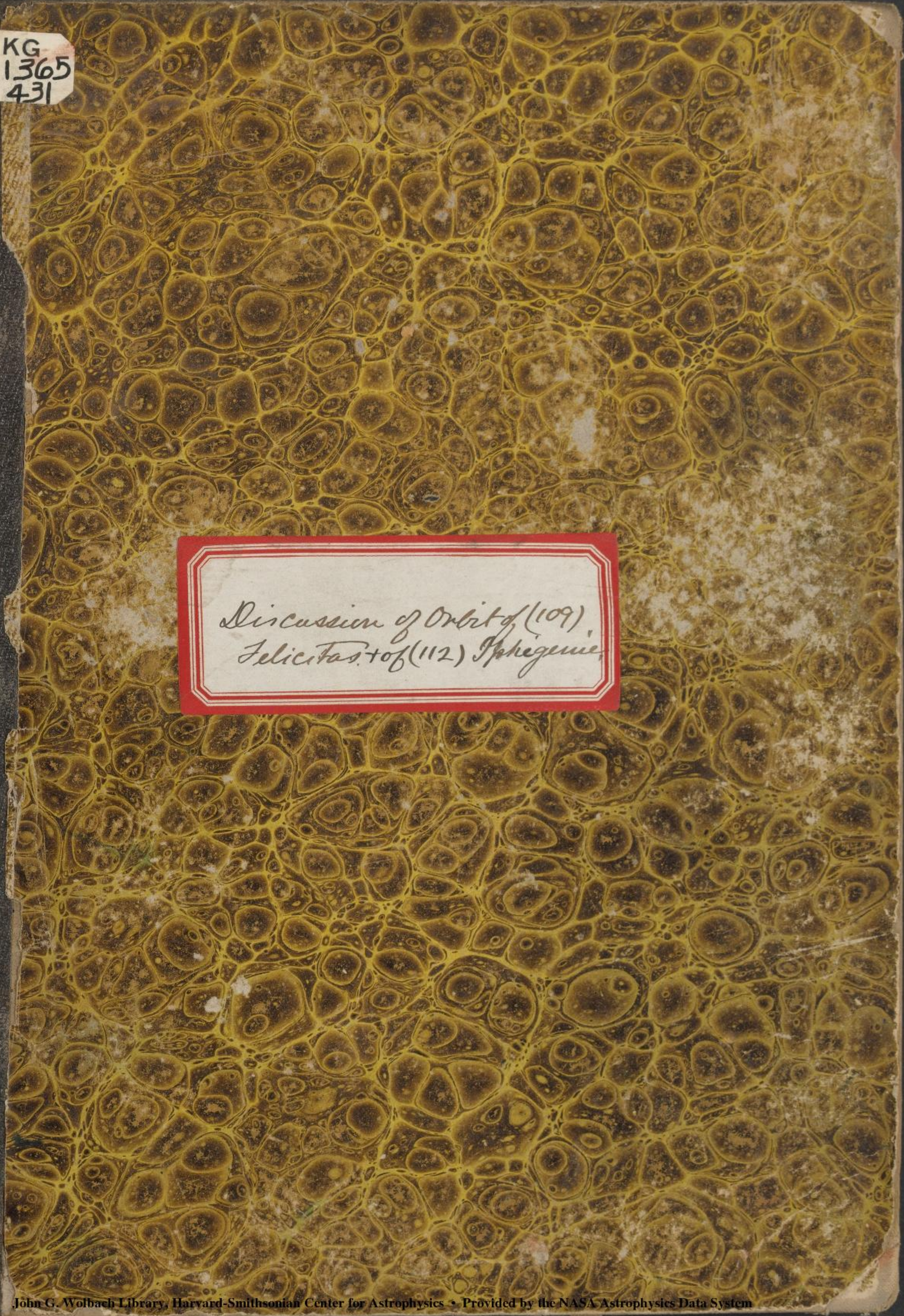
KG
11365
431



Discussion of Orbit of (109)
Felicitas + of (112) Iphigenie.

Kb-11365.431

P6

3 21,6 . 6 01 48

KG11365.431

98 23 51 = W
98 20 30 = B

$$\sin\tfrac{1}{2}E\sqrt{a(1+\varepsilon)} = \sin\tfrac{1}{2}v\sqrt{r}$$

$$\cos\tfrac{1}{2}E\sqrt{a(1-\varepsilon)} = \cos\tfrac{1}{2}v\sqrt{r}.$$

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Discussion of the orbit of (109) Felicitas

Assumed elements.

$M = 339° \; 6' \; 40''.2$ W. M. T. Oct. 9.0

$\pi = 55 \; 56 \; 52.13 + 50.24t$

$\Omega = 4 \; 56 \; 1.70 + 49.49$

$i = 8 \; 2 \; 50.6 + 0.46$

Mean Eq 1870

$\varphi = 17 \; 28 \; 8.6$

$\mu = 801.7415$

$\log a = .4306483$

M Eq 1869 $\left.\right\}$ = 55° 56' 1.89
4 55 12.11
8 2 50.14

200.43

3 20.51
6 40.20
3 19.69

	°	'	''
Ω	4	55	12.11
$\Omega - n$	184	55	12.11
$\frac{1}{2}(\Omega - n)$	92	27	36.05
i	8	2	50.14
ε	23	27	22.16
$i+\varepsilon$	31	30	12.30
$i-\varepsilon$	−15	24	32.02
$\frac{1}{2}(i+\varepsilon)$	15	45	6.15
$\frac{1}{2}(i-\varepsilon)$	−7	42	16.01

$\sin\frac{1}{2}(\Omega - n)$ 9.4337205 $\cos\frac{1}{2}(\Omega - n)$ 9.1243093$_n$
$\sin\frac{1}{2}(i+\varepsilon)$ 9.9995996 $\sin\frac{1}{2}(i'-\varepsilon)$ 8.6326814$_n$
$\sin\frac{1}{2}i' \sin\frac{1}{2}(\Omega'+a)$ 9.4333201 7.7599907
$\sin\frac{1}{2}i' \cos\frac{1}{2}(\Omega'+a)$ 7.7599907
$\tan\frac{1}{2}(\Omega'+a)$ 1.6433294
$\frac{1}{2}(\Omega'+a)$ 88 44 4.47

$\sin\frac{1}{2}(\Omega - n)$ 9.9833769 $\cos\frac{1}{2}(\Omega - n)$ 9.9960617$_n$
$\cos\frac{1}{2}(i+\varepsilon)$ 9.9995996 $\cos\frac{1}{2}(i'-\varepsilon)$ 8.8026814
$\cos\frac{1}{2}i' \sin\frac{1}{2}(\Omega'-a)$ 9.9829765
$\cos\frac{1}{2}i' \cos\frac{1}{2}(\Omega'-a)$ 8.6284431$_n$
$\tan\frac{1}{2}(\Omega'-a)$ 1.3542335$_n$
$\frac{1}{2}(\Omega'-a)$ −88 28 1.81
$\frac{1}{2}(\Omega'-a)$ 92 31 58.19
$\frac{1}{2}(\Omega'+a)$ 88 44 4.47

Ω'	181	19	2.66
a	356	15	6.28
ω	51	0	49.82
ω'	54	45	43.50

$\sin\Omega'$ 8.3615586$_n$
$\cos i'$ 9.9308540
$\cos\Omega'$ 9.9998852$_n$
$\sin i'$ 9.7178486

$-\cos\Omega'$ 9.9998852 $-\sin\Omega'$ 8.3615586$_n$ $A+\omega'$ 145° 53' 8''.30 $\log a$ 9.9999687
$\cos i' \sin\Omega'$ 8.2924181$_n$ $-\cos i' \cos\Omega'$ 9.9307392 $B+\omega'$ 56 18 26.32 $\log b$ 9.9308977
$\tan A$ 1.7074721$_n$ $\tan B$ 8.4308189$_n$ ω' 54 45 43.50 $\log c$ 9.7178486
A −88 52 35.20 B 1 32 42.82
140.81
A 91 7 24.80

$\log e = \sin\varphi$ 9.4773572 $\log\sqrt{1+\varepsilon}$ 0.0570035 $\frac{1}{2}\varphi$ 8 44 4.30 $\log e$ 9.4773572
e .3001907 $\log\sqrt{1-\varepsilon}$ 9.9224898 36 15 55.70 $\log\varepsilon''$ 5.3144251
$1+\varepsilon$ 1.3001907 $\log e''$ 4.7918223
$1-\varepsilon$ .6998093 $\log\sqrt{a(1+\varepsilon)}$ .2723276 $\log\tan(45-\frac{1}{2}\varphi)$ 9.8654164
$\log(1+\varepsilon)$ .1140070 $\log\sqrt{a(1-\varepsilon)}$ .1378139
$\log(1-\varepsilon)$ 9.8449797

$x = r\,a \sin(u + A + \omega')$
$y = r\,b \sin(u + B + \omega')$
$z = r\,c \sin(u + \omega')$

