~+25243~~	~~-36333~~	~~-81045~~
y'	1.02221 -1.22450	-1.36010	-1.49150	-1.61820	-1.73990	-1.85650	-1.96780	2.07330	-2.17300	-2.26650
	-2.07424	-2.05282	-1.94235	-1.77245	-1.57905	1.39939	1.26707	1.20857	1.24154	1.37245
z	-36869	-30056	-19562	-06693	+06979	+19833	+30403	+37520	+40415	+38791
Z	~~-39030~~	~~-36869~~	~~-19562~~	~~+06979~~	~~+30403~~	~~+40415~~	~~+32840~~	~~+10953~~	~~-15764~~	~~-35164~~
z'	-39146 -70710	.79070	.87190	.95030	1.02590	1.09840	1.16470	1.23360	1.29620	1.35490
	-1.07595	-1.09126	-1.06752	-1.01723	~~-1.05568~~ .95611	~~-1.2[illegible]673~~ -.90007	.86367	.85840	.89205	.96699
log Δ cos δ cos α	0.42423$_n$	0.36337$_n$	0.30745$_n$	0.26614$_n$	0.24797$_n$	0.25561$_n$	0.28466$_n$	0.32605$_n$	.37033$_n$	0.41020$_n$
log Δ cos δ sin α	0.08796	~~0.13307~~	0.17362	0.20903	0.24052$_n$	.26869$_n$	0.29398$_n$	.31666$_n$	0.33706	0.35536$_n$
log tan α	9.66373	9.77020	9.86617	9.94289$_n$	9.99255	.01308	.00932$_n$	9.99061	9.96673$_n$	9.94516$_n$
α	304 45 05	210 30 11	216 18 31							
α										
log Δ cos δ	52763 ~~0.47825~~	48885 ~~9.42806~~	0.44861 ~~9.40120~~	.40804	.37511	9.35814	.36276	38723	.42395	46442
log Δ sin δ	0.03173$_n$	0.03794$_n$	0.02837$_n$	0.00741$_n$	9.98050$_n$	9.95429$_n$	9.93634$_n$	9.93369	9.95039	9.98542
log tan δ	~~0.56566~~$_n$	~~0.60988~~$_n$	~~.62917~~	9.59937$_n$	9.60539	9.59615$_n$	9.57358$_n$	9.54646$_n$	9.52645$_n$	9.52108
δ	~~9.55348~~$_n$	9.54805$_n$	9.57976$_n$							
δ	9.50410$_n$ -17 42 17	-19 27 23	-20 48 21	-21 40 46	-21 57 13	-21 32 02	-20 32 12	-19 23 20	-18 34 35	-18 21 39
log Δ	42423	36337$_n$	.30745	26614	24797	.25561$_n$	.28466$_n$	.32605$_n$	.37033$_n$	41020
	31685$_n$	31235$_n$	28832	.24856	19839	.14594	10281$_n$	08228	09395	13748$_n$
	9.89262	9.94898	9.98087$_n$	9.98242	9.95042	9.89033$_n$	9.81815	9.75623	9.72362	9.72728
	217 59 17	221 38 33	223 44 20	223 50 27	221 44 13	217 50 29	33 20 26 213	29 42 12 209	27 53 17 207	28 05 17 208
log Δ	54870	51539	47790	43990	40780	38956	.39128	.41259	.44419	.48711

°	'
-17	42.3
19	27.4
20	48.3
21	40.8
21	57.2
21	32.0
20	32.2
19	23.3
18	34.6
18	21.6
18	46.6
19	38.2

~~Dec 35~~ July 28	Aug 7	Sept 6	Sept 26	Oct 16	Nov 5	Nov 25	Dec 15	Dec 35
172 26 53	176 54 11	181 24 29	185 48 47	190 16 05	194 43 23	199 10 41	203 37 59	208 05 17
174 10 58	177 36 54	181 02 47	184 28 57	187 54 29	191 21 13	194 48 11		301 44 45
	8.61924					9.40739		9.56878
174 11 00	177 36 56	181 02 44	184 28 36	187 54 40	191 21 09	194 48 13	198 16 00	201 44 12
87 05 30	88 48 28	90 31 22	92 14 18	93 57 20	95 40 34	97 24 06	99 8 00	~~301 44 42~~ 100 52 21
9.99944	9.99991	9.99998	9.99967	8.83874	9.99787	9.99637	9.99446	9.99213
8.70534	8.31820	9.96249	8.59169	9.99896	8.99822	9.11000	9.20067	9.27560
.27151	.27198	.27205	.27174	.27103	.26594	.26844	.26653	.26420
8.84355	8.45641	8.10070	8.72590	~~9.73717~~ 8.97655	9.13343	9.24821	9.33888	9.41381
1.42796	1.81557	2.17135	1.54184	1.29408	1.13651	1.02023	.92765	.85035
87 51 44	89 07 27	89 36 50	88 21 18	87 05 30	85 49 24	84 32 57	83 15 47	81 58 02
175 43 28	178 14 54	90 23 10	91 38 42	92 54 30	94 10 36	95 27 8	96 44 13	98 01 58
		180 46 20	183 17 24	185 49 00	188 21 12	190 54 16	193 28 26	196 03 56
27181	27203	27206	27182	27159	27109	.27041	.26954	26848
.54362	.54406	.54412	54384	.54318	.54218	.54082	.53908	.53696
321 41 32	324 12 58	~~326 21 14~~ 326 44 24	~~327 36 46~~ 329 15 28	331 47 04	334 19 16	336 52 20	339 26 30	340 02 00
232 07 04	234 38 30	237 09 56	239 41 00	242 12 36	244 44 48	247 17 52	249 52 02	252 27 32
230 33 23	233 04 49	235 36 15	238 07 19	240 38 55	243 11 07	245 44 11	248 18 21	250 53 51
9.78232	9.76695	9.73913	9.70857	9.67467	9.63664	9.59415	9.54551	9.48920
1.54359	54403	54409	54381	54315	54215	54079	53905	53693
9.89723	9.91145	9.92440n	9.93614n	9.94677n	9.95637n	9.96497	9.97262n	9.97932
~~.47223~~ .47453	.47497	.47503	.47475	.47409	.47309	.47193	.46999	.46788
9.88796	9.90281	9.91654	9.92900n	9.94033	9.95059	9.95983n	9.96810n	9.97540n
9.26446	.26189	.26195	.26167	.26101	.26001	.25865	.25691	.25479
-59107	-82708	-96897	-99973	-91396	-71979	-43899	-10477	+24229
+24229 2.16730	2.04640	1.91940	1.78810	1.65130	1.50940	1.36440	1.21500	1.06200
2.75881	-2.87348	-2.88867	-2.78783	-2.56526	-2.22919	-1.80339	-1.31977	~~1.30429~~ -.81971
+75689	+53493	+25243	-05897	-36333	-62450	-81040	-89750	-87416
-87416	-2.43460	2.50860	2.57570	-2.63550	-2.68820	-2.73340	-2.77080	-2.80020
~~2.38380~~ 1.59691	1.89967	2.25617	2.63467	2.99883	3.31270	3.54385	3.66830	3.67436
+32840 ~~-37928~~	+23210	+10953	-02559	-15764	-27096	-35764	-38941	-39928
1.41000	1.46120	1.50830	1.55120	1.58980	1.62410	1.65380	1.67880	-1.69900
1.08160	1.22910	1.39877	1.57678 ~~1.62361~~	1.74744	1.89506	2.00574	2.06821	2.07828
0.44072n	0.45841n	0.46070n	0.44526	0.40914	0.34815n	0.25609n	0.12051n	8.91365
0.37177n	0.38643	0.39943	0.41098	0.42086n	0.42946n	0.43670n	0.44261n	0.44719
9.93105n	9.92807	9.93873	9.96564	.01172n	.08131	.18061	.32210	0.53357
50347	.53765	56412	58386	59620	.60129	59948	.59189	57544
0.03407	0.08959	0.14575	0.19778	0.24239	0.27763	0.30220	0.31590	0.31771
9.53060n	9.55244	9.58163n	9.61392n	9.64619n	9.67634n	9.70272n	9.72478n	9.74197
-18 44 34	19 38 14	-20 58 17	-22 20 47	23 52 59	-25 23 23	-26 45 49	-27 56 49	-28 54 02
44072n	45841	46070	44526	40914	34815	25609	12051	9.91365
20328n	27868	35338	42973	47695	52018	54947n	56446n	.56519n
9.76256n	9.82027	9.89268	9.97548	.06781	.17203	.29338	.44395n	.65154
30 03 51	33 28 08	37 59 31	43 28 00	49 27 18	56 03 44	63 08 45	70 12 43	77 25 28
210	213	217	223	229	236	243	250	257
.52713	.57318	.59364	.61776	.63508	.64540	.64869	.64474	.63320

	h m		
	α ~~13 39.0~~		
Jan 10	14 31.9		
" 30	14 46.6	+14.7	-6.4
Feb 19	14 54.9	+8.3	7.8
Mar 10	14 55.4	+0.5	9.0
Mar 30	14 46.9	-8.5	7.0
Apr 19	14 31.4	15.5	-2.5
May 9	14 13.4	18.0	
	13 58.8	14.6	+3.4
	13 51.6	-7.2	7.4
	13 52.4	+0.8	8.0
	14 0.4	+8.0	7.2
	14 13.9	13.5	5.5
	14 32.0	18.1	4.6
	14 53.5	21.5	3.3
	15 17.8	24.3	2.8
	15 44.3	26.5	2.2
	16 12.1	27.8	1.3
	16 40.9	28.8	1.0
	17 9.7	28.8	0.