when $c = \sin i'$

N.M.N.	Oct: 13	15	17	19	21	23
M	340 00 7.20	340 26 50.68	340 53 34.16	341 20 17.64	341 47 .113	342 13 44.61
E_0	331 54 3.70	332 30 26.96	333 06 54.53	333 43 26.50	334 20 2.63	334 56 43.07
log sin E_0		9.6642988	9.6553295	9.6461848	9.6366115	9.6268364
log e		9.7918223	9.7918223	9.7918223	9.7918223	9.7918223
log e sin E_0		9.4561195	9.4471518	9.4379271	9.4284388	9.4186587
e sin E_0		1 56 23.82 .74	1 46 39.60	1 36 57.14	1 46 58.46	1 17 1.57
E_1	331 54 3.70	332 30 26.94	333 6 54.56	333 43 26.50	334 20 2.67	334 56 43.04
$\frac{1}{2}E_1$	165 57 1.85	166 15 13.47	166 33 27.28	166 51 43.25	167 10 1.33	167 28 21.52
l sin $\frac{1}{2}E_1$	9.3851769	9.3758879	9.3663633	9.3565987	9.3465671	9.3362710
l cos $\frac{1}{2}E_1$	9.9868104	9.9873741	9.9879360	9.9884811	9.9890143	9.9895355
l $\sqrt{2}$ sin $\frac{1}{2}v$	9.6576045	9.6482150	9.6386909	9.6289213	9.6188947	9.6085986
l $\sqrt{2}$ cos $\frac{1}{2}v$	.1246243	.1251930	.1257499	.1262950	.1268282	.1273494
tang $\frac{1}{2}v$	9.5328802	9.5230221	9.5129410	9.5026263	9.4920665	9.4812492
$\frac{1}{2}v$	−18 50 4.03	−18 26 26.24	−18 02 42.79	−17 38 53.71	−17 14 59.11	−16 50 59.05
$\frac{1}{2}v$	161 9 55.97	161 33 33.76	161 57 17.21	162 21 6.29	162 45 0.89	163 09 0.97
v	322 19 51.94	323 07 07.52	323 54 34.42	324 42 12.58	325 30 1.78	326 18 1.94
log r	.2970464	.2961422	.2953100	.2944628	.2936304	2928130
v+A+ω'	108 13 0.2	109 00 15.8	109 47 42.7	110 35 20.9	111 23 10.1	112 11 10.2
v+B+ω'	18 38 18.3	+19 25 33.8	+20 13 0.7	21 00 38.9	21 48 28.1	22 36 28.3
v+ω'	17 5 35.4	17 52 51.0	18 40 17.9	19 27 56.1	20 15 45.3	21 03 45.4
l sin(v+A+ω')	9.9776693	9.9756586	9.9735477	9.9713344	9.9690169	9.9665930
log r a	.2970178	.2961409	.2952787	.2944315	.2935991	.2927817
	.2746864	.2717995	.2688264	.2657659	.2626160	.2593747
log sin(v+B+ω')	9.5046996	9.5218998	9.5388415	9.5545425	9.5699522	9.5848082
log r b	.2277461	.2270699	.2262077	.2253605	.2245281	.2237107
	9.7325457	9.7489792	9.7647492	9.7799030	9.7944803	9.8085189
log sin(v+ω')	9.4682384	9.4871925	9.5053455	9.5227579	9.5394815	9.5555635
log r c	.0148970	.0140208	.0131586	.0123114	.0114790	.0106616
	9.4831354	9.5012133	9.5185041	9.5350693	9.5509605	9.5662251
x	+1.882290	+1.869819	+1.857061	+1.844022	+1.830695	+1.817082
X	−.934350	−.921222	−.906996	−.891690	−.875320	−.857901
x'	+.947940	+.948597	+.950065	+.952332	+.955375	+.959182
y	+.540189	+.561021	+.581767	+.602425	+.622989	+.643456
Y	−.318799	−.348083	−.376946	−.405356	−.433282	−.460690
y'	+.221390	+.212938	+.204821	+.187069	+.189707	+.182766
z	+.304183	+.317113	+.329993	+.342822	+.355599	+.368320
Z	−.138328	−.151035	−.163560	−.175888	−.188005	−.199897
z'	+.165855	+.166078	+.166438	.166934	+.167594	+.168423
log a cos δ cos α	9.9768808	9.9770816	9.9777533	9.9787884	9.9801739	9.9819010
log a cos δ sin α	9.3451580	9.3282533	9.3113745	9.2946183	9.2780833	9.2618950
log tang α	9.3683772	9.3511717	9.3336212	9.3158299	9.2979094	9.2799945
α	13 08 44.6	12 39 6.7	12 09 59.6	11 41 29.9	11 13 51.7	10 47 16.9
a	23.0	23.2	23.4	23.7	23.8	24.0
	13 9 07.6	12 39 29.9	12 10 21.0	11 41 52.6	11 14 15.5	10 47 40.9
log a cos δ	9.9883134	9.9877568	9.9876188	9.9878934	9.9885714	9.9896452
log a sin δ	9.2197287	9.2203122	9.2212395	9.2225449	9.2242585	9.2264014
log tang δ	9.2314153	9.2325554	9.2336212	9.2346515	9.2356871	9.2367562
δ	9 40 8.9	9 41 38.6	9 43 2.8	9 44 24.3	9 45 46.4	9 47 11.3
	8.2	8.3	8.4	8.6	8.7	8.9
	9 40 17.1	9 41 46.9	9 43 11.2	9 44 32.9	9 45 55.1	9 47 20.2
Meridian log a	9.99452	9.99400	9.99380	9.99420	9.99491	9.99601
h	25 58	25 50	25 43	25 37	25 30	25 24
α	13 09	12 39	12 10	11 41	11 14	10 47
h+α	39 07	38 29	37 53	37 18	36 44	36 11
log cos(h+α)	9.8898	9.8936	9.8972	9.9006	9.9039	9.9069
	1.0267	1.0298	1.0330	1.0362	1.0395	1.0429
log sin(h+α)	9.7999	9.7940	9.7882	9.7825	9.7768	9.7711
log tang δ	9.2374	9.2326	9.2336	9.2347	9.2357	9.2367
A	2. 2193 2193	2211 2211	2229 2229	2248 2248	2267 2267	2287 2287
I	~~1.48~~ 1.14	11.34 1.14	11.34 1.13	11.31 1.13	11.28 1.13	11.25 1.12
a−α	~~3336~~ 2307	3350 2325	3363 2342	3379 2361	3398 2380	3412 2399
δ'−δ	8.25	8.38	8.51	8.65	8.78	8.91
α						
δ						

25	27	29	31	Nov 2	4
342 40 28.09	343 07 11.57	343 33 55.06	344 00 38.54	344 27 22.02	344 54 5.50
335 33 27.54	336 10 15.97	336 47 8.42	337 24 4.77	338 01 4.93	338 38 8.77
9.6167668	9.6063885	9.5956855	9.5846410	9.5732368	
9.7918223	9.7918223	9.7918223	4.7918223	4.7918223	
9.4085891	9.3982108	4.3875078	4.3764633	4.3650591	
-7 7 0.59	-6 56 55.60	-6 46 46.64	-6 36 30.77	-6 26 17.71	-6 15 56.73
335 33 27.50	336 10 15.97	336 47 8.42	337 24 4.77	338 01 4.91	338 38 8.77
167 46 43.75	168 05 7.98	168 23 34.21	168 42 2.38	169 00 32.45	169 19 4.39
9.3256923	9.3146169	9.3036288	9.2921116	9.2802472	9.2680157
9.9900446	9.9905417	9.9910267	9.9914994	9.9919599	9.9924081
9.5980199	9.5871445	9.5759864	9.5644392	9.5525748	9.5403433
.1278585	.1283556	.1288406	.1293133	.1297738	.1302220
9.4701614	9.4587889	9.4471158	9.4351259	9.4228010	9.4101213
-16 26 53.56	16 02 42.84	-15 38 26.88	-15 14 05.81	-14 49 39.73	-14 25 8.70
163 33 6.44	163 57 17.16	164 21 33.12	164 45 54.19	165 10 20.27	165 34 51.30
2920108	2912248	2904550	.2897012	2889644	2882446
327 06 12.88	327 54 34.32	328 43 6.24	329 31 48.38	330 20 40.64	331 09 42.60
112 59 21.2	113 47 42.6	114 36 14.5	115 24 56.7	116 13 48.8	117 02 50.9
23 24 39.2	24 13 00.6	25 01 32.6	25 50 14.7	26 39 6.4	27 28 8.9
21 57 56.4	22 40 17.8	23 28 49.7	24 17 31.9	25 06 24.0	25 55 26.1
9.9640607	9.9614182	9.9586627	9.9557923	9.9528048	9.9496943
.2919795	.2911935	.2904237	.2896699	.2889331	.2882133
.2560402	.2526117	.2490864	2454622	.2417379	.2379106
9.5991430	9.6129861	9.6263661	9.6393061	9.6518294	9.6639059
.2229085	.2221225	.2213527	.2205989	.2198621	.2191423
9.8220515	9.8351086	9.8477188	9.8599050	9.8716915	9.8830982
9.5714467	9.5859668	9.6003605	9.6142540	9.6276779	9.6406574
.0098594	.0090734	.0083036	.0075498	.0068130	.0060932
9.5809061	9.5950402	9.6086641	9.6218038	9.6344909	9.6467506
1.803184	+1.789005	+1.774542	+1.759796	+1.744769	+1.729460
-.839451	-.819987	-.799529	-.778098	-.755717	-.732412
+.963733	+.969018	+.975013	+.981698	+.989052	+.997048
+.663822	+.684083	+.704237	+.724278	+.744203	+.764009
-.487550	-.513826	-.539487	.564497	.588824	-.612434
+.176272	+.170257	+.164750	+.159781	+.155379	+.151575
+.380984	+.393587	+.406129	+.418605	+.431014	+.443354
-.211550	-.222950	-.234083	-.244934	-.255489	-.265734
+.169434	+.170637	+.172046	+.173671	+.175525	+.177620
9.9839568	9.9866318	9.9890109	9.9919780	9.9952191	9.9987161
9.2461833	9.2311050	9.2168254	9.2035251	9.1913823	9.1806277
9.2622265	9.2444732	9.2278150	9.2115471	9.1961732	9.1819116
10 21 54.5	9 57 54.7	9 35 26.9	9 14 39.8	8 55 41.3	8 36 38.1
24.2	24.3	24.0	24.8	25.4	25.8
10 22 18.6	9 58 19.0	9 35 51.5	9 15 04.6	8 46 06.3	8 39 04.3
9.9911025	9.9929338	9.9951235	9.9976555	.0005133	0.0036776
9.2290005	9.2320733	9.2356445	9.2397273	9.2443390	9.2494919
9.2378980	9.2381395	9.2405210	9.2420718	9.2438247	9.2458143
9 48 42.3	9 50 21.4	9 52 12.0	9 54 16.7	9 56 38.1	9 59 19.1
~~34.3~~	~~34.5~~	~~34.7~~			
9.0	9.1	9.2	9.4	9.5	9.6
9 48 51.3	9 50 30.5	9 52 21.2	9 54 26.1	9 56 47.6	9 59 28.7
9.99750	9.99934	0.00156	.00417	0.00708	0.01031
25 18	25 12	25 06	25 00	24 57	24 48
10 22	9 58	9 35	9 15	8 56	8 39
35 40	35 10	34 41	34 15	33 53	33 27
9.9098	9.9125	9.9150	9.9173	9.9192	9.9214
1.0463	1.0499	1.0535	1.0572	1.0609	1.0644
9.7657	9.7604	9.7551	9.7503	9.7462	9.7413
9.2337 23.07	9.2391 23.28	9.2405 23.49	9.2424 23.71	9.2438 23.59	9.2458 24.17
23.07	23.28	23.49	23.71	23.94	24.17
1422 1.12	1520 1.12	1420 1.12	1421 1.12	1424 1.12	1427 1.13
3429 24.19	3448 24.40	3469 24.61	3452 24.83	3418 25.06	3410 25.30
9.04	9.17	9.30	9.43	9.55	9.69

	Nov 6	8	10	12	14
M	345 20 4898	345 47 3247	346 14 1595	346 40 59.43	347 07 4291
	339 15 16.28	339 52 27.38	340 29 41.95	341 6 59.89	341 44 21.13
	–		9.5236026	9.5100657	9.4960196
	–		4.7918223	4.7918223	4.7918223
	–		4.3154249	4.3018880	4.2878419
	−6 5 32.70	−5 55 6.10	−5 44 34.02	−5 33 59.55	−6 23 21.80
	339 15 16.28	339 52 27.37	340 29 41.93	341 06 59.88	341 44 21.11
	169 37 38.14	169 56 13.68	170 14 50.96	170 33 29.94	170 52 10.56
	9.2553959	9.2423641	9.2258947	9.2149595	9.2005277
	9.9928437	9.9832672	9.9936781	9.9940760	9.9944622
	9.5277235	9.5146917	9.5012223	9.4872871	9.4728553
	.1306576	.1310811	.1314920	.1318904	.1322761
	9.3970659	9.3836106	9.3697303	9.3553967	9.3405792
½ z	~~.7335917~~	−13 35 52.30	−13 11 7.10	−12 46 17.40	−12 21 23.33
	−14 00 32.88 ~~2.8754516~~				
½ z	165 59 27.12	166 24 7.70	166 48 52.90	167 13 42.60	167 38 36.67
z	331 58 54.24	332 48 15.40	333 37 45.80	334 27 25.20	335 17 13.34
log z	.2875416	.2868568	.2861896	.2855404	.2849098
v+A+ω'	117 52 25	118 41 23.7	119 30 54.1	120 20 33.5	121 10 21.6
v+B+ω'	28 17 20.6	29 06 41.7	29 56 12.1	30 45 51.5	31 35 39.7
v+ω'	26 44 37.7	27 33 58.9	28 23 29.3	29 13 08.7	30 02 56.8
	9.9464681	9.9431138	9.9396323	9.9360208	9.9322766
log sin(v+A+ω')	~~117 52 2.5~~	~~118 41 23.7~~	~~119 30 54.1~~	~~120 20 33.5~~	~~9.3 31 45.0~~ ~~121 10 21.6~~
log a	.2875103	.2868255	.2861583	.2855091	.2848785
sin(v+B+ω')	9.6757051	9.6870936	9.6981380	9.7088521	9.7192504
b	.2184393	.2177545	.2170873	.2164381	.2158075
sin(v+ω')	9.6582143	9.6653705	9.6771444	9.6885537	9.6996142
c	.0053902	.0047054	.0040382	.0033890	.0027584
x	+1.713872	+1.688006	+1.681864	+1.665443	+1.648750
X	−.708211	−.668147	−.657252	.630556	602096
x'	+1.005661	+1.019859	+1.024612	+1.034887	+1.045654
y	+.783690	+.803245	+.822669	+.841957	+.861109
Y	−.635294	−.657375	−.678648	−.699087	−.718669
y'	+.148396	+.145870	+.144021	+.142870	+.142440
z	+.455622	+.467817	+.479935	+.491975	+.503983
Z	−.275653	−.285236	−.294467	−.303337	−.311885
z'	+.179969	+.182581	+.185468	+.188638	+.192098
Log sec δ sec α	0.0024518	0.0064060	0.0105590	0.0148932	0.0193883
log a cos δ sin α		9.1635660	9.1584258	9.1549410	9.1536320
log tang α	9.1714222	9.1575600	9.1478663	9.1400478	9.1342437
α'	9.1689704				
α	8 23 38.5	8 10 45.6	8 0 42	7 51 36.8	7 45 25.7
	25.5	25.7	26.0	26.3	26.5
	8 24 04.0	8 11 11.3	8 0 30.2	7 52 03.1	7 45 52.2
log Δ cos δ	.0071293	.0108463	.0148080	.0189929	.0233808
log Δ sin δ	9.2551977	9.2614556	9.2682691	9.2756293	9.2835230
log tang δ	9.2480684	9.2506093	9.2534611	9.2566364	9.2601422
δ	10 2 22.4	10 05 50.1	10 09 44.6	10 14 7.4	10 18 59.7
	9.8	9.9	10.0	10.1	10.2
	10 2 32.2	10 6 00.0	10 9 54.6	10 14 17.5	10 19 09.9
log Δ	0.01383	.01763	0.02168	0.02596	0.03046
g	24 42	24 35	24 28	24 21	24 14
a	8 24	8 11	8 01	7 52	7 45
g+a	33 06	32 46	32 29	32 13	31 59
tan δ	9.2481	9.2506	9.2535	9.2566	9.2601
cot (g+a)	9.9231	9.9247	9.9261	9.9274	9.9285
log g	1.0686	1.0725	1.0764	1.0805	1.0845
sec (g+a)	9.7372	9.7334	9.7300	9.7268	9.7240
δ	9.2481	9.2506	9.2535	9.2566	9.2601
g	~~2440~~ 2440	~~2460~~ 2465	~~2489~~ 2489	~~2510~~ 2510	~~2541~~ 2541
g	~~11.37~~ 1.13	~~11.39~~ 1.14	~~11.48~~ 1.15	~~11.58~~ 1.16	~~11.71~~ 1.17
a' − a	35.72 2553	36.04 2579	36.37 2604	36.73 2631	37.12 2658
δ' − δ	9.81	9.93	10.06	10.18	10.30
a					
δ					

Computation of Perturbations.

For (109)

~~1880~~ 1870.0	π_0			Ω			i		
Reduc. to July 25 1872	55°	56′	52″	4°	56′	02″	8°	2′	51″
		+2	9		+2	07		+	1
	55	59	01	4	58	09	8	2	52

For ♃   For ♄

	L'	Ω'			i'			L'	Ω'			i'	
~~July 25 1872~~													
Nov 16 1858		99°	01′	38″	1	18	39.5		112	28	04	2	29 21.2
Reduction from 1858 to 1872	+11′ 28″	+	5	38		−	4.4	+0° 11′ 28″	+	2	52		−2
July 25 1872		99	7	16	1	18	35		112	30	56	2	29 19

For ♃

i 8 2 52
i' 1 18 35
$i'+i$ 9 21 27
$i'-i$ −6 44 17
$\frac{1}{2}(i'+i)$ 4 40 43
$\frac{1}{2}(i'-i)$ −3 22 08

Ω' 99 07 16
Ω 4 58 09
$\Omega'-\Omega$ 94 09 07
$\frac{1}{2}(\Omega'-\Omega)$ 47° 04′ 33″

$\sin\frac{1}{2}(\Omega'-\Omega)$ 9.86466
$\sin\frac{1}{2}(i'+i)$ 8.91151
$\sin\frac{1}{2}I \sin\frac{1}{2}(N+N')$ 8.77617
$\sin\frac{1}{2}I \cos\frac{1}{2}(N+N')$ 8.60228n
$\tan\frac{1}{2}(N+N')$ 0.17389n
−56 10 34
$\frac{1}{2}(N+N')$ 123 49 26
I

$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.88317
$\sin\frac{1}{2}(i'-i)$ 8.76911n
8.60228n

$\sin\frac{1}{2}I$ 8.85670
$\frac{1}{2}I$ 4 07 23
I 8 14 46

$\sin\frac{1}{2}(\Omega'-\Omega)$ 9.86466
$\cos\frac{1}{2}(i'+i)$ 9.99855
$\cos\frac{1}{2}I \sin\frac{1}{2}(N-N')$ 9.86321
$\cos\frac{1}{2}I \cos\frac{1}{2}(N-N')$ 9.83242
$\tan\frac{1}{2}(N-N')$ 0.03079
$\frac{1}{2}(N-N')$ ~~9.80163~~ ~~123 48 26~~ 47 01 46
$\frac{1}{2}(N+N')$ ~~32 20 51~~ 123 49 26
N ~~156 10 17~~ 170 51 12
$\omega = \pi - \Omega$ ~~57 00 52~~ 51 00 52
$\omega' = \pi - \Omega - N$ ~~254 50 35~~ 240 09 40
N' ~~81 28 35~~ ~~268 31 25~~ 76 47 40
Ω' ~~99 7 16~~ 49 7 16
$N'+\Omega'$ ~~367 38 41~~ ~~190 35 51~~ 175 54 56

$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.88817
$\cos\frac{1}{2}(i'-i)$ 9.99925
9.83242

For ♄

i 8 2 52
i' 2 29 19
$i'+i$ 10 32 11
$i'-i$ 5 33 33
$\frac{1}{2}(i'+i)$ 5 16 05
$\frac{1}{2}(i'-i)$ 2 46 46

Ω' 112 30 56
Ω 4 58 09
$\Omega'-\Omega$ 107 32 47
$\frac{1}{2}(\Omega'-\Omega)$ 53 46 23

$\sin\frac{1}{2}(\Omega'-\Omega)$ 9.90670
$\sin\frac{1}{2}(i'+i)$ 8.96292
$\sin\frac{1}{2}I \sin\frac{1}{2}(N+N')$ 8.86962
$\sin\frac{1}{2}I \cos\frac{1}{2}(N+N')$ 8.45724n
$\tan\frac{1}{2}(N+N')$ 0.41238
$\frac{1}{2}(N+N')$ −65 10 01
~~124 49 59~~
−68 50 51
111 09 09

$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.77158
$\sin\frac{1}{2}(i'-i)$ 8.68566n
~~8.50457~~
8.45729n

$\sin\frac{1}{2}I$ 8.89994
$\frac{1}{2}I$ 4 33 18
I ~~8 43 42~~
9 06 36

$\sin\frac{1}{2}(\Omega'-\Omega)$ 9.90670
$\cos\frac{1}{2}(i'+i)$ 9.99816
$\cos\frac{1}{2}I \sin\frac{1}{2}(N-N')$ 9.90486
$\cos\frac{1}{2}I \cos\frac{1}{2}(N-N')$ 9.77107
$\tan\frac{1}{2}(N-N')$ 0.13379
$\frac{1}{2}(N-N')$ ~~47 41 02~~ 53 41 21
$\frac{1}{2}(N+N')$ ~~124 49 59~~ 111 09 09
N ~~173 31 01~~ 164 50 30
ω ~~51 00 52~~ 51 00 52
ω' ~~287 28 51~~ 246 10 22
N' ~~76 08 57~~ 57 27 48
Ω' ~~112 30 56~~ 112 30 56
$N'+\Omega'$ ~~188 39 53~~ 169 58 44

$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.77158
$\cos\frac{1}{2}(i'-i)$ 9.99949
~~9.81840~~
9.77107

$\Omega' = 240\ 09\ 40$
$\omega = 51\ 00\ 52$
φ 17° 28′ 09″
log cos φ 9.97949
log cos² φ 9.95898
log a .43065
log p .38963
log √p .19481

log e 9.47740
sin i 9.14612

½ i 4 01 26
log √a .21532

½ φ 8 44 04
tang ½ φ 9.18650
log e″ 4.791822

log √a(1+e) .27233
log √a(1−e) .13781

log p tang ½ φ

log 40 m′ k (~~2~~ 4) = 2.13176
log 120 k ~~4~~ = 0.31476

log 40 m′ k h = 1.60779 ~~1.77115~~
log 120 k ~~4~~ = 0.31476

log (1) $\frac{40\,k\,m'}{\sqrt{p}}$ 1.93698 (4) 1.41298 (h)
log (2) $\frac{1}{\sin i}$ 0.85388
log (3) (a cos φ) 0.41014
log (4) $\frac{p}{e}$ 0.91223
log (5) $\frac{1}{e}$ 0.52260
log (6) tang ½ i 8.84724

log (7) $\frac{120\,k\,e}{\sqrt{a}}$ 0.~~01948~~ 9.57684
log (8) $\frac{120\,k}{\sqrt{a}}$ p 0.48907
log (9) p tang ½ φ 9.57613
log (10) 2 cos φ 0.28052
log (11) tang ½ φ 9.18650
log (12) p cot φ 89172
log (13) cot φ 0.50209

	1869 Oct 19	~~Oct 29~~ Nov 18	Dec 28	1870 Feb. 6	Mar 18	Apr 27	June 6	July 16	Aug 25	Oct 4
M	339 06 40	348 01 10	357 55 40	5 50 09	14 44 39	23 39 09	32 33 38	41 28 08	50 22 38	59 17 07
E	330 41 32	5 02 04	355 36 45	8 19 38	20 52 22	33 01 36	44 38 58	55 40 23	66 06 09	75 58 19
log sin E	8.68975n	[illegible]	8.88867n	9.16085	9.55181	9.73642	9.84681	9.91689	9.96108	9.98686
e″ sin E	−8 25 40	5 01 58	−1 18 57	2 29 27	6 07 41	9 22 38	+12 05 19	14 12 14	15 43 31	+16 41 12
E	330 41 30	342 59 11	355 36 43	8 19 36	20 52 20	33 01 38	44 38 57	55 40 22	66 06 09	75 58 19
½ E	165 20 45	171 29 37	177 48 22	4 9 48	10 26 10	16 30 49	22 19 25	27 50 11	33 03 05	37 59 10
log sin ½ E	9.40309	9.17003	8.58299	8.86094	9.25801	9.45369	9.57960	9.66927	9.73671	9.78921
log cos ½ E	9.98564n	9.99520n	9.99965n	9.99885	9.99276	9.98171	9.96617	9.94659	9.92334	9.89661
~~log tang ½ E~~										
log sin ½ v √r	9.67541	9.44238	8.85532	9.13327	9.53034	9.72602	9.85193	9.94160	.00904	.06154
log cos ½ v √r	0.13345	.13301	.13749	.13666	.13057	.11952	.10398	.08440	.06115	.03492
log tang ½ v	9.55196n	9.30935n	8.71783	8.99661	9.39977	9.60650	9.74795	9.85720	9.94789	.02712
½ v	−19 37 08	−11 31 23	+2 59 21	+5 39 59	14 05 36	22 00 17	29 14 08	35 44 45	41 34 15	46 47 17
½ v	160 22 50	168 28 37	177 00 39							
v	320 45 54	336 57 14	354 01 18	11 19 58	28 11 12	44 00 31	58 28 16	71 29 31	83 08 30	93 34 34
log √r	29884	14186	13808	13899	.14384	15237	16315	17505	18717	19892
log r	29884	.28370	.27616	.27758	.28768	.30474	.32630	.35010	.37434	.39784
u = v + ω	11 46 46	27 58 06	45 02 10	62 20 51	79 12 04	95 01 23	109 29 08	122 30 23	134 09 22	144 35 26
log cos u	9.99076	9.94606	9.84921	9.66662	9.27268	8.94229n	9.52319n	9.73029n	9.84299n	9.91117n
log sin u	9.30994	9.67116	9.84976	9.94733	9.99224	9.99833	9.97439	9.92599	9.85579	9.76290
log r sin u	9.60878	9.95486	12592	22491	27992	30307	30070	27609	23013	16074
r cos u	.28960	.22976	.12537	9.94420	9.56036	9.24703n	9.84950n	0.08039n	0.21733n	.30901n
log sin v	9.80106	9.59270n	9.01767n	9.29339	9.67426	9.84184	9.93063	9.97694	9.99688	9.99915
log cos v	9.88906	9.96388	9.99763	9.99145	9.94518	9.85687	9.71844	9.50166	9.07706	8.77950n
log cos E	9.94052	9.98057	9.99873	9.99540	9.97052	9.92346	9.85213	9.75121	9.60756	9.38453n
cos v	+.77457	+.42020	+.99456	+.98051	+.88142	+.71924	+.52223	+.31744	+.11941	−.06238
cos E	+.87201	+.95625	+.99709	+.98947	+.93438	+.83842	+.71143	+.56392	+.40510	+.24240
log (cos v + cos E)	= 0.21658	~~+.87645~~	1.99165	+1.96998	+1.81580	+1.55766	+1.23436	.88136	.52451	+.18002
	= .09079	.27334	.29921	.29446	.25907	.19247	.09144	9.94515	9.71975	9.25532
log $\frac{p}{2\frac{p}{2}}$	1.2325	19693	11847	11205	10195	08489	06332	03953	01529	9.99179
	.34870	1.2762	1.2986	1.2944	1.2646	1.2159	1.1570	1.0953	1.0358	.98128
log $(\frac{p}{2}+1)$	.34879	.35721	.36146	.36067	.35499	.34555	.33385	.32125	.30874	.29695
log 2 sin $\frac{v}{2}$	+.09990	9.87640n	9.29383	9.57097	9.96194	.14658	.25694	.32704	.37122	.39690
.44862	+1.9900	0.23361n	9.65529n	9.93164	0.31693	.49213	.59077	.64829	.67996	.69394
p	+~~24526~~									
p + r	44426									
lg (p + r)	~~0.64764~~									
log $(\frac{p+1}{2})$ sin 2v	0.44862n	.23361n	9.65529n	9.93164	.31693	.49213	.59079	.64829	.67996	.69394