Dolsiel
Au 27/1876

17° 42.3'		
19 27.4	1 45.1	-24.2
20 48.3	1 20.9	28.4
21 40.8	0 52.5	36.1
21 57.2	+ 16.4	41.6
21 32.0	- 25.2	34.6
20 32.2	59.8	- 9.1
19 23.2	1 8.5	—
18 34.6	0 48.7	
18 21.6	-0 13.0	35.7
18 44.6	+ 23.0	36.0
19 38.2	53.6	30.4
20 53.3	1 15.1	21.5
22 20.8	1 27.5	12.4
23 53.0	1 32.2	+ 4.7
25 23.4	1 30.4	+ 1.8
26 45.8	1 22.4	8.0
27 56.8	1 11.0	11.4
28 54.0	0 57.2	13.8

lg A	
549	
515	34
478	37
440	38
408	32
390	18
391	1
413	22
447	34
487	40
527	40
563	36
594	31
618	24
635	17
645	10
649	-1 4
645	- 4
633	12

~~Yeau Ephemeris (109)~~

	1875 Jan 15	Feb 24	~~April~~ Apr 5	May 15	June 24	Aug 3	Sep 12	Oct 22	Dec 1	1876 Jan 10	Feb 19
E	62 57 27	72 59 24	82 30 10	91 33 10	100 11 55	108 29 41	116 29 27	124 13 59	131 45 33	139 06 24	146 16 22
v	79 36 36	90 23 42	100 05 22	108 51 48	116 52 12	124 14 32	131 05 22	137 30 46	143 34 44	149 21 42	154 54 48
log r											
u = v + ω*	130 39 12	141 26 18	151 07 58	159 54 24	167 54 48	175 17 08	182 08 08	188 33 22	194 37 20	200 24 18	205 57 24
log sin v	9.99282	9.99999	9.99323	9.97603	9.95038	9.91722	9.87717	9.82958	9.77358	9.70724	9.62735
log r	36718	39086	41332	43408	45298	46992	48494	49806	50942	51904	52702
log tg v	9.25611	7.83847n	9.24350n	9.50962n	9.65511n	9.75027n	9.81775n	9.86772n	9.90562n	9.93470n	9.95697n
log 2 sin v	.36000	.39085	.40655	.41011	.40336	.38724	.36211	.32764	.28306	.22628	.15437
log 2 cos v	9.62329	8.22933n	9.65682n	9.94370n	0.10809n	.22019n	.30269n	.36578n	.41504n	.45374n	.48359n
log sin u	9.88005	9.79474	9.68375	9.53599	9.32096	8.91482	8.57129n	9.17254n	9.40217n	9.54239n	9.64117n
log r	36718	39086	41332	43408	45298	46992	48494	49806	50942	51904	52702
log cos u	9.81390	9.89317n	9.94238n	9.97273	9.99026	9.99853	9.99970n	9.99514n	9.98570	9.97186	9.95382
log cos E	9.65768n	9.46618n	9.11554	8.43293n	9.24812n	9.50136n	9.64940n	9.75017n	9.82347n	9.87848n	9.92013n
cos v	+ 18035	+00689	−17519	−32331	−45197	−56269	−65728	−73743	−80468	−86046	−90568
cos E	+45466	+29254	+13048	−.02710	−17706	−31722	−44607	−56257	−66600	−75594	−83202
cos v + cos E	+.63561	+.28565	−.04471	−.35041	−.62903	−.87991	−1.10335	−1.30000	−1.47068	−1.61634	−1.73770
log (cos v + cos E)	9.80278	9.45583	8.65040n	9.54458n	9.79867n	9.94444n	0.04270n	0.11394n	0.16752n	.20854n	0.23997n
$\frac{p}{2}+1$	2.0539	1.9980	1.9477	1.9034	1.8650	1.8319	1.8036	1.7797	1.7595	1.7429	1.7294
log $(\frac{p}{2}+1)$	.31258	.30060	.28952	.27953	.27068	.26290	.25614	.25035	.24539	.24127	.23787
log 2 sin v	.36000	.39085	.40655	.41011	.40336	.38724	.36211	.32764	.28300	.22628	.15437
log 2 sin v $(\frac{p}{2}+1)$	.67258	.69145	.69607	.68964	.67404	.65014	.61825	.57799	.52839	.46755	.39224
log 2 sin w	.24723	.18560	.09707	9.97007	9.77394	9.38474	9.05623n	9.67060n	9.91159n	0.06143n	0.16819n
log 2 cos w	.18108n	.28403n	.35570n	.40681n	.44324n	.46845n	.48464n	.49320n	.49512n	.49090n	.48084n

$\varphi = 17\ 20\ 29.10$

For Ahu 195 1876

Mars	Moy 9
153 23 15	160 22 39
160 17 02	165 31 04
211 1938	216 8340
9.62809	9.39808
.53342	.53830
9.97876_n	9.98598
.06151	9.93638
.50918	.52428
9.71594_n	9.79501_n
.53342	.53830
9.93157_n	9.90484_n
9.85136_n	9.97402
$-.94137$	$-.96824$
$-.84405$	$-.94194$
-1.83542	-1.91018
0.26373_n	0.28107_n
1.7187	1.7107
.23520	.23317
.06151	9.93638
.29671	.16955
$.24936_n$	$.31331_n$
$.46455_n$	$.44314_n$

	°	′	″
Ω	4	57	30.21
$\Omega - \pi$	184	57	30.21
$\frac{1}{2}(\Omega-\pi)$	92	28	45.10
i'	8	2	2.12
ε	23	27	19.45
$i'+\varepsilon$	31	29	21.57
$i'-\varepsilon$	− 15	25	17.33
$\frac{1}{2}(i'+\varepsilon)$	15	44	40.78
$\frac{1}{2}(i'-\varepsilon)$	− 7	42	38.66

$\sin\frac{1}{2}(\Omega-\pi)$ 9.9995933
$\sin\frac{1}{2}(i'+\varepsilon)$ 9.4335310
$\sin\frac{1}{2}i'\sin\frac{1}{2}(\Omega'+a)$ 9.4331243
$\sin\frac{1}{2}i'\cos\frac{1}{2}(\Omega'+a)$ 7.7637141_n
1.6694102_n
$\tan\frac{1}{2}(\Omega'+a)$
$\frac{1}{2}(\Omega'+a)$ ~~+88~~ 46 24.82
$\frac{1}{2}(\Omega'+a)$ ~~91 13 35.18~~

$\cos\frac{1}{2}(\Omega-\pi)$ 8.6360525_n
$\sin\frac{1}{2}(i'-\varepsilon)$ 9.1276616_n
7.7637141_n

$\log\sin\frac{1}{2}i'$ 9.4332238
$\frac{1}{2}i'$ 15 43 59.65
i' 31 27 59.30

$\sin\frac{1}{2}(\Omega-\pi)$ 9.9995933
$\cos\frac{1}{2}(i'+\varepsilon)$ 9.9833919
$\cos\frac{1}{2}i'\sin\frac{1}{2}(\Omega'-a)$ 9.9829852
$\cos\frac{1}{2}i'\cos\frac{1}{2}(\Omega'-a)$ 8.6321078_n
$\tan\frac{1}{2}(\Omega'-a)$ 1.3508774_n
$\frac{1}{2}(\Omega'-a)$ 87 26 5!!
$\frac{1}{2}(\Omega'-a)$ ~~87 26 51.17~~ 92 33 8.83
$\frac{1}{2}(\Omega'+a)$ ~~91 13 35.18~~ 88 46 24.82
Ω' ~~178 40 26.35~~ 181 19 33.65
a 356 13 15.99
ω 51 19 8.18
ω' 55 05 52.19

$\cos\frac{1}{2}(\Omega-\pi)$ 8.6360525_n
$\cos\frac{1}{2}(i'-\varepsilon)$ 9.9960553
8.6321078_n

9.9834163

$\sin\Omega'$ 8.3643866_n
$\cos i'$ 9.9309214
$\cos\Omega'$ 9.9998837_n
$\sin i'$ 9.7176701

$\cos\Omega'$ 9.9998837
$\cos i'\sin\Omega'$ 8.2953080_n
$\tan A$ 1.7045757
A −88 52 08.14
$\log a$ 9.9999683
A 91 07 51.86

$-\sin\Omega'$ 8.3643866
$\cos i'\cos\Omega'$ 9.9308051
$\tan B$ 8.4335815
B 1 33 16.29
$\log b$ 9.9309650

	°	′	″		
$A+\omega'$	146	13	44.05	$\log a$	9.9999683
$B+\omega'$	56	39	8.48	$\log b$	9.9309650
ω'	55	05	52.19	$\log c$	9.7176701

$\log e$ 9.4443109
e .2980649
$1+\varepsilon$ 1.298065
$1-\varepsilon$ .7019351
$\log(1+\varepsilon)$ .1132964
$\log(1-\varepsilon)$ 9.8462970

$\log\sqrt{1+\varepsilon}$ .0566482
$\log\sqrt{a}$ .2155831
$\log\sqrt{1-\varepsilon}$ 9.9231485

$\log\sqrt{a(1+\varepsilon)}$ .2722313
$\log\sqrt{a(1-\varepsilon)}$ .1387316

φ 17 20 29.10
$\frac{1}{2}\varphi$ 8 40 14.55
$45°-\frac{1}{2}\varphi$ 36 19 45.45
$\tan(45-\frac{1}{2}\varphi)$ 9.8665004