−(p tang ½ φ cos 2 9.46519n
−.29187
−879630
−l2 r cos φ 0.57936n
coeff dL₁ −408817
log coeff. dL 0.61153n

	1870 Nov 13	1870 Dec 23	1871 Feb 1	Mar 13	Apr 22	Jun 1	Jul 11	Aug 20	Sept 29	Nov 8	Dec 18
M	68 11 37	77 06 07	86 00 37	94 55 06	103 49 36	112 44 06	121 38 35	130 33 04	139 27 35	148 22 04	157 16 33
E	85 20 11	94 15 15	102 47 01	110 58 41	118 53 10	126 33 07	134 00 47	141 15 16	148 27 27	155 30 01	162 27 39
$\frac{1}{2}E$	42 40 06	47 07 37	51 23 30	55 29 20	59 26 35	63 16 33	67 00 23	70 39 08	74 13 44	77 45 01	81 13 48
$\log\sin\frac{1}{2}E$	9.83107	9.86502	9.89289	9.91594	9.93504	9.95094	9.96405	9.97475	9.98333	9.99000	9.99489
$\log\cos\frac{1}{2}E$	9.86646	9.83275	9.79518	9.75325	9.70620	9.65292	9.59176	9.52022	9.43426	9.32670	9.18371
$\log\sqrt{2}\sin\frac{1}{2}v$	.10340	.13735	.16522	.18827	.20740	.22227	.23638	.24708	.25566	.26233	.26722
$\log\sqrt{2}\cos\frac{1}{2}v$	.00427	9.97056	9.93299	9.89106	9.84401	9.79073	9.72957	9.65803	9.57206	9.46451	9.32107
$\log\tan\frac{1}{2}v$	.09913	.16679	.23223	.29721	.36339	.43254	.50681	.58905	.68360	.79782	.94620
$\frac{1}{2}v$	51 29 00	55 44 30	59 38 14	63 13 59	66 34 54	69 43 39	72 42 30	75 33 17	78 17 38	80 56 39	83 32 33
v	102 58 00	111 29 00	119 16 28	126 27 58	133 09 48	139 27 18	145 25 00	151 06 34	156 35 16	161 53 08	167 05 07
$u=v+\omega$	153 58 52	162 29 52	170 17 20	177 28 50	184 10 40	190 28 10	196 25 02	202 07 26	207 36 08	212 54 50	218 05 59
$\log\cos u$	9.95309$_n$	9.97946$_n$	9.99373$_n$	9.99958$_n$	9.99884$_n$	9.99271$_n$	9.98189$_n$	9.96679$_n$	9.94752$_n$	9.92401$_n$	9.89594
$\log r$	.41992	.44020	.45858	.47498	.48946	.50208	.51294	.52206	.52958	~~4052~~ 53556	.53996
$\log\sin u$	9.64214	9.47820	9.22707	8.64304	8.86244$_n$	9.25938$_n$	9.45158$_n$	9.57089$_n$	9.66589$_n$	9.73510$_n$	9.79031
$\log r\cos u$	.37351$_n$	.41961$_n$	.45231$_n$	.47456$_n$	.48830$_n$	.49479$_n$	.49483$_n$	.48885$_n$	.47710$_n$	.45957$_n$	.43590$_n$
$\log r\sin u$	0.06206	9.91840	9.68565	9.11802	9.35190	9.76146	9.96452	0.09795	0.19547	0.27066	.33027
$\log\sin v$	9.98878	9.96873	9.94066	9.90537	9.86297	9.81294	9.75405	9.68407	9.59917	9.49232	9.34928
$\log r$	41992	44020	45858	47498	48946	50208	51294	52206	52958	53556	53996
$\log\cos v$	9.35099	9.56375	9.68930$_n$	9.77404	9.83511$_n$	9.88075	9.91556	9.94228	9.96269	9.97796	9.98887
$\log\cos E$	8.91012	8.87020	9.34492	9.55398	9.68401	9.77492	9.84187	9.89236	9.93059	9.95902	9.97932
$\cos E$	−.22439	−.36623	−.48899	−.59435	−.68409	−.75990	−.82331	−.87555	−.91768	−.95052	−.97470
$\cos E$	+.08131	−.07418	−.22127	−.35802	−.48307	−.59556	−.69482	−.78048	−.85226	−.90996	−.95350
$\cos E+\cos v$	−.14308	−.44041	−.71026	−.95237	−1.16716	−1.35546	−1.51813	−1.65603	−1.76994	−1.86048	−1.92820
$\log(\cos E+\cos v)$	9.15558$_n$	9.64386$_n$	9.85142$_n$	9.97881$_n$	0.06712$_n$	.13208$_n$	.18131$_n$	.21907$_n$	0.24796$_n$	.26963$_n$	.28515$_n$
$\log\rho$											
$\log r$											
$\log\frac{\rho}{r}$	9.96891	9.94943	9.93105	9.91465	9.90017	9.88755	9.87669	9.86757	9.86005	9.85407	9.84967
$\frac{\rho}{r}$	.93264	.89009	.85320	.82759	.79464	.77190	.75283	.73718	.72452	.71461	.70741
$\frac{\rho}{r}+1$											
$\log(\frac{\rho}{r}+1)$	0.28615	.27648	.26792	.26045	.25397	.24844	.24374	.23984	.23667	.23416	.23234
$\log r\sin v$	.40870	.40893	0.39924	.38035	.35243	.31502	.26699	.20613	.12875	.02788	9.88924
$\log r\sin v(\frac{\rho}{r}+1)$	.69485	.68541	.66716	.64080	.60640	.56346	.51073	.44597	.36542	.26204	.12158

	1872 Jan 27	Mar 7	Apr 16	May 26	Jul 5	Aug 14	Sept 23	Nov 2	Dec 12	1873 Jan 21	Mar 2
M	166 11 03	175 05 32	184 00 02	192 54 32	201 49 01	210 43 31	219 38 01	228 32 31	237 27 00	246 21 30	255 15 59
E	169 21 36	176 13 28	183 04 38	189 56 23	196 50 07	203 47 16	210 49 16	217 57 42	225 14 16	232 40 48	240 19 21
$\frac{1}{2}E$	84 40 48	88 06 44	91 32 19	94 58 12	98 25 04	101 53 38	105 24 38	108 58 51	112 37 08	116 20 24	120 09 40
$\log\sin\frac{1}{2}E$	9.99812	9.99976	9.99984	9.99836	9.99530	9.99057	9.98410	9.97572	9.96524	9.95239	9.93682
$\log\cos\frac{1}{2}E$	8.96718	8.51775	8.42895	8.93766$_n$	9.16550$_n$	9.31408$_n$	9.42445$_n$	9.51222$_n$	9.58501$_n$	9.64709$_n$	9.70108$_n$
$\log\sqrt{2}\sin\frac{1}{2}v$	.27045	.27205	.27217	.27069	.26763	.26290	.25643	.24805	.23757	.22472	.20915
$\log\sqrt{2}\cos\frac{1}{2}v$	9.10597	8.65556	8.56676	9.07590	9.30837$_n$	9.45189	9.56226	9.65003	9.72282	9.78490	9.83888
$\log\tan\frac{1}{2}v$	1.16548	1.61653	1.70541$_n$	1.19517$_n$	0.96437$_n$	.81101$_n$	.69417$_n$	.59802	.51475	.43982	.37026
$\frac{1}{2}v$	86 05 31	88 36 53	91 07 54	93 39 01	96 11 49	98 47 02	101 25 56	104 09 44	106 59 48	109 57 44	113 05 23
$\frac{1}{2}v$	172 11 02	177 13 47	182 15 28	187 18 03	192 23 38	197 34 09	202 51 52	208 19 28	213 59 36	219 55 28	226 10 46
v											
$u=v+\omega$	223 11 54	228 14 38	233 16 20	238 18 52	243 24 20	248 34 56	253 52 44	259 20 20	265 00 28	270 56 20	277 11 38
$\log\cos u$	9.86272$_n$	9.82346$_n$	9.77671$_n$	9.72036$_n$	9.65096$_n$	9.56249$_n$	9.44353$_n$	9.26717$_n$	8.93962$_n$	8.21447	9.09770
$\log r$	54292	54444	54450	54314	54035	53604	53026	52290	.51394	50326	49082
$\log\sin u$	9.83539	9.87273	9.90390	9.92990	9.95143	9.96892	9.98258	9.99244	9.99835	9.99994	9.99657
$\log r\cos u$	.40564$_n$	.36789$_n$	.32121$_n$	.26350$_n$	.19131$_n$	.09853$_n$	9.97379$_n$	9.79007$_n$	9.45356$_n$	8.71773	9.58850
$\log r\sin u$	0.37831	.41717	.44840	.47304	.49178	.50496	.51284	.51534	.51229	.50320	.48739
$\log\sin v$	9.13352	8.68423	8.59545$_n$	9.10407$_n$	9.33160$_n$	9.47977$_n$	9.58945$_n$	9.67620$_n$	9.74744$_n$	9.80738$_n$	9.85824$_n$
$\log r$	54292	54444	54450	54314	54035	53604	53026	52290	51394	50326	49082
$\log\cos v$	9.99595	9.99949	9.99966$_n$	9.99646$_n$	9.98976	9.97926	9.96446	9.94462	9.91867	9.88474	9.84036
$\log\cos E$	9.99247$_n$	9.99906	9.99937	9.99343	9.98095$_n$	9.96144	9.93388	9.89676	9.84768	9.78266	9.69441
$\cos E$	−.99072	−.99884	−.99922	−.99190	−.97670	−.95338	−.92143	−.88028	−.82917	−.76691	.69241
$\cos E$	−.98282	−.99785	−.99856	.98500	−.95716	−.91505	−.85878	−.78843	−.70418	−.60627	.49512
$\cos E+\cos v$	−1.97354	−1.99669	−1.99778	−1.97690	−1.93386	−1.86843	−1.78021	−1.66871	−1.53329	−1.37318	−1.18753
$\log(\cos E+\cos v)$	0.29525$_n$	0.30031$_n$	0.30005$_n$	.29598$_n$	.28642$_n$	.27148$_n$	.25044$_n$	.22238$_n$	.18563$_n$	.13773$_n$	.07464$_n$
$\log\rho$											
$\log\rho$											
$\log\frac{\rho}{r}$	9.84671	9.84519	9.84513	9.84649	9.84928	9.85359	9.85937	9.86673	9.87569	9.88637	9.89881
$\frac{\rho}{r}$	.70261	.70015	.70005	.70226	.70678	.71383	.72339	.73575	.75110	.76980	.79216
$\frac{\rho}{r}+1$											
$\log(\frac{\rho}{r}+1)$	.23111	.23049	.23046	.23107	.23218	.23397	.23638	.23949	.24331	.24792	.25338
$\log r\sin v$	9.67644	9.22867	9.13995	9.64721	9.87195	0.01581	0.11971	0.19910	.26143	.31064	[illegible]
$\log r\sin v(\frac{\rho}{r}+1)$	9.90755	9.45916	9.37041$_n$	9.87828$_n$	0.10413$_n$	0.24978$_n$	0.35609$_n$	.43859$_n$	.50474$_n$	.55856$_n$	.60244