$\log e$ 9.4743109
$\log b$ 5.3144251
$\log e''$ 4.7887360

Opposition Ephemeris

1876	Apr. 7.5	11	15	19	23	27	May
M	~~149 55 38.74~~ 147 15 35.05	148 08 56.28	149 02 17.51	149° 55′ 38.″74	150 48 59.97	151 42 21.20	152 35 42.43
E	154 35 17.55	155 17 18.26	155 59 15.84	156 41 10.52	157 23 2.43	158 04 51.53	
log sin E	9.6325798	9.6212294	9.6095222	9.5974383	9.5849562	9.5720524	
	4.4213158	4.4099654	4.3982582	4.3861743	4.3736922	4.3607884	
				6 45 31.80	6 34 2.43	6 22 30.30	6 11 55.57
	154 35 17.54	155 17 18.19	155 59 15.83	156 41 10.54	157 23 2.40	158 04 51.50	158 46 38.00
log sin E	9.6325798	9.6212296	9.6095221	9.5974382	9.5849564	9.5720539	9.5587028
log e sin E	4.4213158	4.4098656	4.3982581	4.3861742	4.3736924	4.3607892	4.3474388
e sin E	+7 19 42.49	+7 8 21.92	+6 56 18.32	+6 45 31.50	+6 34 2.44	+6 22 30.34	+6 10 55.57
E	154 35 17.55	155 17 18.20	155 59 15.83	156 41 10.54	157 23 2.41	158 04 51.54	158 46 38.00
½E	77 17 38.77	77 38 39.10	77 59 37.92	78 20 35.27	78 41 31.20	79 02 25.77	79 23 19.00
log sin E	9.9892326	9.9898224	9.9903991	9.9909491	9.9914863	9.9920061	9.9925088
log cos E	9.3422143	9.3308770	9.3180976	9.3054590	9.2924408	9.2790169	9.2651640
	0.2614639	.2620537	.2626258	.2631804	.2637278	.2642374	.2647401
	9.4810489	9.4691086	9.4568292	9.4441906	9.4310919	9.4177485	9.4038956
log tan ½v	.7804150	.7929451	.8057966	.8189898	.8326559	.8464885	.8608445
½v	80 35 9.56	80 50 56.84	81 06 41.84	81 22 24.66	81 38 05.84	81 53 43.97	82 09 20.62
v	161 10 19.12	161 41 53.68	162 13 23.68	162 44 49.32	163 16 10.68	163 47 27.94	164 18 41.24
log √r	.2673826	.2676165	.2678728	.2681215	.2683629	.2685966	.2688231
log r	.5347052	.5352330	.5357456	.5362430	.5367258	.5371932	.5376462
v+A+ω′	307 24 3.17	307 55 37.73	308 27 7.73	308 58 33.37	309 29 54.73	310 01 11.59	310 32 25.29
v+B+ω′	217 49 27.60	218 21 2.16	218 52 32.16	219 23 57.80	219 ~~[illegible]~~ 55 19.16	220 26 36.42	220 57 49.72
v+C+ω′	216 16 11.31	216 47 45.87	217 19 15.87	217 50 41.51	218 22 2.87	218 53 20.13	219 24 33.43
log sin(v+A+ω′)	9.9000042n	9.8969630n	9.8938327n	9.8906503n	9.8874152n	9.8841267	9.8807841
log r a	.5346735	.5352013	.5357139	.5362113	.5366938	.5371615	.5376145
log sin(v+B+ω′)	9.7876323n	9.7927220	9.7977048	9.8025837	9.8073618	9.8120420	9.8166271
log r b	.4656702	.4661980	.4667106	.4672080	.4676905	.4681582	.4686112
log sin(v+C+ω′)	9.7720197n	9.7774041	9.7826739	9.7878332	9.7928836	9.7978300	9.8026751
log r c	.2523753	.2529031	.2534157	.2539131	.2543956	.2548633	.2553163
x	+2.7209148	−2.7049818	+2.6887265	−2.6721546	−2.6552720	−2.6380812	−2.6205873
X	+.9503225	+.9274659	+.9002619	+.8688437	+.8333561	+.7939769	+.7509214
x′	−1.8157812	−1.8382958	−1.8611744	−1.8838461	−1.9063394	−1.9285827	−1.9506031
ξ	+.2911318	+.3504602	+.4081681	+.4639779	+.5176407	+.5688876	+.6174481
z	−1.0577793	−1.0722775	−1.0866498	−1.1008959	−1.1150141	−1.1289882	−1.1428547
η	+.1263185	+.1520582	+.1770945	+.2013133	+.2245997	+.2468365	+.2679181
log ρ cos δ cos a	~~2481196~~ +114	~~2498142~~	~~2524803~~	~~2560706~~	~~2605790~~	~~2657855~~	~~.2717640~~
log ρ cos δ sin a	.1763002n	0.1657549n	.1553763n	.1452637n	.1355256	.1262781n	.1176373
log tan x	9.9281806	9.9159407n	9.9028960n	9.8891931	9.8749966	~~9.8616074~~ 9.8604526	9.8458733
q	40 17 2.16	39 29 21.82	38 38 50.34	37 46 07.48	36 51 56.88	35 57 06.50	35 02 24.31
x	~~220 17 +2.16~~ +10.74	+11.19	+11.67	+12.15	+12.66	+13.20	+13.76
α	220 17 12.90	219 29 33.01	218 39 2.04	217 46 19.63	216 52 9.54	215 57 19.70	215 02 38.07
log ρ cos δ	.3656807	3623419 ~~.8874423~~	.3598265	.3581747	.3574157	.3575626	.3586124
log sin δ	9.9691645n	9.9638914	9.9588291	9.9540410n	9.9495907n	9.9455483	9.9419766
log tan δ	9.6034838	9.6015495	9.5990026n	9.5958663n	9.5921750	9.5879857n	9.5833643
δ	−21 51 38.52	−21 46 41.61	−21 39 45.64	−21 31 15.97	−21 21 19.52	−21 10 07.11	−20 57 50.85
	−10.27	−10.33	−10.46	−10.47	−10.53	−10.60	−10.68
	−21 52 08.79	−21 46 51.94	−21 38 56.04	−21 31 26.44	−21 21 30.05	−21 10 17.71	−20 58 ~~9.43~~ 1.57

	Apr. 7.5	11	15	19	23	27	May
l	299 12		301 14		303 25		305 43
a	220 17		218 39		216 52		215 02
q+a	159 29		159 53		160 17		160 45
log tan δ	9.6035		9.5990n		9.5922n		9.5834n
log sin(l+q)	9.5447		9.5365		9.5281		9.5181
log q	1.0402		1.0442		1.0485		1.0537
log cos(l+q)	9.9915n		9.9727n		9.9788		9.9750
log f	−1.54		−1.51		−1.47		1.43
f	+12.28		13.18		14.13		15.19
a′−a	+10.74	+11.19	+11.67	+12.15	+12.66	+13.20	+13.76
δ′−δ	−10.27	−10.33	−10.46	−10.47	−10.53	−10.60	10.68

.3981066	.3945006	.3916363	.3895599	.3883077	.3879037	.3883564

$$\delta^2 f_x = \frac{1}{16}\left(\Delta^2 f_x - \frac{5}{64}\Delta^4 f_x\right)$$

$$\delta f(x_0 - \tfrac{1}{2}h) = \tfrac{1}{4}\Delta f x_0 - \tfrac{1}{2}\delta^2 f(x+h)$$

$$\delta f(x_0 + \tfrac{1}{2}h) = \tfrac{1}{4}\Delta f x_0 + \tfrac{1}{2}\delta^2 f(x_0-h)$$

Mar 5	Mar 9	Mar 13	~~Mar 19~~
153 29 36.6	154 22 24.89	155 15 46.12	~~156 09 7.35~~
159 28 21.90		160 51 42.35	
9.5448775		9.5156731	
4.3336135		4.3044081	
5 59 18.24	5 47 38.42	5 35 56.22	
159 28 21.90	160 10 03.31	160 51 42.34	
9.5448774	9.5305457	9.5156732	
4.3336134	4.3192817	4.3044092	
+5 59 18.24	+5 47 38.43	+5 35 56.22	
159 28 21.90	160 10 3.32	160 51 42.34	
79 44 10.95	80 05 1.66	80 25 51.17	
9.9929944	9.9934680	9.9939147	
9.2508530	9.2360526	9.2207285	
.2652257	.2656943	.2661460	
9.3895846	9.3747842	9.3594601	
.8756411	.8909101	.9066859	
82 24 50.33	82 40 28.20	82 55 59.30	
164 49 50.66	165 20 56.40	165 51 58.60	
.2690421	.2692536	.2694578	
.5380842	.5385072	.5389156	
311 03 34.71	311 34 40.45	312 05 42.65	
221 28 59.14	222 00 4.88	222 31 7.08	
219 55 42.85	220 26 48.59	220 57 50.79	
9.8773865	9.8739330	9.8704228	
.5380525	.5384755	.5388839	
9.8211197	9.8255222	9.8298344	
.4690492	.4694722	.4698806	
9.8044214	9.8120721	9.8166298	
.2557543	.2561773	.2565857	
-2.6027892	-2.5846905	-2.5662959	-2.5662959
+.7044211	+.6547021	+.5883671	+.6019872
-1.9723973	-1.9939670	-1.7918535	-1.9939670
+.6632064	+.7058848	+.7546903	.7453488
-1.1565800	-1.1701712	-1.1836283	1.1836283
+.2877563	+.3062734	+.3274486 8662333	~~.3233980~~ ~~.4382795~~
.2783804	.2855547	.2962106	.2932097
.1097124	.1026084	.0931682	.0964296
9.8313320	.8170537	.7969576	.8032199
34 08 36.76	83 16 26.20		82 26 31.88
+14.33	+14.92		+15.53
214 08 51.09	213 16 41.12		212 26 47.41
.3605420	.3633189		.3669017
9.9389316	9.9364623	~~9.9325649~~	9.9316163
9.5783896	9.5731434		9.5647446
20 44 44.86	20 31 03.24	~~20 9 18.75~~	~~9.5…2466~~
-10.78	-10.89	11.01	~~-11.01~~
20 44 55.64	20 31 14.13	-20 9 29.76	~~17 59 40.67~~
		20 17 0.85	
		11.01	
		- 20 17 11.86	

308 07
213 16
161 23
9.5781
9.5041
1.0603
9.9767
-1.37
16.29

+14.33	+15.52	15.53
-10.78	10.89	-11.01
3.96553	.3917811	~~.3988926~~ ~~3943604~~ 3547043

	Δ_1	Δ_2	Δ_3	Δ_4
220 17 12.90		-3 26.7		
	-47 39.89		35.6	
219 29 33.01		-2 51.08		+4
	-50 30.97		+39.64	
218 39 2.04		-2 11.44		+4.12
	-52 42.41		+43.76	
217 46 19.63		-1 27.68		+4.17
	-54 10.09		+47.93	
216 52 9.54		-39.75		-.05
	-54 49.84		+47.88	
215 57 19.70		+8.13		-1.28
	-54 41.71		+46.60	
215 02 38.07		+54.73		-4.32
	-53 46.98		+42.28	
214 08 51.09		+1 37.01		-3.03
	-52 9.97		+39.25	
213 16 41.12		+2 16.26	36	
	-49 53.71	2 52		
212 26 47.41				

-21 52 08.79				
	+5 16.85	+42		
21 46 51.94		+1 39.03	3.0	
	+6 55.90		-5.33	
21 39 56.04		+1 33.70		-15.8
	+8 29.60		-6.91	
21 31 26.44		+1 26.79		-3.93
	+9 56.39		-10.84	
21 21 30.05		+1 15.95		-1.27
	+11 12.34		-12.11	
21 10 17.71		+1 03.84		-1.94
	+12 16.14		-14.05	
20 58 1.57		+0 49.79		-0.16
	+13 05.98		-14.21	
20 44 55.64		+0 35.58		-0.61
	+13 41.51		-14.82	
20 31 14.13		20.76		
	+14 2.27			
-20 17 11.86		5.0		