	1873 Apr. 11	May 21	Jun 30	Aug 9	Sept. 18	1873 Sept. 18	Oct 28	~~Dec~~ Dec 7	Jan 16
	° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″				
~~At~~ M	264 10 29	273 04 59	281 59 28	290 13 58	299 48 27	299 58 27	308 53 07	317 47 47	326 42 27
E₁	248 12 16	256 22 05	264 51 38	273 44 10	283 03 08	283 17 58	293 7 41	303 30 35	314 28 58
½E₁	124 06 08	128 11 02	132 25 49	136 52 05	141 31 34	141 38 59	146 33 50	151 45 18	157 14 29
log tan ½E₁	9.91805	9.89544	9.86811	9.83485	9.79390	9.79272	9.74116	9.67508	9.58754
log cos ½E₁	9.74871n	9.79112n	9.82911n	9.86319n	9.89370n	9.89444n	9.92143n	9.94499	9.96480
log √r sin ½v	0.19038	.16777	.14044	.10718	.06623	.06487	.01331	9.94923n	9.85565
log √r cos ½v	9.88652	9.92893	9.96692	~~.00412~~ .00100	.03151	.03262	.05961	.08312	.10298
log tan ½v	.30386	.23884	.17352	.10618	.03472	.03225	9.95370	9.86411	9.75671
						47 07 32	41 57 04	36 10 45	29 43 57
½v	116 24 54	119 59 02	123 50 48	128 03 52	132 42 43	132 52 28	138 02 54	143 49 15	150 16 09
v	232 49 54	239 58 04	247 41 36	256 07 44	265 25 26	265 44 56	276 05 48	287 38 30	300 32 18
					51 0 2 40				
u	283 50 46	290 58 56	298 42 28	307 08 36	316 26 18	316 47 36	327 08 28	338 41 10	351 34 58
log cos u	9.37897	9.55398	9.68150	9.78090	9.86012	9.86266	9.92428	9.96923	9.99530
log e	47654	46034	44216	42206	~~33072~~ 40016	39972	37642	35230	~~[illegible]~~ .32856
log sin u	9.98719	9.97020	9.94304	9.90153	9.83880	9.83545	9.73446	9.56047n	9.16548n
log e sin u	.46373n	.43054n	.38520n	.32359n	.23846n	.23517n	.11088n	9.91277n	9.49404n
log sin v	9.90138n	9.93739n	9.96622n	9.98715n	9.99861n	9.99880n	9.99754n	9.97908n	9.93515n
log e	47654	46034	44216	.42206	40016	89972	87642	35230	32856
log cos v	9.78118	9.69939	9.57928	9.37974	8.90191	8.86998n	9.02615	9.48153	9.70596
log cos E	9.56972n	9.37233n	8.95221n	8.81399n	9.35380	9.36180n	9.59416	9.74200	9.84553
cos E	-60416	-50049	-37956	-23974	-.07978	-07413	+10621	+30306	+50811
cos E₁	-37130	+23569	-.08958	+06516	+.22584	+23004	+39279	+55209	+70070
cos E₁ + cos v	-97546	-73618	-46914	-17458	+14606	+15591	+49900	+85515	+1.20881
log (cos E₁ + cos v)	9.98921n	9.86698n	9.67130n	9.24199n	9.16453	9.19287	9.69810	9.93209	0.08236
log p log r log p/r	9.91305	9.92929	9.94747	9.96757	9.98947				
p/r²	.81864	.84976	.88608	.92805	.97605	.97681	1.0306	1.0895	1.1507
p/r+1 log (p/r+1)	.25975	26711	27556	28512	29580	.29596	.30762	32004	33258
log r sin v	.37792	.39773	0.40838	.40921	0.38877	.39652	.37396	.33138	.26371
log r sin v (p/r+1)	.63767n	.66484n	.68394n	.69433n	.69457n	.69448n	.68158n	.65142n	.59629n
r cos w	9.85551	.01432	.12371	.20296	.26028	.26238	.30070	.32153	.32386

Feb 25	Apr. 6	May 16	June 25	Aug 4	Sept 13	Oct 23	Dec 2	Jan 11
335 37 07	344 31 47	353 26 27	2 21 07	11 15 47	20 10 27	29 5 07	37 59 47	46 54 27
326 02 58	338 09 13	350 39 36	3 21 16	15 58 49	28 17 47	40 07 42	51 23 04	62 02 32
163 01 29	169 04 36	175 19 48	1 40 38	7 59 24	14 08 48	20 03 51	25 41 32	31 01 16
9.46532	9.27760	8.91071	8.46641	9.14302	9.38807	9.53539	9.63703	9.71211
9.98066	9.99206	9.99856	9.99881	9.99576	9.98663	9.97281	9.95479	9.93297
9.73749	9.54975	9.18286	8.73856	9.41517	9.66022	9.80754	9.90918	9.98426
.11884	.13024	.13674	.13795	.13394	.12481	.13846	.09297	.07115
9.61868	9.41951	9.04612	8.60057	9.28123	9.53541	9.69655	9.81621	9.91311
22 35 51	14 43 15	6 20 44	2 16 58	10 49 06	18 56 12	26 26 16	33 13 23	39 18 28
187 26 08	165 16 45	173 39 16						
314 52 06	330 33 30	347 18 32	4 33 56	21 38 12	37 52 24	62 52 32	66 26 46	78 36 46
55446	21 36 10	38 21 12	55 36 36	72 40 52	88 55 04	103 55 12	117 29 26	129 39 26
9.99768	9.96837	9.89443	9.75191	9.47336	8.27617	9.38123	9.66427	9.80495
30684	28946	27882	27666	28346	29794	.31792	34096	.36508
9.01290	9.56605	9.79275	9.91657	9.97989	9.99992	9.98705	9.94797	9.88642
9.31974	9.85551	.07157	.19323	.26335	.29786	.30497	.28893	.25150
9.85048	9.69156	9.34182	8.80091	9.56670	9.78811	9.90164	9.96222	9.99137
.30684	.28946	27882	27666	.28846	29794	31792	.34096	36508
9.84848	9.93995	9.98926	9.99862	9.96827	9.89728	9.78071	9.60164	9.29543
9.91883	9.96763	9.99420	9.99826	9.98288	9.94473	9.88344	9.79525	9.67101
+.70548	+.87087	+.97558	+.99684	.92955	+.78938	+.60355	+.39961	+.19744
+.82953	+.92818	+.98674	+.99276	+.96135	+.88051	+.76460	+.62410	+.46883
+1.53501	+1.79905	+1.96232	+1.98960	+1.89090	+1.66989	+1.36815	+1.02371	+.66627
0.18611	0.25504	0.29277	0.28877	0.27667	0.22269	0.13613	0.01017	9.82359
1.2098	1.2591	1.2904	1.2968	1.2767	1.2348	1.1793	1.1183	1.0579
.34435	.35394	.35991	.36112	.35731	.34924	.33832	.32559	.31342
.15732	9.98102	9.62064	9.17757	9.85016	.08605	.21956	.30318	.35645
.60167	.33496	9.98055	9.58869	.20747	.43529	.53788	.62917	.66987
~~.55214~~ .30452	.25783	.17325	.02857	9.75682	8.59411	9.69915	.00523	.17003

N + Ω' 175 54 56

	1869 Oct 9	Nov 18	Dec 28	2 Feb 6	Mar 18	Apr 27	June 6	July 16	Aug 25	~~Jan 18~~ Oct 4
ω = π − Ω − N	43 17 07	46 54 08	50 30 27	54 06 00	57 40 44	61 14 36	64 47 32	68 19 30	71 50 29	75 20 25
u' = L' − (Ω' + N')	227 22 11	230 57 12	234 35 31	238 11 04	241 45 48	245 19 40	248 52 36	252 24 39	255 55 33	259 26 29
log sin u'	9.86672	9.89042n	9.91118n	9.92929n	9.94498	9.95843	9.96974	9.97920	9.98676	9.99256
log sin I	9.15663									
log tang u'	.03597	.09142	.14821	.20736	.27001	.33785	.41304	.49889	.60044	.72886
log cos I	9.99549	.08691	.14370	.20285	.26550	.33334	.40853	.49438	.57633	.72435
log tang λ'	0.03146 =									
λ'	227 04 26	230 41 43	234 18 40	237 55 10	241 30 54	245 06 06	248 40 35	252 14 15	255 47 06	259 19 01
Ω + ω'	200 55 36	217 06 54	234 10 58	251 29 39	268 20 52	284 10 11	298 37 56	311 39 11	323 18 10	333 44 14
λ' − (Ω + ω')	26 08 50	13 34 49	0 07 42	346 25 31	333 10 02	320 55 55	310 02 39	300 35 04	292 28 56	285 34 47
log sin β'	9.02335n	9.04705n	9.06781n	9.08592n	9.10161	9.11506	9.12642	9.13583	9.14339n	9.14918n
log r'	.69729	.69796	.69869	.69949	~~.07589~~ .70035	.70126	.70222	.70323	.70428	.70537
log cos β'	9.99757	9.99729	9.99701	9.99675	9.99650	9.99628	9.99608	9.99590	9.99576	9.99569
log z' = log r' sin β'	9.72064n	9.74501n	9.76650n	9.78541n	9.80196n	9.81632n	9.82864n	9.83906n	9.84767n	9.85456n
log sin(λ' − (Ω + ω')) (1)	9.64418	9.37071	7.35022	9.37054	9.65455	9.79951	9.88397	9.93494	9.96567	9.98374
log r' cos β'	0.69486	0.69525	.69570	.69624	.69685	.69754	.69830	.69913	.70004	.70101
log cos(λ' − (Ω + ω')) (1)	9.95316	9.98769	10.00000	9.98769	9.95053	9.89008	9.80847	9.70615	9.58251	9.42907
log cos γ' = cos β' cos(λ' − (Ω + ω'))	9.95068	9.98498	9.99701	9.98444	9.94703	9.88636	9.80455	9.70245	9.57827	9.42471
log r'	.69729	.69796	.69869	.69949	.70035	.70126	.70222	.70323	.70428	.70537
log sin γ'	9.65362	9.41244	9.06786	9.41981	9.66769	9.80504	9.88670	9.93636	9.96639	9.98408
log r' cos γ'	0.64797	0.68294	.69570	.68393	.64738	.58762	.50677	.40568	.28255	.13008
− r' cos γ'	−4.4454	−4.8189	−4.9625	−4.8299	−4.4400	−3.8692	−3.2120	−2.5450	−1.9167	−1.3492
ρ	+1.9900	+1.9218	+1.8887	+1.8949	+1.9395	+2.0172	+2.1199	+2.2392	+2.3676	+2.4994
ρ − r' cos γ'	−2.4554	−2.8971	−3.0738	−2.9300	−2.5005	−1.8520	−1.0921	−0.3058	+0.4509	1.1502
log r' sin γ' = log Q sin ψ'	0.35125	.11040	9.76655	.11930	.36804	.50630	.58892	.63959	.67067	.68995
log Q cos ψ'	.39012n	.46195n	.48768n	.46761	.39803	.26764n	.03826	9.48544	9.65408	0.06077
log tang ψ'	9.96113n	9.64845	9.27887n	9.65169	9.97007n	.23866	.55066	1.15415	1.01659	.62868
log Q	.52206	.50120	.49539	.50740	.53407	.56874	.60547	.64066	.67267	.70114
	9.47784									
log 1/Q	9.47784	9.49880	9.50461	9.49260	9.46593	9.43126	9.39453	9.35934	9.32733	9.29886
log 1/Q³	8.43352	8.49640	8.51383	8.47780	8.39779	8.29378	8.18359	8.07802	7.98199	7.89658
log 1/ρ	9.30271	9.30204	9.30131	9.30051	9.29965	9.29874	9.29778	9.29677	9.29572	9.29463
log 1/ρ³	7.90813	7.90612	7.90393	7.90153	7.89895	7.89622	7.89334	7.89031	7.88716	7.88389
1/Q³ =	+.027135	+.031362	.032646	.030047	.024991	.019669	.015261	.011968	.0095940	.0078810
−1/ρ³ =	−.008093	−.008056	8015	7971	7924	7874	7822	7768	77120	76540
A	+.019042	+.023306	+.024631	+.022076	+.017067	+.011795	+.007439	+.004200	+.0018820	.0002270
log A	8.27971	8.36745	8.39148	8.34392	8.23216	8.07170	7.87151	7.62325	7.27462	6.35603
log z'	9.72064n	9.74501	9.76650	9.78541	9.80196	9.81632	9.82864	9.83906	9.84767	9.85456
log (1)	1.93695									
log W₀	9.93730n	0.04941n	0.09493n	0.06628n	9.97107n	9.82497n	9.63710n	9.39926n	9.05924n	8.14754n
log A	8.33898	8.36745	8.39148	8.34392	8.23216	8.07170	7.87151	7.62325	7.27462	6.35603
log y'	= 11 8.27971	0.06546	8.04592	0.06678n	.35140n	.49705n	.58227n	.63407n	.66571n	.68475n
log (1)	1.93695									
log S₀	0.55564	0.37038	8.37435	0.34765n	0.52051n	0.50570n	0.39073n	0.19427n	9.87728n	8.97773n
log ρ	.29884	.28370	.27616	.27758	.28768	.30474	.32631	.35010	.37434	.39784
log 1/Q³	8.43352	8.49640	8.51383	8.47780	8.39779	8.29378	8.18359	8.07802	7.98199	7.89658
log ρ/Q³	8.73236	8.78010	8.78999	8.75538	8.68537	8.59852	8.50980	8.42812	8.35633	8.29442
log A	8.27971	8.36745	8.39148	8.34352	8.23216	8.07170	7.87157	7.62325	7.27462	6.35603
log x'	.64797	.68294	.69570	.68393	.64738	.58762	.50677	.40568	.28255	.13008
log Ax'	8.92768	9.05039	9.08718	9.02785	8.87954	8.65932	8.37828	8.02893	7.55717	6.48611
Ax'	+.084655	+.11231	+.12223	+.10662	+.07578	.04564	.02389	.01069	.00361	.00030
− ρ/Q³	−.053996	−.06027	−.06166	−5693	−4846	−3968	−3235	−2680	−2272	−1970
Ax' − ρ/Q³	+.030660	+.05204	+.06057	+.04969	+.02732	+.00596	−.00846	−.01611	−.01911	−.01939
log (Ax' − ρ/Q³)	8.48657	8.71634	8.78226	8.69627	8.43648	7.77525	7.92737n	8.20710n	8.28126n	8.28718n
log (1)	1.93695									
log R₀	0.42352	0.65329	0.71921	0.63322	0.37343	9.71220	9.86432n	0.14405n	0.21821n	0.22453n