3981066		6897		
	-36060		520	
3945006		+7417		
	-28643		+462	
3916363		+7879		
	-20764		+363	99
3895599		+8242		123
	-12522		+240	
3883077		+8482		155
	-04040		+85	
3879037		+8567		188
	+4527		-103	
3883564		+8464		96
	12991		199	
3896555		+8265		99
	21256		289	
3917811		7976		
79 43	29232		385	
3947043	~~21115~~ ~~25798~~	7587		

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	$\int^2 f_x$ '' x				$\int^2 f_x$ ''		° ' ''		$\int$ h m s
Apr 7.5	−12.90	−12.90		220 17 12.90	+6.38		−21 52 8.79	' ''	14 41 8.86
8	12.37	−12.37	−11 36.97	220 05 35.93	6.34	+1 9.75	21 50 59.04	9.7	14 40 22.40
X 9	11.82	−11.82	−11 49.34	219 53 46.59	6.30	+1 16.09	21 49 42.95	16.1 44	14 39 35.11
10	11.26	−11.26	12 1.15	219 41 45.44	6.24	+1 22.38	21 48 20.57	22.4 63	14 38 47.03
11	10.68	10.68	12 12.41	219 29 33.01	6.18	+1 28.62	21 46 51.84	28.6 62	14 37 58.20
12	10.08	10.08	12 23.25	219 17 9.76	6.10	+1 34.92	21 45 17.02	34.9 63	14 37 8.65
X 13	9.47	9.47	12 33.33	219 04 36.43	6.02	+1 41.02	21 43 36.00	41.0 61	14 36 18.43
14	8.84	8.84	12 42.78	218 51 53.65	5.93	+1 47.03	21 41 48.97	47.0 60	14 35 27.58
15	8.20	8.20	12 51.62	218 39 2.04	5.84	1 52.96	21 39 56.04	52.9 59	14 34 36.14
16	7.53	7.53	12 59.99	218 26 2.05	5.75	1 58.88	21 37 57.16	58.9 60	14 33 44.14
X 17	6.87	6.87	13 7.52	218 12 54.53	5.66	+2 4.63	21 35 52.532	46 57	14 32 51.63
18	6.17	6.17	13 14.36	217 59 40.17	5.55	2 10.27	21 33 42.26	10.3 57	14 31 58.67
19	5.47	5.47	13 20.53	217 46 19.63	5.44	2 15.82 X	21 31 26.44	15.5 55	14 31 5.31
20	4.72	4.72	13 26.16	217 32 53.44	5.29	2 21.33	21 29 5.11	21.3 55	14 30 11.58
X 21	3.97	3.97	13 30.88	217 19 22.56	5.13	2 26.62	21 26 38.49	26.6 53	14 29 17.52
22	3.23	3.23	13 34.98	217 05 47.58	4.96	2 31.74	21 24 6.75	31.7 51	14 28 23.19
23	2.48	2.48	13 38.11	216 52 9.54	4.78	2 36.70	21 21 31.05	36.7 50	14 27 28.64
24	1.73	1.73	13 40.61	216 38 28.93	4.60	2 41.38	21 18 48.67	41.4 47	14 26 33.93
X 25	0.98	.98	13 42.34	216 24 46.59	4.41	2 45.88	21 16 2.69	46.0 46	14 25 39.11
26	−.24	−.24	13 43.32	216 11 3.27	4.20	2 50.38	21 13 12.31	50.4 44	14 24 44.22
27	+.50	+.50	13 43.56	215 57 19.70	3.99	2 54.58	21 10 17.71	54.6 42	14 23 49.31
28	1.25	1.25	13 43.03	215 43 36.67	3.77	2 58.60	21 7 19.11	58.6 40	14 22 54.44
X 29	2.01	2.01	13 41.78	215 29 54.89	3.55	3 2.87	21 4 16.74	2.4 38	14 21 59.65
30	2.71	2.71	13 39.81	215 16 15.08	3.33	3 5.91	21 1 10.83	5.9 35	14 21 5.00
May 1	4.10	3.40	13 37.10	215 02 38.07	3.11	3 9.24	20 58 1.57	9.2 33	14 20 10.54
2	4.75	4.10	13 33.54	214 49 4.53	2.89	3 12.37	20 54 48.20	12.4 32	14 19 16.30
X 3	5.40	4.75	13 29.44	214 35 35.09	2.67	3 15.26	20 51 33.94	15.3 29	14 18 22.34
4	6.05	5.40	13 24.69	214 22 10.40	2.45	3 17.92	20 48 16.02	17.9 26	14 17 28.69
5	6.68	6.05	13 19.25	214 08 51.09	2.22	3 20.37	20 44 55.64	20.4 25	14 16 35.41
6	~~4.05~~ 7.30	6.68	13 13.12	213 55 37.97	1.99	3 22.67	20 41 32.97	22.7 23	14 15 42.53
X 7	4.75 7.90	7.30	13 6.44	213 42 31.53	1.76	3 24.62	20 38 8.35	24.6 18	14 14 50.10
8	5.40 8.50	7.90	12 59.15	213 29 32.38	1.53	3 26.38	20 34 41.97	26.4	14 13 58.16
9	6.05	8.80	12 51.25	213 16 42.12	1.29	3 27.91	20 31 14.13	27.8 14	14 13 6.74
10	6.68	9.25	12 42.77	X 213 03 58.35	1.06	3 29.21	20 27 44.52	29.2 14	14 12 15.89
X 11	7.30	9.65	12 33.52	212 51 24.83	.82	3 30.27	20 24 14.65	30.3 11	14 11 25.66
12	7.90	10.19	12 23.81	212 39 1.02	.59	3 31.10	20 20 43.55	31.1 8	14 10 36.07
13	8.50	10.74	12 13.62	212 26 47.41	+.35	3 31.69	20 17 11.86	31.9 6	14 09 47.16

				h m s
	+ 4.31		−3981066	= 20 45
10	+ 4.41	−9683	3971383	20 42
	X + 4.47 X	−9242	−3962141	20 39
	+ 4.55	−8795	3953346	20 37
	− + 4.63	8340	−3945006	20 35
	+ 4.70 X	7873	3937133	20 33
	+ 4.78 X	−7403	−3929730	20 30
	4.85	−6926	3922804	20 28
	− 4.92	6441	−3916363	20 26
	4.98	5943	3910420	20 24
	X 5.04	5445	−3904975	20 23
	5.09	4942	3900033	20 22
	~~5.12~~	4433	−3895599	20 21
	− 5.15		3891687	20 20
	5.19	3912	−3888294	20 19
	X 5.23	3393	3885424	20 18
	5.26	2870	−3883077	20 17
	− 5.30	2344	3881269	20 16
	5.31	1808	−3879992	20 16
	X 5.33	−1277	3879247	20 16
	5.34	−745	−3879037	20 16
	− 5.35	−211	3879370	20 16
	X 5.34	+333	−3880237	20 16
	X 5.33	+ 867	3881636	20 17
	5.31	+ 1399	−3883564	20 17
	− 5.29	+1930	3886025	20 18
	X 5.27	.2461	−3889013	20 19
	X 5.24	+2988	3892524	20 20
	5.21	+3511	−3896555	20 22
	− 5.17	+4032	3901105	20 22
	X 5.13	4550	−3906168	20 24
	X 5.08	5063	3911738	20 25
	5.03	5570	−3917811	20 27
	− 4.98	6073	3924387	20 29
	X 4.92	6576	−3931455	20 31
	X 4.86	7068	3939009	20 33
	4.80	7554	−3947043	20 35
	− 4.74	8034	8955073	

Mag of (109) for 1874 = 11.5
" " 1875 = 9.9

lg $a^2(a-1)^2$ = 1.31944
lg $2^2 a^2$ 1.85146
lg h = 9.46798

I = 0.29
.5321

lg 2 = .53719
lg a = .38854
lg 2^2 1.07438
lg 4^2 .77708
lg $2^2 a^2$ 1.85146

m fr 1865 = 9.2
1871 10.5
1873 11.5
1875 9.8
31.0

M = 10.3

lg 2.45 = .38917
9.46798
9.85715

.5321
2.45
26605
21284
10642
1.30

M = 10.3 + 1.3 = 11.6

Elements of (123) from observations of 1872 and 1875

Epoch = Sept. 7.5 1872 B. M. T.

M 271° 49' 16".26 M for Aug 5.3 = ~~266 24 51.01~~ 264 26' 15".76

π 70 37 58.73 + 50.21 T

M. Eq. 1872.0 ☊ 308 30 23.48 + 53.17 T ☊' ~~80 18 42.63~~ 169 16 35.30

i 6 22 40.54 + 0.33 T i' 27 51 5.89

φ 6 31 52.59

μ 805.46956

log a .4293050

ω 122 07 35.25 ω' 80 18 42.63

Elements for Apr 5.5 1875

ΣΣ dμ/dt² dμ di d☊ dφ dπ dM log a

+1' 43".06 −64727 −20.44 −3' 46.14 +34 22.34 −36 38.31

+ .99 +2 39.51 +2 30.63 +1 43.06

−64727 −19.45 −1 6.63 +8.03 +36 52.97 −34 55.25

805.46956 6 22 40.54 308 30 23.48 6 31 52.59 70 37 58.73 271 49 16.26

804.82229 6° 22' 21".09 308° 29' 16".85 6° 32' 0".62 71 14 51.70 271° 14' 21".01 4295378

210 18 01.39 = 940 μ

121 33 22.40

☊ 308 29 16.85 sin ½(☊−ω) 9.9545574 cos ½(☊−ω) 9.6380293 sin ½(☊−ω) 9.9545574 cos ½(☊'−ω) 9.6380293

☊−ω 128 29 16.85 sin ½(i'+ε) 9.4105569 cos ½(i'−ε) 9.1718019 cos ½(i'+ε) 9.9851178 cos ½(i'−ε) 9.9951561

½(☊−ω) 64 14 38.42 9.3651143 8.8098312n 9.9396752 9.6331854

i 6 22 21.09 8.8098312n 9.6331854

ε 23 27 19.93 0.5552831 0.3064898

i+ε 29 49 41.02 −74 26 28.22 π = 71 14 51.70 63 43 19.13 Log.