169 58 44

	Oct 9	Nov 18	Dec 28	Feb 6	Mar 18	Apr 27	June 6	July 16	Aug 25	Oct 4
	257 43 55	258 56 17	260 08 36	261 20 53	262 33 09	263 45 42	264 57 34	266 09 46	267 21 56	268 34 05
	87 45 11	88 57 33	90 09 52	91 22 09	92 34 25	93 46 58	94 58 50	96 11 02	97 23 12	98 35 21
	9.99967	9.99993	9.99998	9.99988	9.99956	9.99905	9.99836	9.99746	9.99638	9.99510
	9.19956									
	~~8.59336~~	~~8.25923~~	~~7.45863~~	~~9.37829~~	~~8.65227~~	~~9.81937~~	~~8.93861~~	~~9.03230~~	~~9.10909~~	~~9.74419~~
	1.40639	1.74069	2.54280n	1.62167n	1.34729n	1.17968n	1.05975n	0.96517n	0.88326n	0.82090n
	1.40080	1.73518	2.53655n	1.61616	1.34178	1.17415n	1.05422n	0.95946	0.88175	0.81539n
	87 43 28	88 56 45	90 10 00	91 23 11	92 36 23	93 49 51	95 02 38	96 15 44	97 28 47	98 41 50
	206 56 16	223 07 36	240 11 40	257 30 21	274 21 34	290 10 53	304 38 38	317 39 53	329 18 52	339 44 56
	240 47 12	225 49 05	209 58 20	193 52 50	178 14 49	163 38 58	150 24 00	138 35 51	128 05 53	118 56 54
	9.19923	9.19949	9.19954	9.19944	9.19912	9.19861	9.19792	9.19702	9.19594	9.19466
	1.00148	1.00159	1.00170	1.00181	1.00190	1.00197	1.00205	1.00210	1.00215	1.00218
	9.99450	9.99449	9.99449	9.99449	9.99450	9.99451	9.99453	9.99455	9.99458	9.99461
	0.20071	0.20108	.20124	0.20125	0.20102	0.20058	0.19997	0.19912	0.19809	0.19684
	9.94092n	9.85561n	9.69861n	9.38003n	8.48560	9.44950	9.69368	9.82043	9.89555	9.94204
	0.99598	.99608	.99619	.99630	.99640	.99648	.99658	.99665	.99673	.99679
	9.68848n	9.84319n	9.93765n	9.98713n	9.99980n	9.98207n	9.93927n	9.87511	9.79094	9.68486n
	9.68298	9.83768	9.93214	9.98162	9.99430	9.97658	9.93380	9.86966	9.78552	9.67947
	1.00148	1.00159	1.00170	1.00181	1.00190	1.00197	1.00205	1.00210	1.00215	1.00218
	9.94261	9.86067	9.71937	9.45462	9.20652	9.50480	9.70978	9.82723	9.89883	9.94366
	.94409	.86226	.71270	.45643	.20842	.50677	.71183	.82933	.90098	.94584
	0.68442n	.83927n	0.93434n	.98343	.99623n	.97855	.93585n	.87176	.78767n	.68165n
	+48258	+69067	+86870	+96257	+99136	+95141	+86269	+74433	+61330	+48040
	1.9900	1.9218	1.8887	1.8949	1.9395	2.0172	2.1199	2.2392	2.3676	2.4994
	6.8258	8.8285	10.4757	11.5206	11.8531	11.5353	10.2468	9.6825	8.5006	7.3046
	0.94405	0.86226	.71607	0.45643	.20842	0.50677	0.71183	0.82933	0.90098	0.94584
	0.83415	.94589	1.02078	1.06147	1.07383	1.06219	1.03127	0.98599	0.929450	.86356
	.10994	9.91637	9.69586	9.39496	9.13459	9.44458	9.68056	9.84334	.97153	1.08228
	1.04652	~~1.06144~~ 05860	1.06802	1.07446	1.07783	1.07840	1.07437	1.07201	1.06620	1.05984
	8.95348	8.94140	8.93197	8.92554	8.92217	8.92160	8.92363	8.92799	8.93380	8.94091
	6.86044	6.82420	6.79591	6.77662	6.76651	6.76480	6.77089	6.78367	6.80190	6.82273
	8.99852	8.99841	8.99830	8.99819	8.99810	8.99803	8.99795	8.99790	8.99785	8.99782
	6.99556	6.99523	6.99490	6.99457	6.99430	6.99409	6.99385	6.99370	6.99355	6.99346
	.0007252	.0006671	.0006251	.0005979	.0005841	.0005818	.0005901	.0006051	.0006330	.0006649
	−.0009888	9891	9884	9876	9870	9865	9860	9856	9853	9851
	−.0002646	.0003220	.0003633	.0003897	.0004029	.0004047	.0003955	.0003725	.0003523	.0003202
	6.42259	6.50786	6.56027	6.59073	6.60520	6.60713	6.59759	6.57692	6.54695	6.50542n
	.20071n	.20108n	.20124n	.20125n	.20102n	.20058n	.19997n	.19912	.19809	.19684
W_1	8.03628n	8.12192n	8.17449n	8.20496n	8.21920n	8.22069n	8.21054n	8.18902n	8.15802n	8.11524n
	6.42259	6.50786	6.56027	6.59073	6.60520	6.60713	6.59759	6.57692	6.54695	6.50542
	0.93690n	.85169n	.69488n	.37635n	9.48200n	.44598n	.69026	.81708	.89228	.93883n
S_0	8.77249n	8.77253n	8.66805	8.38004n	7.50018n	8.46609n	8.70083	8.80698	8.85921	8.85723
	29884	28370	27616	27755	28768	30474	32631	35010	37434	.39784
	6.86044	6.82420	6.79591	6.77662	6.76657	6.76480	6.77089	6.78367	6.80140	6.82273
	7.15928	7.10790	7.07207	7.05420	7.05419	7.06954	7.09720	7.13377	7.17574	7.22057
	6.42259	6.50786n	6.56027n	6.59073	6.60520	6.60713	6.59759	6.57692	6.54695	6.50542n
	0.68448n	.83927n	.93434n	.98343	.99620n	.97855	.93585n	.87176	.78767n	.68165n
	7.10705n	7.34713	7.49461n	7.57416	7.60140n	7.58568	7.53344n	~~7.44944~~ 44868	~~7.31582~~ 7.33462	7.18707
	+.0012795	+.0022240	+.0031233	+.0037512	+.0039939	+.0038520	+.0034154	+.0028099	+.0021603	+.0015384
	−.0014431	12820	11805	11329	11330	11737	12508	13607	14988	−.0016618
	−.0001636	~~0580~~ +.0009420	+.0019428	+.0026183	+.0028609	+.0026783	+.0021646	+.00~~12638~~ 14492	~~+.0005721~~ .0006620	−.0001234
	6.21378n	6.97405	7.28843	7.41704	7.45650	7.42786	7.33538	7.16113	6.82086	6.09182n
R_a	7.62676n	8.38703	8.70141	8.83002	8.86948	8.84084	8.74836	8.57411	8.23384	7.50430n

	Nov. 13	1870 Dec 23	1871 Feb. 1	Mar 13	♃ Apr 22	June 1	July 11	Aug 20	Sept 29	Nov 8
L'	78 49 47	82 17 03	85 43 44	89 09 16	92 33 41	95 56 57	99 19 05	102 40 04	105 59 55	109 18 39
u' = L' − (Ω' + ω')	262 54 21	266 22 07	269 48 48	273 14 20	276 38 45	280 02 01	283 24 09	286 45 08	290 04 59	293 23 43
log sin u'	9.99666n	9.99913n	10.00000n	9.99931n	9.99707n	9.99338n	9.98801n	9.98117n	9.97275n	9.96274n
log sin I	4.15663									
log tang u'	0.90499	1.19747	2.48705	1.24726n	0.93362n	0.75219n	.62291n	.52142n	.43698n	.36387n
log cos I	9.99549									
log tang λ'	0.90048	1.19296	2.48254	1.24275	0.92911	.74768	.61840	.51691	.43247	.35936
λ'	262 49 57	266 19 51	269 48 41	273 16 22	276 42 52	280 08 10	283 32 14	286 55 02	290 16 31	293 36 46
ν + ω'	343 07 40	351 32 40	359 26 08	6 37 38	13 19 28	19 36 58	25 34 40	31 16 14	36 44 56	42 03 38
λ' − (ν + ω')	279 42 17	274 41 11	270 22 33	266 38 44	263 23 24	260 31 12	257 57 34	255 38 48	253 31 35	251 33 08
log sin β'	9.15329n	9.15576n	9.15663n	9.15594n	9.15370n	9.14994n	9.14464n	9.13780n	9.12938n	9.11938n
log r'	.70649	70764	70881	71001	71122	71244	71366	71489	71611	.71733
log cos β'	9.99556	9.99550	9.99552	9.99550	9.99555	9.99562	9.99573	9.99586	9.99602	9.99620
log z' = log r' sin β'	9.85978n	9.86340n	9.86544n	9.86595n	9.86492n	9.86238n	9.85830n	9.85269n	9.84549n	9.83680n
log sin (λ' − (ν + ω'))	9.99374n	9.99853n	9.99999n	9.99926n	9.99710n	9.99403n	9.99034n	9.98623n	9.98180n	9.97709n
log r' cos β'	.70205	.70314	.70433	.70551	.70677	.70806	.70939	.71075	.71213	.71353
log cos (λ' − (ν + ω'))	9.22677	8.91223	7.81687	8.76725n	9.06116n	9.21670n	9.31932n	9.39430n	9.45267n	9.50030n
log cos j' = cos β' cos λ' − (ν + ω')	9.22233	8.90773	7.81239	8.76275n	9.05671n	9.21232n	9.31505n	9.39016n	9.44869n	9.49650n
log r'	.70649	.70764	.70881	.71001	.71122	.71244	.71366	.71489	.71611	.71733
log sin j'	9.99387	9.99857	9.99999	9.99927	9.99717	9.99410	9.99053	9.98649	9.98214	9.97751
log r' cos j'	9.92882	9.61537	8.52120	9.47276n	9.76793n	9.92476n	0.02871n	0.10505n	0.16480n	0.21883n
− r' cos j'	− .8488	− .4125	− .0332	+ .2970	+ .5867	+ .8410	+ 1.0683	+ 1.2737	+ 1.4615	+ 1.6362
r	2.6298	2.7555	2.8746	2.9853	3.0865	3.1775	3.2579	3.3271	3.3852	3.4321
r − r' cos j'	+ 1.7810	+ 2.3430	+ 2.8414	+ 3.2823	+ 3.6726	+ 4.0185	+ 4.3262	+ 4.6008	+ 4.8467	+ 5.0683
log r' sin j' = log Q sin l'	0.70036	0.70621	.70880	.70928	.70839	.70654	.70419	.70138	.69825	.69484
log Q cos l'	0.25066	.36977	.45353	.51618	.56497	.60406	.63611	.66283	.68545	.70486
log tang l'	0.44970	.33644	.25527	.19310	.14342	.10253	.06808	.03855	.01280	9.98998
log ~~tang~~ Q	.72614	.74803	.76721	.78404	.79883	.81183	.82332	.83347	.84246	.85042
log 1/Q	9.27382	9.25197	9.23279	9.21596	9.20116	9.18817	9.17668	9.16653	9.15754	9.14958
log 1/Q³	7.82146	7.75591	7.69837	7.64788	7.60348	7.56451	7.53004	7.49957	7.47262	7.44874
log 1/2'	9.29351	9.29236	9.29119	9.28999	9.28878	~~0.00588~~ 9.28756	~~0.00947~~ 9.28634	~~0.01351~~ 9.28511	0.01786 9.28389	0.02267
log 1/2·3	7.88053	7.87708	7.87357	7.86999	7.86634	7.86265	7.85902	7.85533	7.8516	7.84801
1/Q³	+.0066292	+.0057005	+.0049931	+.0044451	+.0040131	+.0036657	+.0033888	+.0031593	+.002969	+.0028103
− 1/ρ³	π. −.0075952	− .75350	74743	74130	73510	72896	72281	71670	71070	70471
Δ	−.0009660	18345	24812	29679	33379	36206	38393	40077	41374	.0042368
log Δ	~~6.96292~~ 6.98498n	7.26352	7.39466	7.47245	7.52346	7.55878	7.58425	7.60290	7.61678	7.62704
log z'	9.85978n	9.86340n	9.86544n	9.86595n	9.86492n	9.86238n	9.85830n	9.85269n	9.84549n	9.83680n
log (1) W₀	8.78171	9.06387	9.19705	9.27535	9.32533	9.35811	9.37950	9.39254	9.39921	9.40065
log 4	6.98498	7.26352	7.39466	7.47245	7.52346	7.55878	7.58425	7.60290	7.61678	7.62704
log y'	0.69579n	.70169n	.70432n	.70477n	.70387n	.70209n	.69975n	.69678n	.69353n	.69062
log (1) S₀	9.61772	9.90216	.03593	.11417	.16428	.19782	.22093	.23683	.24766	.25461
log r	.41992	.44020	.45858	.47498	.48946	.50208	.51294	.52206	.52958	.53996
log 1/Q³	7.82146	7.75591	7.69837	7.64788	7.60348	7.56451	7.53004	7.49957	7.47262	7.44874
log r/Q³	8.24138	8.19611	8.15695	8.12286	8.09294	8.06659	8.04298	8.02165	8.00220	7.98870
log 4	6.98498n	7.26352n	7.39466n	7.47245n	7.52346n	7.55878n	7.58425n	7.60290n	7.61678n	7.62704n
log x'	9.92882	9.61537	8.52120	9.47276	9.76793	9.92476	0.02871	.10505	0.16480	0.21883
log 4x'	6.91380n	6.87889n	5.91586n	6.94521n	7.29139n	7.48354n	7.61296n	7.70795n	7.78158n	7.84087n
4x'	+.0008199	+.0007566	+.0000824	+.0008815	+.0019561	+.0030447	+.0041017	+.0051045	+.0060476	+.0069323
− r/Q³	−.017433	−15708	−.014358	− 13270	− 12386	− 11657	−.011040	− 10511	− 10051	− 9743
4x' − r/Q³	−.018253	−.016465	−.014435	−.012386 −.014151	−.010430	−.008612	−.006948	−.005407	−.004003	−.002810
	~~−.016613~~	~~−.014951~~	~~−.014271~~	~~−.012387~~	~~−.014342~~	~~−.014702~~	~~−.015142~~	~~−.015615~~	~~−.016099~~	~~−.016675~~
log (4x' − r/Q³) log (1) Q²	8.26133n	8.21656n	8.15942n	8.09269n	8.01828n	7.93510n	7.84186n	7.73296n	7.60239n	7.44871n
log R₀	0.19828n	0.15351n	0.09637n	0.02964n	9.95523n	9.87205n	9.77881n	9.66991n	9.53934n	9.38566n

169 58 44

2

	Nov 13	Dec 23	Feb. 1	Mar 13	Apr. 22	June 1	July 11	Aug 20	Sept 29	Nov 8
	265 46 13	270 58 21	272 10 30	273 22 38	274 34 47	275 46 56	276 59 05	278 11 17	279 23 29	280 35 42
	99 49 29	100 59 37	102 11 46	103 23 54	104 36 03	105 48 12	107 00 21	108 12 33	109 24 45	110 36 58
	9.99363	9.99190	9.99009	9.98802	9.98574	9.98327	9.98058	9.97763	9.97468	9.97126
	0.76302	.71161	.66524	.62309	.58420	.54817	.51450	.48286	.45297	.42459
	.75757	.70610	.65976	.61758	.57869	.54266	.50899	.47735	~~9.96904~~	~~9.96576~~
	99 54								44746	.41508
	99 54 50	101 07 49	102 20 49	103 33 43	104 46 44	105 59 40	107 12 37	108 25 33	109 38 28	110 51 23
	349 08 22	357 39 22	5 26 50	12 38 20	19 20 10	25 37 40	31 35 22	37 16 56	42 45 38	48 04 20
	110 46 28	103 28 27	96 53 59	90 55 23	85 26 34	80 22 00	75 37 15	71 08 37	66 52 49	62 47 03
	9.19319	9.19152	9.18965	9.18758	9.18530	9.18283	9.18014	9.17724	9.17414	9.17082
	1.00221	1.00222	1.00222	1.00221	1.00219	1.00216	1.00212	1.00207	1.00201	1.00194
	9.99465	9.99469	9.99474	9.99479	9.99484	9.99490	9.99496	9.99503	9.99510	9.99518
	0.19540	0.19374	0.19187	0.18979	0.18749	0.18499	0.18226	.17931	.17615	.17276
	9.97080	9.98788	9.99684	9.99994	9.99862	9.99383	9.98618	9.97604	9.96364	9.94902
	0.99686	0.99691	.99696	.99700	.99703	.99706	.99709	.99710	.99711	.99712
	9.54981	9.36737	9.07966	8.20709	8.90015	9.22360	9.39504	9.50947	9.59401	9.66023
	9.54449$_n$	9.36206$_n$	9.07440$_n$	8.20188$_n$	8.89499	9.21850	9.39001	9.50450	9.58911	9.65541
	1.00221	1.00222	1.00222	1.00221	1.00219	1.00216	1.00212	1.00207	1.00201	1.00194
	9.97156	9.98818	9.99692	9.99994	9.99866	9.99398	9.98650	9.97661	9.96457	9.95030
	0.54670$_n$	0.36428$_n$	0.07662	9.20409	9.89718	0.22066	0.39213	0.50657	0.59112	0.65735
	+.35213	+.23136	+0.1924	+.1600	-.07892	-.16621	-.24668	-.32105	-.39005	-.45431
	2.6298	2.7558	2.8746	2.9853	3.0865	3.1770	3.2579	3.3271	3.3852	3.4321
	+6.1511	5.0691	4.0875	3.1403	2.2973	1.5754	0.7911	+0.1166	-.5153	-1.1110
	0.97377	0.99040	0.99910	1.00215	1.00085	0.99614	0.98862	0.97868	0.96653	0.95224
	0.78895	.70493	.60932	.49766	.36122	.18052	9.88523	9.06670	9.71206	0.04571
	.18482	.28547	0.38981	.50449	.63963	.81562	1.09039	9.91198	1.25449$_n$	0.90653$_n$
	1.05097	1.04206	~~1.02986~~ 1.03251	1.02244	1.01197	1.00116	0.99005	.97871	.96720	.95555
	8.94903	8.95794	8.96749	8.97756	8.98803	8.99885	9.00995	9.02129	9.03280	9.04445
	6.84709	6.87382	6.90247	6.93268	6.96409	6.99655	7.02985	7.06387	7.09840	7.13335
	8.99779	8.99778	8.99778	8.99779	8.99781	8.99784	8.99788	8.99793	8.99799	8.99806
	6.99337	6.99334	6.99334	6.99337	6.99343	6.99352	6.99364	6.99379	6.99397	6.99418
	+.0007632	+.0007479	+.0007981	+.0008564	+.0009207	+.0009921	+.0010712	+.0011584	+.0012543	+.0013594
	-.0009849	.0009848	9848	9849	9850	9852	9855	9858	9862	-.0009867
	-.0002817	-.0002369	-.000~~1288~~ 1856	-.0001285	-.0000643	+.0000069	+.0000857	+.0001726	+.0002681	+.0003727
	6.44979$_n$	6.37457$_n$	6.26928$_n$	6.10890$_n$	5.80821$_n$	4.83885	5.93298	6.23704	6.42830	6.57136
	19540	19374	19187	18979	18749	18499	18226	17931	17615	17276
ψ_0	8.05817$_n$	7.98129$_n$	7.87413$_n$	7.71167$_n$	7.40868$_n$	6.43682	7.52822	7.82933	8.01743	8.15710
	6.44979	6.37457	6.26928	6.10890	5.80821	4.83885	5.93258	6.23704	6.42830	6.57136
	0.96966$_n$	0.98479$_n$	0.99380$_n$	0.99694$_n$	.99565$_n$	.99089	.98327	.97314	.96075	.94616
δ_0	8.83043$_n$	8.77234$_n$	8.67606$_n$	8.51882$_n$	8.21684$_n$	7.24272	8.32523	8.62316	8.80203	8.93050
	41992	44020	45858	47498	48946	50208	51294	52206	52958	.53596
	~~8.94907~~	~~8.95794~~	~~8.96749~~	~~8.97756~~	~~8.98803~~	~~8.99885~~	7.02985	7.06387	7.09840	7.13335
	6.84709	6.87382	6.90247	6.93268	6.96409	6.99658				
	7.26701	7.31402	7.36105	7.40766	7.45355	7.49863	7.54279	7.58593	7.62798	7.67331
	6.44979$_n$	6.37457	6.26928	6.10890	5.80821	4.83885	5.93258	6.23704	6.42830	6.57136
	0.54670$_n$	0.36428$_n$	.07662$_n$	9.20409$_n$	9.89718$_n$	.22066	.39213	.50657	.59112	.65735
	6.99649$_n$	6.73885$_n$	6.34590	6.31299	5.70539$_n$	5.05951	6.32511	6.74361	7.01942	7.22871
	+.0009920	+.0005481	+.0002218	+.0000206	-.0000507	+.0000115	+.0002114	+.0005541	+.0010457	+.0016532
	-.0018493	-.0020607	-.0022964	-.0025566	-.0028416	-.0031523	-.0034897	-.0038542	-.0042460	-.0047132
	-.0008573	-.0015126	-.0020746	-.0025360	~~-.0027909~~ -.0028923	-.0031408	-.0032783	-.0033001	-.0032003	-.00~~30200~~ 29700
	6.93313$_n$	7.18001$_n$	7.31693$_n$	7.40415$_n$	7.46124$_n$	7.49704$_n$	7.51565$_n$	7.51853$_n$	7.50519$_n$	7.47276$_n$
R_0	8.34611$_n$	8.59299$_n$	8.72991$_n$	8.81713$_n$	8.87422$_n$	8.91002$_n$	8.92863$_n$	8.93151$_n$	8.91817$_n$	8.88574$_n$