i−ε −17 04 58.84 108 33 31.78 ☊ 308 29 16.85

½(i+ε) 14 54 50.51 63 43 19.13 ω 122 45 34.85 i 13 55 22.81

½(i−ε) −8 32 29.42 169 16 50.91 Δ 41 50 12.65 i' 27 50 45.62

41 50 12.65 ω' 80 55 22.20

~~122 07 35.25~~

~~81 17 22.60~~

φ 6 36 43.86

½φ 3 18 21.93

45−½φ 41 41 38.07

Elements July 8.5 1876

log √(1−e)/(1+e) 9.9497691

∫dμ di d☊ dφ dπ dM

+55071 −3".27 −12' ~~44.45~~ +4' 51".27 +50' 51".23 −57' 32".77 log e 9.0612578

+1.32 +3 32.68 +3 20.84 .1151484

+55071 −1.95 −9 11.77 +4 51.27 +54 12.07 −57' 32".77 1−e 8848516

805.46956 6 22 40.54 308 30 23.48 6 31 52.59 70 37 58.73 271 49 16.26 log(1+e) 0.0473327

806.02027 6° 22' 38".59 308 21 11.71 6 36 43.86 71 32 10.80 270 51 43.49 log(1−e) 9.9468705

308 21 11.71 313 14 17.38 1400 μ 0236663

123 10 59.09 224 06 0.87 21.45535

9.9734352

☊ 308° 21' 11".71

☊−ω 128 21 11.71 9.9543106 9.6390862 9.9543106 9.6390862 log √a(1+e) .2382198

½(☊−ω) 64 10 35.85 9.4106243 9.1716709 9.9851131 9.9951590 log √a(1−e) .1899887

i 6 22 38.59 9.3649349 8.8107631n 9.9394237 9.6342452

ε 23 27 19.45 8.8107631 9.6342452 log e 9.0612578

i+ε 29 49 58.04 0.5541778 9.3812286 .3051785 5.3144251

i−ε −17 4 40.86 −74 24 11.82 i 13 55 ~~23.00~~ 11.14 log μ" 4.3156829

½(i+ε) 14 54 59.02 105 35 48.28 i' 27 50 ~~47.20~~ 22.28

½(i−ε) −8 32 20.43 63 39 11.68 Log.

log μ 2.9063400 ☊' 169 14 59.86 sin ☊' 9.2707364 9.9923105 9.2707364 A+ω' 161° 42' ~~54.53~~ 34.25

3.5500066 Δ 41 56 36.52 cos i" 9.9465795 9.2173154 9.9388708 B+ω' 69 07 ~~18.19~~ 18.23

.6436606 π 123 10 59.09 cos ☊' 9.9923106 .7749946 1168 9.3318403 ω 81 14 ~~22.48~~ 57

2145535 ω' 81 14 22.~~48~~ 57 sin i" 9.6693138 .8028120 −12 07 04.20 log a 9.9983460

.4291070 9.9983460 347 52 55.80 log b 9.9486737 66

9.9486737 log c 9.6693138

δ
i' = 27° 55' 42"
Δi' − 3 51
i'' 27 51 51
log cos i'' 9.94648
cos i'' .88405
1 − cos i'' .11595
log(1 − cos i'') 9.06427
log dΩ' 2.42535
log dΩ'(1 − cos i'') 1.48962
dΩ'(1 − cos i'') + 30.88
dχ − 1 40 0.00
dπ' − 1 39 29.12
dΩ' + 4 26.29
dω' = − 1 43 55.41

log cos i' 9.94648
log dΩ' 2.42535
log cos i' dΩ' 2.37183$_n$
cos i' dΩ' − 2 35.42
− 3 55.42
dχ − 1 40 00.00
dω' − 1 43 55.42
dL = + 13 18.22
dΩ'(1 − cos i') + 30.88
L' + 13 49.10
dπ' = − 1 39 29.12
dM + 1 53 18.22

log b = 7.76644$_n$
log dlog a 2.38006
log dμ 0.14650$_n$
dμ − 1.40120
μ$_0$ 802.84414
μ 801.44294
log μ 2.9038726
3.5500066
0.6461390
2153780
4307560

P for 1875
with perturbations ♃
log M a i'' 4.32335
log dlog a 2.38006
log dlog a 6.70341
dlog a + 000 5007
log a$_0$ 4302504
log a 4307555

Elements of (123) from observa

Normal places for (123)

1872
Aug 5.5 B.M.T.
α$_0$ = 328° 36' 10.72 δ$_0$ = − 10° 11' 37.74
Δα(C−O) − 5.50 Δδ(C−O) + 1.00
α(O) 328 36 16.22 δ(O) − 10 11 38.74

Sep. 4.5
α$_0$ 822° 02' 0.83 δ$_0$ = − 11° 20' 12.87
Δα(C−O) − 1.92 Δδ(C−O) − 1.80
α(O) 822 02 2.75 δ(O) − 11 20 11.07

Elements corrected for perturbations of ♃ for May 3.5 1875
Epoch May 3.5 1875

M$_0$ 126° 22' 30.45 μ$_0$ 802.84414 φ$_0$ 6 31 20.62 log a 4.302504
dM + 1 53 18.22 dμ − 1.40120 dφ + 4 2.85 dlog a + 5054
1001 dμ − 23 21.20 μ 801.44294 φ 6 35 23.47 log a 4.307558
M 127 52 33.47

Ω'$_0$ = 164° 11' 26.17 ω' = 81° 50' 9.41 i' 27° 55' 21.88
dΩ' + 4 26.39 dω' − 1 43 55.41 di' − 3 51.35
Ω' 169 15 52.56 ω' 80 06 14.00 i'' 27 51 30.53

Log:
sin Ω' 9.2701575 − cos Ω' 9.9923316 − sin Ω' 9.2701575 A + ω' 160° 35' 14.53
cos i' 9.9465036 cos i' sin Ω' 9.2166451 − cos i' cos Ω' 9.9388352 B + ω' 68 0 1.42
cos Ω' 9.9923316 tg A 0.7756765 log tg B 9.3313163 ω' 80 6 14.00
sin i'' 9.6695858$_n$ A 80 29 45.3 B − 12 6 12.58
log a 9.9983485 B 347 53 47.42
log b 9.9485983

log e'' 4.3742202
log e 9.0599757
e .1147612
1 + e 1.1147612
1 − e .8852388

log √a(1+e) ~~.2986357~~ ~~.2389688~~
log √a(1−ε) ~~.07862~~ .1889083

log(1+ε) .0471818
log(1−ε) 9.9470604
log √(1+ε) .0235909
log √a 2153777
log (1−ε) 9.9735302

log √a(1+ε) .2389686
log √a(1−ε) .1889079

Equations for (23)

				dΩ′	di′	dla	dφ	$\frac{d\psi}{10}$	s
0 =	+000″	+000 di	+000	+1.485	−0.136	−2.945	+0.729		−.867
	−2238	+00	+000	+1.281	−7.261	+2.119	+1.912		−1.549
	0	−.730	−648	+.000	−.009	−.001	−.010		−1.358
	−427	−928	+.542	−.006	+.112	+.040	−.082		−0.322

	a	b	c	d	e	f	s	n
aa1	+1.3941	−0300	+0056	−0973	−0364	+0834	+1.3194	+396.25
log aa	.1442939	8.4771213n	7.7481880	8.9881128n	8.5611014n	8.9211661	0.1203765	2.5979693
bb		+7137	−0033	+0665	+0223	−0379	+7313	−231.43
ab ab/aa		+0006	−0001	+0021	+.0008	−0018	−.0284	−8.53
bb1		+0.7131	−0032	+0644	+0215	−0361	+7597	−22290
log bb1		9.8531504	7.5051500n	8.8088859	8.3324385	8.5575072n	9.8806421	2.3481101n
cc			+3.8461	−9.5040	−1.6589	+3.5324	−3.7821	−2864.32
ac ac/aa cc1			+0000	−0004	−0001	+0003	+0053	+1.59
			+3.8461	−9.5036	−16588	+3.5321	−3.7874	−2865.91
bc bc1/bb			+0000	−0003	+0001	+0002	−0034	+1.00
cc2			+3.8461	−9.5033	−16587	+3.5319	−3.7840	−2866.91
log cc2			.5850206	.9778144n	.2197678n	.5480084	.5779511n	3.4574140n
dd				+52.7532	−149812	−13.9912	+14.2462	+16202.30
ad ad				+0068	+0025	−0058	+.0921	−27.606
dd1				+52.7464	−149837	−13.9854	+14.338	+16229.986
bd bd1				+.0058	+0079	−0033	+.0686	−20.131
bb dd2				+52.7406	−149856	−13.9821	+14.2695	+16250.087
cd2 cd2/cc2				+23.4816	+49954	−8.7269	+9.3498	+7083.823
dd3				+29.2590	−1.9890	−5.2662	+4.9198	+9166.26
log dd3				1.4662595	1.2806694n	0.7205 n	0.6919474	3.9621922
ee					+13.1647	+1.9013	−1.5882	−4759.40
ea ea/aa ee1					+0009	−0022	−.0345	−10.35
					+13.1638	+1.9035	−1.5537	−4749.05
be be1					+0006	−0011	+0229	−6.72
bb ce2					+13.1632	+1.9046	−1.5766	−4742.33
ce2 ce2					+.7153	−1.5232	+1.6319	+1236.41
cc ee3					+12.4479	+3.4278	−3.2085	−5978.74
de3 de3					+12.4477	+3.4277	−3.2089	−5978.64
dd3 ee4					+0002	+0001	+.0009	−0.10
log ee4					6.3010300	6.0000000	6.4771213	9.0000000n
ff						+4.1939	−4.3181	−4244.05
af af/aa						+.0050	+.0789	+23.70
ff1						+4.1889	−4.3970	−4267.75
bf bf1						+0019	−0385	+11.28
bb ff2						+4.1870	−4.3085	−4279.03
cf2 cf2/cc2						+3.2434	−3.4749	−2632.70
ff3						+0.9436	−0.8837	−1646.33
df3 df3/dd3						+0.9439	−8836	−1646.35
ff4						−0.0003	−0001	+0.02
ef4 ef4/ee4						+0000	+0002	+0.05
ff5						−0003	−0003	+0.07
						6.47712n		8.84510

log n5 8.80103 8.84510
−log ff5 6.47712 6.47712
log dψ 1.82391 2.36798
$\frac{d\psi}{10}$ +66.67 +233.340
dψ +11 6.67 +38′ 53.40″

$\frac{d\psi}{10}$ ef4 + 0.02
e n4 −0.10
s +.08
log s 8.90309n
−log ee4 6.30103n
log dφ 2.60206
dφ +4.0000
dφ = +6 40.00

dψ df3 −1226.25
dφ de3 −763.370
dn3 +916.626
s +306.31
log s 2.48616
−log dd3 1.46626n
dla log a 1.01990n
dla −10.47

$\frac{d\psi}{10}$ cf2 +824.12
dφ ce2 −663.49
dla cd2 + 99.49
dn2 −2866.91
s −2606.79
log s 3.41511n
−log cc2 0.58502n
log di′ 2.83009n
di′ +676.23 +11′ 16.23

dψ bb1 −842
dφ be1 +860
dla bd1 −067
di′ be1 −216
bn1 −222.90
s
log s −225.55
−log bb1 2.35324n
log dΩ′ 9.85315n
dΩ′ 2.50009
dΩ′ +316.29 +5′ 16.29″

dψ ab +19.46
dφ ae −14.56
dla ad +1.02
di′ ac +3.79
dΩ′ ab −9.49
an +396.25
s +396.47
log s 2.59821
−log aa 14429
log di″ 2.45392n
di′ −284.40
di′ −4′ 44.40″

	ns	nn
	+449930	+5190973
	+ 37502	+ 112628
sn1 nn1	+412433	+5078345
	+ 23746	69674
	~~+888687~~	
sn2 nn2	+4361.79	5008671
	+ 282062	2137015
sn3 nn3	+1541.17	2871606
	1541.27	2871606
sn4 nn4	− 0.10	50
	− 0.11	1
sn5 nn5	+ .06	49
	+ .06	

− 233 + 0.09
− 0.20 + .00 3
−204.96 207.61
+ 0.21

+170.10
+ 1.42
+1004.20 1
−1175.72
−1 28.0
+2.3

4
− 19.13 + 16.00
− 1.17 171.43
− 4.05 263.88
24.35 451.41
24.35
427.06
427.0
+0.1

+ 446.14
+ 847.60
+ 76.02 2
+ 866.25
+2236.01
−2238.0
− 2.0

Elements of (123) for May 3.5 1875

log(1 − cos i′) 9.06427
log dΩ′ 2.50009
log(dΩ′(1 − cos i′)) 1.56436
dΩ′(1 − cos i′) + 36.67
dχ + 38 53.40
dπ′ + 39 30.07
dΩ′ + 5 16.29
dω′ + 34 13.78

log cos i′ 9.94648
log dΩ′ 2.50009
log dΩ′ cos i′ 2.44657
dΩ′ cos i′ 279.62
− 4 39.62
dχ + 38 53.40
dω 34 13.78

° ′ ″
dL = + 11 16.23
dΩ′(1 − cos i) + 36.87
dL′ + 11 53.10
dπ′ + 39 30.07
dM − 27 36.97

log L 7.76644
log d log a 1.01998
8.78634
log dμ − .06114
μ₀ 802.84414
μ 802.78300

log μ 2.9045981
3.5500066
.6454085
2151362
.4302724

log Mar″ 4.32335
log d log a ~~1.01990~~
~~6.79344~~
5.34325
.0000220
.4302504
log a .4302724

° ′ ″
M 176 22 ~~36.45~~
dM − 27 36.97
μ′ d a − 1 1.14
M 125 53 58.34

Ω′ 169 11 26.17
dΩ′ + 5 16.29
Ω 169 16 42.46

μ = 802.78300
log a = 4302724

φ = 6 31 20.62
dφ + 6 40.00
φ = 6 38 0.62

i₀ = + 27 55 21.88
di − 4 44.40
i = 27 50 37.48

ω° 81 50 9.41
dω + 34 13.78
ω 82 24 23.19

log sin Ω′ 9.2695951
cos i″ 9.5465626
cos Ω′ 9.9923516ₙ
sin i″ 9.6693745ₙ

− cos Ω′ 9.9923516
cos i′ sin Ω′ 9.2161577
tan A 0.7761939
A 80 29 44.57
log a 9.9983543

− sin Ω′ 9.2695951ₙ
− cos i′ cos Ω′ 9.9389142
tan B 9.3306809ₙ
B − 12 05 10.84
B 347 54 49.16
log b 9.9486490

φ = 6 38 0.62
½φ 3 19 0.31
(45° − ½φ) 41 40 59.69
log tan (45° − ½φ) 9.9456062

° ′ ″
A + ω′ 162 54 7.76
B + ω′ 70 19 12.35
ω′ 82 24 23.19

log a 9.9983543
log b 9.9486490
log c 9.6693745

log e 9.0626498
e .1155180
1 + e 1.115518
1 − ε .884482
log(1 + ε) .0474766
log(1 − ε) 9.9466890
log √(1 + e) .0237383
log √a .2151363
log √(1 − ε) 9.9733445

log √a(1 + ε) .2388746
log √a(1 − ε) .1884808

log e 9.0626498
log c 5.3144251

log e″ 4.3770749
log φ 9.06556

	1875 May 3.5			Aug 1872 15.5		
	°	′	″	°	′	″
M	125	53	58.3	263	05	19.9
E	130	54	7.8	256	39	04
½E	65	27	4	128	19	32
sin ½E	9.9588538			9.8945929		
cos ½E	9.6185392			9.792482		
~~tan ½E~~	~~3403146~~					
	.1977284			.1333432		
	9.8070200			9.9808552		
tan ½v	.3907084			.1524880		
½v	67	52	34	54	51	29
v	135	44	7	125	08	31
log r	2309697			2501702		
log r	.4619394			.4414680		

New (approximation)

Elements for Sept. 7.5 1872

° ′ ″
M₀ 270 54 50.12
dM − 27 36.97
M 270 27 13.15

Ω′ 169 11 12.32
dΩ′ + 5 16.29
Ω′ 169 16 28.61

μ 803.49141
dμ − 06114
μ 803.43027

log a₀ 4300168
d log a + 220
log a .4300388

φ″ 6 31 12.59
dφ ~~+ 6 40.00~~
φ ~~6 43 05.69~~
φ 6 37 52.97

i₀′ 27 55 42.22
di′ − 4 44.40
i 27 50 57.82

ω′ 81 13 28.15
dω′ + 34 13.78
ω′ 81 47 41.93

(263 05 19.9 for Aug 15.5)

φ 3 18 56.30
45° − ½φ 41 41 3.70
log tan(45° − ½φ) 9.9496232
log e 9.0625057
e .115480
1 − ε .884520
log(1 + ε) .0474619
log(1 − ε) 9.9467077
log √(1 + ε) .0237309
log √a .2150194
log √(1 − ε) 9.9733538

log √a(1 + ε) .2387503
log √a(1 − ε) .1883732

~~log~~ sin Ω′

log e 9.0625057
log ε 5.3144251
4.3769308

cos φ 9.9970847
cos² φ 9.9941694
log a .4300388
log p .4242082

log φ 9.06541

log sin Ω′ 9.2697511
cos i″ 9.9465400
cos Ω′ 9.9923460ₙ
sin i″ 9.6694554

Aug 5.5

52 34 18	298 38 15
319 59 15	206 03 19
332 04 44	218 08 30
9.8988829	9.9433310
4398205	4602937
9.8081804	9.6427000
3900973	4105884
9.6704828	9.7907129
1109234	.1313169
+ 2186.2680	− .2532940
− 7010780	+ 7369.01
− 1.5786200	− 1.1305240
6720500	+ 631986
~~+ .6045146~~	− .8356500
~~− 7010780~~ + 2916028	+ 274212
1717819	0.2543160
9.5740130ₙ	9.6977120
9.7856184	9.4433961
31 24 16	1.15 30 50
328 35 59.4	195 30 50
9.4954070	9.7492986
.2405583	.2704360
9.2548537	~~.5211374~~
10 11 35.6	9.4788626
24746	1645 41

9.9923460
9.2162911
.7760549
80 29 33.70
9.9983525

9.2697511
9.9388860
9.3308657ₙ
− 12 5 28.7
347 54 31.3
9.9486293

162 17 15.6 9.9983525
69 42 13.2 9.9486293
81 47 41.9 9.6694554

New discussion of (123) 1874 1875 ; a b c dL, e f

	1872 Aug 5.5	1875 May 3.5
	0	1001
i	2	300043
lg 3 μ sin 1″	5.76661	5.76661 n
lg f x		9.76704 n
lg r	44147	46194
R	27636	28970
p	2.6559	2.6560
r+p	5.4196	5.5530
lg (r+p)	0.73396	0.74453
E	250 37 04	130 54 18
log sin E	9.98810	9.87842
lg a cos φ	.42735	.42713
log f y	.29477 n	.19582
lg r²	88294	.92388
log a a cos φ	85715	85762
lg r²/(a a cos φ)	.02579	.06626
r²/(a a cos φ)	1.06120	1.16488
r²/(a a cos φ)	.06120	.16488
r²/(a a cos φ)	9.78675	0.21704
log f z	~~9.78716~~	~~0.21880~~
lg cos E	9.36339	9.81609 n
e	+.11548	+.11582
cos E	-.23088	-.65478
e + cos E	-.11540	-.53926
-lg (e + cos E)	9.06224	9.73180
lg cos φ	9.99709	9.99708
lg f y	9.06512	9.73472
lg f z	.05351	9.94398 n
log cot ψ	9.05351 n	8.94398
ψ	96 27 13	84 58 36
log sin ψ	9.99724	9.99833
log r	.44147	.46194
log a a cos φ	85715	85762
lg r sin ψ	.43871	.46027
lg e′	.41844	.39735
a	328 36 11	195 33 19
Ω″ = Ω′ + 410	349 16 29	349 16 42
v	-10 11 38	-16 47 00
a - Ω°	339 19 42	206 16 37
lg cos v	9.99309	9.98110
lg sin (a - Ω°)	9.54779	9.64612 n
lg sin cos θ	9.54088 n	9.62722 n
lg tan σ = ...	9.24792	9.46053 n
log tan σ	9.70704 n	9.83331 n
σ	206 59 36	214 15 54
i°	27 50 58	27 50 37
σ - i°	179 08 38	186 25 17
lg cos (a - Ω°)	9.97110	9.95263 n
lg (σ - i°)	8.17489	9.04860 n
log m	9.59097	9.71001 n
log cot (σ - i°)	9.99995 n	9.99727 n
log sin θ	7.76536	8.75861 n
log sin ... cos θ	9.59097	9.70728 n
log cos ... cos θ	9.96419	9.93373
log tan n	9.62670	9.77355 n
log cos θ	9.99999	9.99928
n	337 04 14	210 41 48
u = ...	332 04 44	218 08 30
u - n	355 01 33	7 26 42
ψ	96 27 13	84 58 36
u + ψ - n	91 28 46	92 25 18
lg a	24746	.28913
log e′	41844	39735
lg e′/a	.17098	.10822
lg sin (u′ + ψ - n)	~~9.96048~~ 9.99986	9.99961
lg M	17084	.10783
-log e′/a sin θ	7.93634 n	8.86683
log cos (u + ψ - n)	~~8.64125~~ 8.41193 n	8.62586 n
lg M°	6.34827	7.49269 n
log r/a	.19401	.17281
lg sin (u - n)	8.93805	9.11252
log N	9.86445	9.28533
log -r/a sin θ	7.95937	8.93142
lg cos (u - n)	9.99836	9.99632
lg N°	7.95773	8.92774

	1874 Aug 5.5	1875 May 3.5
lg e′/a	.17098	.10822
lg sin (u + ψ - n)	~~8.41193~~ 9.99986	9.99961
log M	.17084	.10783
-lg e′/a sin θ	7.93634 n	8.86683
log cos (u + ψ - n)	8.41193 n	8.62586 n
log M°	6.34827	7.49269 n
lg r/a	.19401	.17281
lg sin (u - n)	8.93805	9.11252
lg N	9.13206 n	9.28533
lg -r/a sin θ	7.95937 n	8.93142
log cos (u - n)	9.99836	9.99632
lg N°	7.95773	8.92774
d r cos θ / dφ = M	+1.4820	+1.2818
M f x		-.74967
N	-.1355	+.1929
d r cos θ / d lg a	-.1355	-7.3038
M f y	+.29212	+.20121
N f y	-.0157	+.1047
d r cos θ / dφ	+.29069	+.21168
M f z	+.9070	+.21129
N f z	+.1533	-.1696
10 d r cos θ / dχ	~~+1.0603~~ +.7537	+1.9433
M° = dθ/dφ	+.0002	-.0031
M° f x		+.0182
N°	-.0091	+.0847
dθ / d lg a	-.0091	+.1029
M° f y	-.0004	-.0049
N° f y	-.0011	+.0460
dθ / dφ	-.0015	+.0411
M° f z	+.0001	-.0051
N° f z	-.0103	-.0744
10 dθ / dχ	-.0102	-.0795
lg r/a	.19401	.17281
lg sin u	9.67048 n	9.79071 n
log cos θ	9.99999	9.99928
lg dθ/di°	9.86448	9.96280
dθ/di°	-.7380	-.9179 n
-lg r/a	19401 n	17281 n
cos u	9.94625	9.89569 n
sin i°	9.66946	9.66987
cos θ	9.99999	9.99928
dθ/dΩ′	9.80971 n	9.73915
	-.6452	+.5460
log sin i°	9.66946	9.66937
log cos (a - Ω°)	9.97110	9.95263
lg sec θ	1	72
log cos ...	9.64057	9.62272
lg sin ...	9.95396	9.95797
log cos v	9.99309	9.98110
4a = -2302	3.36211 n	3.36211 n
4v = +556		2.74507
log a a		3.36211
log cos u		9.62272 n
lg 4v		2.74507
I		~~-2000.07~~
II		-23318
d r cos θ		-2233.26
-lg cos u		9.62272
lg cos v		9.98110
lg 4a		3.36211
lg sin ...		9.95797
lg 4v		2.74507
I		-92455
II		-50471
dθ		-419.84

σ = ~~+ ... + ... di + ... dΩ′ + 1.4820~~

		di′	dΩ′	dL₁	d lg a	dφ	dχ/10	S
0 = ~~.0212~~	...	+ ...	+ ...	+1.4820	-.1355	-2.9369	~~+1.0603~~ +0.7537	-.8367
0 = -.2233 ...	+ ...	+ ...	+1.2818	-7.3038	+2.1168	+1.9433		-1.9619
0 = ...	~~.7380~~	-6452	+.0002	-.0091	-.0015	-.0102		-1.3978
0 = -.420	-.9179	+.5460	-.0031	+.1029	+.0411	-.0795		-.3105

lg n		3.3488887		2.6232493
a			9.8645111	9.9624954 n
b			9.8096942 n	9.7371926 n
c	0.1708482	0.1078203	6.3010300 n	7.4913617
d	9.1319393	0.8635489	7.9590414	9.0124159 n
e	0.4678892	0.3256798 n	7.1760913 n	8.6138418
f	9.8771985 n	0.2885399	8.0086002 n	8.8003671 n
S	9.9225698 n	0.2926769 n	0.1454450 n	9.4920616 n

lg tan 5 8.07918 n
lg tan b 5 5.60206 n
lg dχ 2.47712 n
dχ° ~~-~~ 300.00″
10 dχ ~~-~~ 50′ 00.0″

dχ/10 e f 4 -.009
e n 4 +.007
S -.002
log S 7.30103
-lg e 5.69897 n
lg dφ 1.60206
dφ +40.0″

dχ d/fo +1592.98
dφ d e₃ 765.83
dx 3 +9180.23
S +10007.18
lg S 4.0003117
-lg dd₃ 1.4704883 n
lg d lg a 2.5298234 n
d lg a 338.71

dχ c/₂ -1082.40
dφ c₂ - 65.57
d lg a c d₂ +3238.99
~~... +1.6266...~~ -2862.23
S ~~+1830...~~ 19 -77123
lg S 4. ~~2630...~~ 2.88718 n
lg ... ~~5842565~~ 58426 n
lg dL ~~3679...~~ 2.30292 n
dL₁ +200.87

dχ b b₁ +10.55
dφ b e₁ +.90
d lg a b d₁ -20.39
dL b e₁ - .35
b x₁ -221.24
S -230.53
lg S 2.36273
lg b b₁ 9.83357 n
lg dΩ′ 2.50916 n
dΩ′ +322.97

dχ a b -24.13
dφ a e -1.46
d lg a a d +29.74
dL a e + 0.54
dΩ′ a b - 9.33
a n +385.52
S
lg S +380.88
lg a a 2.58079
lg di′ .13936 n
di′ 2.44143 n
di′ -276.33

lg dΩ′ (1 - cos i′) 9.06427
lg dΩ′ 2.50916
l (dΩ′ (1 - cos i′)) 1.57343
m. +37.45
dχ -50 00.0
dπ′ -49 22.55
dΩ′ +5 22.97
~~... 58~~
dω′ = -54 45.52

- lg cos i′ 9.94648 n
dΩ′ 2.50916
l cos i′ dΩ′ 2.45564
m. 285.52
~~+4~~ 4 45.52
dχ -50 0.00
~~5 14.48~~
dω′ -54 45.52

dL₁ +3′ 20.87″
+37.45
dL₁′ +3 58.32
dπ′ -49 22.55
dM₀ +53 20.87

lg ... 7.76644 n
lg d lg a 2.52982
lg d u 0.29626 n
di +1.9781
u₀ 802.8441
u 804.8222
lg ... 2.905 ~~7000~~
3.5500066
0.6443066
.2147689
.4295378

lg M 4.32335
lg d lg u 2.52982 n
6.85317 n
-.0007126
.4302504
4295378

3

7126

nn na nb nc nd ne nf ns

4980292 — — −2862.259 + 16309.385 4726.814 −4339.389 +4380.923

176400 +38.557 −229.320 + 1.302 − 43.278 − 17.262 + 33.390 − 130.410

5162692 ~~+38.558~~ −229.320 −2860.957 +16266.107 4744.076 ~~−4306.006~~ +4511.333

385.518 167 4305.999

aa ab ab ac ac ad ad ae ae af af as as

+53582 +47229 — −00015 +00666 + 00139 +00747 + 102319

+84254 +50117 +00284 −09445 − 03772 +07297 + 28500

+1.37836 −02888 +00269 −.08779 −.03663 +.08044 +1.30819

bb bc bd be bf bs

+.41628 +00013 +00587 +00097 +00658 +.90186

+ 29812 −00169 +.05618 +02247 −04341 −.16953

+.71440 −.00182 +.06205 +.02344 −.03683 +.73233

cc cd cd ce ce cf cf cs cs

2.19632 −.20081 − 435248 +1.11698 −123999

1.64301 −9.36201 + + 2.71332 +2.49093 −2.51477

00000 − 00000 − 00000 + 00000 − 00028

00001 − 00032 − 00013 + 00025 + 00096

+3.83934 −9.56314 −1.63929 +3.60816 −3.75406

dd de df ds ee ef es ff fs

+01836 +39795 −.10212 +.11337 +.862589 −2.21354 +2.45731 .56806 −.63062

5.334550 −15.46068 +14.19348 +14.32933 +4.48084 +4.11358 −4.15295 3.77642 +3.81256

00108 + 00001 + 00009 + .01272 + 00002 + 00002 +.00210 .00010 + .01022

00059 + 00423 −.00818 −.03195 +.00169 −.00327 −.01276 .00632 + .02406

~~5.3362~~ −15.05849 ~~+14.08309~~ +14.42347 ~~+5.34501~~ +1.89679 −1.70627 4.35090 ~~+3.11108~~

53.37453 −14.30369 47 13.10794 ~~−4.42832~~

−4.40424

53.37453 −15.05849 −14.30369 +14.42347

+38.5518 1.37836

2.5860446 0.1393628 (aa)

log(aa)

a b c d e f s n

−02888 +00269 −08779 −03663 +08044 +1.30819 +38.552

8.4605972n 7.4297523 8.9434450n 8.5638369n 8.9054721 0.1166708 2.5860469

bb +.71440 −00182 +06205 +02344 −03683 +.73233 −229.32

ab/aa ab +00060 −00006 +00184 +00077 −00168 −02741 − 8.08

bb₁ +.71380 −00176 +06021 +02264 −03515 +.75974 −221.24

log bb₁ 9.8535764 7.2455127n 8.7796686 8.3548764 8.5459253n 9.8806650 2.3448636n

cc +3.83934 −9.56314 −1.63929 +3.60816 −3.75406 −2860.96

ac/aa ac + 00000 − .00017 − 00007 + 00016 + 00255 − .75

cc₁ +3.83934 −9.56297 −1.63922 +3.60800 −3.75661 −2861.71

be₁/bb₁ be₁ + 00000 − 00015 − 00005 + 00028 − 00187 + 0.54

cc₂ +3.83934 −9.56282 −1.63917 +3.60772 −3.75848 −2862.25

log cc₂ 0.5842565 0.9805860n 0.2146241n 0.5572569 0.5745770n 3.4567075n

dd +53.37453 −15.05849 −14.30369 +14.42347 +16266.15

ad/aa ad + 00559 + 00233 − 00512 − .08332 − 24.55

dd₁ +53.36894 −15.06082 −14.29857 +14.50679 +16290.70

bd₁/bb₁ bd₁ + 00508 + .00191 − 00297 + 06409 − 18.66

dd₂ +53.36386 −15.06273 −14.29560 +14.44270 +16309.36

cd₂/cc₂ cd₂ +23.81857 +4.08276 −8.98642 +9.35211 +7129.14

dd₃ +29.54529 −19.14549 −5.30918 +5.09059 +9180.22

log dd₃ 1.4704883 1.2820665n 0.7250274n 0.7067707 3.9628529

ee +13.10794 +1.89679 −1.70627 −4744.08

ae/aa ae + 00097 − 00214 − 03476 − 10.24

ee₁ +13.10697 +1.89893 −1.67151 −4733.84

be₁/bb₁ be₁ + 00072 − 00111 + 02410 − 7.02

ee₂ +13.10625 +1.90004 −1.69561 −4726.82

ce₂/cc₂ ce₂ + .69983 −1.54036 +1.60305 +1222.91

ee₃ +12.40642 +3.44040 −3.25866 −5948.83

de₃/dd₃ de₃ +12.40637 +3.44037 −3.29875 −5948.83

ee₄ + .00005 + 00003 + 00008 00

log ee₄ + 4.35090 −4306.00

~~+4.35090 +4.40424 −4.40424~~ ~~−4306.03~~

ff + .00469 + .09635 + 22.50

af/aa af ff₁ +4.34621 −4.48059 −4328.50

bf₁/bb₁ bf₁ + 00173 − 03741 + 10.90

ff₂ +4.34448 −4.44318 −4339.40

cf₂/cc₂ cf₂ ff₃ +3.39045 −3.52842 −2689.73

df₃/dd₃ df₃ ff₄ +0.95403 −0.91476 −1649.67

ef₄/ee₄ ef₄ ff₅ +.95404 −.91476 −1649.65

± .00001 + .00004 − 02

+ .00002 + .00005 .00

− .00004 − .00004 − 02

5.6589700 5.4771213 5.9030900 7.8450980

−229.320 ns nn

2.5860446 4511.31 5162692) −229.320

− 8.077

221.243

2.3448695n , May 3. 1875

−2860.957 M 12622 36.45

+ .752 dM⁰ + 53 20.87

−2861.709 100/dM + 33 0.10

+ .545 M 127 48 59.42 chked.

−2862.254

3.4567082n Ω₀' 169 11 26.17

+16266.167 dΩ' + 5 22.97

− 24.554 Ω' 169 16 49.14

+16290.721

− 18.662 w 804.82229

+16309.383 log a 4295378

+ 7129.149

+ 9180.234 φ 6 31 20.62

3.9628537 + 40.00

−4744.076 φ 6 32 00.62

− 10.245

−4733.831 i 27 55 21.88

− 7.017 − 4 36.33

−4726.814 i' 27 50 45.55

+ 1222.913

−5948.827 5948.827

~~−4744.314~~ 5948.834 ω' 81 50 9.41

~~430.5.999~~ dω' − 54 45.52

+ .007 ω' 80 55 23.89

−4305.999

+ 22.498

−4328.497

+ 10.895

−4339.392

−2689.730

−1649.662

−1649.654

− .008

+ .004

− .012

8.079182n

Elements of 173 for July 8.5 1876

M_0 22° 45′ 33.24″ ☊$'_0$ 169° 09′ 22.53″ μ^0 803.39685 log μ 4300510 φ_0 6° 36′ 11.89″
$d\mu$ + 53 20.87 + 5 22.97 $d\mu$ + 1.97815 − 7120 40.00
146 $d\mu$ + 48 10.1 ☊$'$ = 169 14 45.50 μ = 805.37500 .4293390 φ = 6 36 51.89
M 223 27 04.2

i' 27 54 21.08
− 4 36.33
i' 27 49 49.75

ω' 82 43 44.67
$d\omega'$ = − 54 45.52
ω' = 81 48 59.15

log sin ☊$'$ 9.2708956 − cos ☊$'$ 9.9923048 − sin ☊$'$ 9.2708956 n
cos i'' 9.9466056 cos i' sin ☊ 9.2175112 n cos i'' ☊ 9.9389204
cos ☊$'$ 9.9923048 n tg A .7747936 tg B 1.9331975 2
sin i'' 9.6691841 A 80 27 56.1 B − 120 71 68
log a 9.9983459 B 347 82 432
log b 9.9487130

A + ω' 162 16 55.2 log a 9.9983459
B + ω' 69 41 42.3 log b 9.9487130
ω' 81 48 59.1 log c 9.6691841

6 36 51.89
φ ~~9.0614039~~ log e 9.0614039 log $\sqrt{1+e}$ 0236738
½φ 3 18 25.9 e .1151871 log $\sqrt{a}$ ~~2146695~~
45 − ½φ 41 41 34.06 1 + e 8848129 log $\sqrt{1-e}$ 9.7734257
log(45 − ½φ) 9.9497548 ~~(1+e)~~ 0473477 log $\sqrt{a(1+e)}$ .2383433
log(1 − e) 9.9468514 log $\sqrt{a(1-e)}$ .1880952

log e 9.0614039
log C 5.3144251
log e″ 4.3758290

July 8.5
M 223 27 42
E_0 219 16 24
sin E 9.8014179
4.3758290
3.1772469
− 4 10 40.0
E 219 16 24.2
½E 109 38 12.1

sin ½E 9.9739783
cos ½E 9.5264096 n
2173116
9.7145048 n
tg ½v .4978068
½v 72 22 57
½v 107 37 54.3
v 215 15 49
log r 4464160
v + A + ω' 17 32 44
v + B + ω' 284 57 31
v + ω' 297 4 48
9.9792355
4647619
9.9850277 n
4151210
9.9497714 n
1356001
.8790 20
± .2396 20
− ~~.2446 15~~
− 2.650 920
+ .8851 800
− 12 166 7
+ .3869 4
9.7644750
0.2327725 n
0.4682975 n
− 71 12 47
288 47 13
9.9189368 n
2565497
9.6623871 n
− 24 41 02

125

Correction of elements for Sept 7.5 1872

M = 271 54 50.12
$d\mu$ + 53 20.87
33 $d\mu$ + 1 5.27
M 271 49 16.26

☊$'$ 169 11 12.32
d☊$'$ + 5 22.97
☊$'$ 169 16 35.29

i' 27 55 42.22
di' − 4 36.33
i' 27 51 5.89

μ 803.49141
$d\mu$ + 1.97815
μ 805.46956
log μ 2.9060492
3.5500166
0.6439574
2146525
log a 4293050

φ 6 31 12.59
+ 40.00
φ 6 31 52.59

☊ = 308 30 23.48
i = 6 22 40.54

ω' 81 13 28.15
− 54 45.52
80 18 42.63

☊$'$ 169 16 35.29
½☊$'$ 84 38 17.64
i' 27 51 5.89
ε 23 27 20.77
i' + ε 51 18 26.66
i' − ε 4 23 45.12
½(i' + ε) 25 39 13.33
½(i' − ε) 2 11 52.56

Red. to Ecliptic

cos ½(i' − ε)
cos
sin ½☊$'$ 9.9980956 cos ½☊$'$ 8.9705512
cos ½(i' − ε) 9.9996803 cos ½(i' + ε) 9.954930
9.9977759 8.92548 19
8.9254819
1.0722940

sin ½☊$'$ 9.9980956 cos ½☊$'$ 8.9705512
sin ½(i' − ε) 8.5837853 sin ½(i' + ε) 9.6364186
8.5818809 8.6069698
8.6069698
9.9749111

log cos ½i 9.9993269
sin ½i 8.7453026
½i 3 11 20.27
i 6 22 40.54

½(☊ − ν) + ½ 85 09 38.0
½(☊ − ν) − ½ 43 20 45.48
☊ − ν 128 30 23.48
☊ 308 30 23.48
Δ 41 48 52.62
~~ω 80 55 23.89~~
~~ω = ω' + 122 44 16.51~~ 71 14 39.99
π ~~71 14 39.99~~

Reversal.

Δ 41 48 52.62
ω' 80 18 42.63
ω 122 07 35.25
☊ 308 30 23.48
π 70 37 58.73

~~☊ 308 40 33.88~~
☊ 308 30 23.48
☊ − ν 128 30 23.48
½(☊ − ν) 64 15 11.74

i 6 22 40.54
ε 23 27 20.77
i + ε 29 50 1.31
i − ε − 17 04 40.23
½(i + ε) 14 55 0.65
½(i − ε) − 8 32 20.12

sin ½(☊ − ν) ~~9.9545912~~ cos ½(☊ − ν) ~~9.9545912~~ sin ½(☊ − ν) ~~9.9545912~~ cos ½(☊ − ν) ~~9.9545912~~
sin ½(i + ε) 9.9545912 sin ½(i − ε) 9.6378838 cos ½(i + ε) 9.9545912 cos ½(i − ε) 9.6378838
9.4106371 9.1716716 9.9851122 9.9951591
~~9.6439574~~ 8.8095554 n 9.9397035 9.6330429
9.3652283 9.6330429
8.8095554 n .3066606
0.5556729 n 63
− 74 27 16.04
105 32 43.96
63 43 51.34

i' = 27 51 5.90

☊$'$ 169 16 35.30
A 41 48 52.62 41 48 52.62
ω ~~122 44 16.51~~ 122 [illegible] 35.25
ω' ~~80 55 23.89~~ 80 18 42.63

1870phae.proj..430O