	1871 Dec 18	1872 Jan 27	Mar 7	Apl 16	May 26	July 5	Aug 14	Sept 23	Nov 2	Dec 12
ω'	112 36 16	115 52 48	119 08 10	122 22 40	125 36 03	128 48 26	131 59 52	135 10 23	138 19 59	141 28 44
u' = L' − (Ω' + ω')	296 41 20	299 57 52	303 13 19	306 27 44	309 41 07	312 53 30	316 04 56	319 15 27	322 25 03	325 33 48
log sin u'	9.95107	9.93769	9.92249	9.90548n	9.88624n	9.86489n	9.84112n	9.81469n	9.78526n	9.75242
log sin I	9.15663									
log tang u'	9.29869	.23918n	.18381n	.13165n	.08104n	.03199n	9.98359n	9.93522n	9.88627n	9.83611n
log cos I	9.99549									
log tang λ'	9.29418	.23467	.17930	.12714	.07653	.02748	9.97908	9.93071	9.88176	9.83160
λ'	296 55 40	300 13 21	303 29 41	306 43 49	309 58 39	313 11 18	316 22 45	319 33 04	322 42 17	325 50 33
v + ω'	47 14 47	52 20 42	57 23 27	62 25 08	67 27 43	72 33 08	77 43 44	83 01 32	88 29 08	94 09 16
λ' − (v + ω')	249 40 53	247 52 39	246 06 14	244 18 41	242 30 56	240 38 10	238 39 01	236 31 32	234 13 09	231 41 17
log sin β'	9.10770n	9.09432	9.07912	9.06211	9.04287	9.02152	8.99775	8.97132	8.94189	8.90906
log r'	.71854	.71973	.72091	.72207	.72320	.72430	.72537	.72641	.72741	.72837
log cos β'	9.99640	9.99662	9.99685	9.99704	9.99734	9.99759	9.99784	9.99809	9.99833	9.99857
log z' = log r' sin β'	9.82624n	9.81405n	9.80003n	9.78418n	9.76607n	9.74582n	9.72312n	9.69773n	9.66930n	9.63743n
log sin (λ' − (v + ω'))	9.97210n	9.96679n	9.96108n	9.95480n	9.94799n	9.94028n	9.93146n	9.92123n	9.90916n	9.89467n
log r' cos β'	0.71494	.71635	.71776	.71916	.72054	.72189	.72321	.72450	.72574	.72694
log cos (λ' − (v + ω'))	# 9.54064	9.57587n	9.60754n	9.63697n	9.66418n	9.69051n	9.71622n	9.74160n	9.76692n	9.79236n
log cos j' = cos β' cos λ	9.53704	9.57249	9.60439	9.63406	9.66152	9.68810	9.71406	9.73969	9.76525	9.79093
log r'	.71854	.71973	.72091	.72207	.72320	.72430	.72537	.72641	.72741	.72837
log sin j'	9.97259	9.96734	9.96179	9.95547	9.94870	9.94104	9.93226	9.92206	9.91000	9.89556
log r' cos j'	.25558	.29222	.32530	.35613	.38472	.41240	.43943	.46610	.49266	.51930
− r' cos j'	+1.8013	+1.9598	+2.1150	+2.2705	+2.4250	+2.5847	+2.7506	+2.9248	+3.1093	+3.3060
r	+3.4671	3.4908	3.5089	3.5035	3.4925	3.4702	3.4359	3.3905	3.3335	3.2655
r − r' cos j'	5.2684	5.4506	5.6189	5.7740	5.9175	6.0549	6.1865	6.3153	6.4428	6.5715
log r' sin j' = log ρ sin b'	.69113	.68707	.68270	.67754	.67190	.66534	.65763	.64847	.63741	.62393
log ρ cos b'	.72168	.73644	.74965	.76148	.77214	.78211	.79145	.80040	.80907	.81766
log tang b'	9.96945	9.95063	9.93305	9.91606	9.89976	9.88323	9.86618	9.84807	9.82834	9.80627
log ρ	.85747	.86378	.86926	.87406	.87827	.88200	.88521	.88798	.89029	.89224
log 1/ρ	9.14253	9.13622	9.13074	9.12594	9.12173	9.11800	9.11479	9.11202	9.10971	9.10776
log 1/ρ³	7.42759 ~~9.2~~	7.40866	7.39222	7.37782	7.36519	7.35400	7.34437	7.33606	7.32913	7.32338
log r'	9.28146	9.28027	9.27909	9.27793	9.27680	9.27570	9.27463	9.27359	9.27257	9.27163
log 1/r'³	7.84438	7.84081	7.83727	7.83399	7.83040	7.82710	7.82389	7.82077	7.81777	7.81489
1/ρ³	.0026767	.0025625	.0024673	.0023868	.0023184	.0022595	.0022099	.0021680	.0021337	.0021056
− 1/r'³	−.0069885	69313	68750	68201	67670	67159	66665	66187	65731	65298
4	−.0043118	−.0043688	−.0044077	−.0044333	−.0044486	−.0044564	−.0044566	−.0044507	−.0044394	−.0044242
log 4'	~~0.68704~~	~~0.68314~~	~~.67884~~	~~0.67396~~	~~.66853~~	~~.66217~~	~~.65467~~	~~.64573n~~	~~.63496n~~	~~.62161n~~
log 4	7.63466n	7.64036n	7.64421n	7.64673n	7.64822n	7.64898n	7.64902n	7.64843n	7.64732n	7.64583n
log W₀ =	~~0.25865~~	~~0.26045~~	~~.26006~~	~~0.25764~~	~~.25370~~	~~.24810~~	~~.24062~~	~~.23111~~	~~.21917~~	~~.20449~~
log 4	~~7.63466~~	~~7.64036~~	~~7.64421~~	~~7.64673~~	~~7.64822~~	~~7.64898~~	~~7.64902~~	~~7.64843~~	~~7.64732~~	~~7.64583~~
log z' ; log W₀	9.82624n	9.81405n	9.80003n	9.78418n	9.76607n	9.74582n	9.72312n	9.69773n	9.66930n	9.63743n
log (1/ρ) =	9.39788	9.39136	9.38119	9.36786	9.35124	9.33155	9.30907	9.28311	9.25357	9.22027
log S₀	0.25865	0.26045	.26006	.25764	.25370	.24810	.24062	.23111	.21917	.20449
log r	.53996	.54292	.54444	.54450	.54314	.54035	.53604	.53026	.52290	.51394
log 1/ρ³	7.42759	7.40866	7.39222	7.37782	7.36579	7.35400	7.34437	7.33606	7.32913	7.32338
log r/ρ³	7.96755	7.95158	7.93666	7.92232	7.90833	7.89435	7.88141	7.86632	7.85203	7.83732
log 4	7.63466n	7.64036	7.64421	7.64673	7.64822	7.64898	7.64902	7.64843	7.64732	7.64583
log x'	.25558n	0.29222n	.32530n	.35613n	.38472n	.41240n	.43943n	.46610n	.49266n	.51930n
log 4x'	7.89024n	7.93258n	7.96951n	8.00286n	8.03294n	8.06138n	8.08843n	8.11450n	8.13998n	8.16513n
4x'	+.0077668	+.0085622	+.0093221	+.0100664	+.0107880	+.0115180	+.012258	+.013018	+.013803	+.014626
− r/ρ³	−.0092800	− 89450	−.0086430	−.0083623	−.0080972	−.0078407	− 7610	7351	7113	6876
4x' − r/ρ³	~~4868~~ −.0015132	−.0003828	+.0006791	+.0017037	+.0026908	+.0036773	+.004648	+.005667	+.006690	+.007750
log (4x' − r/ρ³)	7.17990n	6.58297n	6.83193	7.23139	7.42988	7.56553	7.66727	7.75335	7.82543	7.88930
log R₀	9.11685n	8.51992n	8.76888	9.16834	9.36683	9.50248	9.60422	9.69030	9.76238	9.82625

	Dec 18	Jan 27	Mar 7	Apr 16	May 26	July 5	Aug 14	Sept 23	Nov 2	Dec
	281 47 58	283 00 15	284 12 35	285 24 57	286.07 21	287 49 48	289 02 19	290 14 52	291 27 29	292 40 09
	111 49 14	113 01 31	114 13 51	115 26 13	116 38 37	117 51 04	119 03 35	120 16 08	121 28 45	122 41 25
	9.96771	9.96395	9.95995	9.95572	9.95125	9.94653	.68639 9.94159	9.93635	9.93086	9.92511
‖	0.39201	.36612	.34125	.31722	.29408	.27184	.24964	.22836	.20753	.18713
//	39752	37163	34676	32273	9.29954	27705 .28929	25518	23384	0.21304	0.19264
	112 04 20	113 17 14	114 30 07	115 43 12	116 56 10	118 09 07	119 22 10	120 35 09	121 48 12	123 01 16
	53 15 29	58 21 24	63 24 09	68 25 50	73 28 25	78 33 50	83 44 26	89 02 14	94 29 50	100 09 58
	58 48 51	54 55 50	51 05 58	47 17 22	43 27 45	39 35 19	35 37 44	31 32 55	27 18 22	22 51 18
	9.16927	9.16351	9.15951	9.15528	9.15081	9.14609	9.14113	9.13591	9.13042	9.12467
	1.00185	1.00176	1.00165	1.00154	1.00141	1.00128	1.00113	1.00098	1.00081	1.00063
	9.99526	9.99534	9.99542	9.99551	9.99560	9.99570	9.99580	9.99590	9.99600	9.99611
	0.16912	0.16527	0.16116	0.15682	0.15222	0.14737	0.14826	0.13689	0.13123	0.12530
	9.93222	9.91300	9.89111	9.86616	9.83751	9.80432	9.76532	9.71869	9.66157	9.58928
	0.99711	0.99710	0.99707	0.99705	0.99701	.99698	0.99693	.99688	.99681	.99674
	9.71417	9.75935	9.79794	9.83142	9.86084	9.88685	9.90999	9.93054	9.94869	9.96455
	9.70943	9.75469	9.79336	9.82693	9.85644	9.88255	9.90579	9.92644	9.94469	9.96066
	1.00185	1.00176	1.00165	1.00154	1.00141	1.00128	1.00113	1.00098	1.00081	1.00063
	9.93393	9.91525	9.89404	9.86991	9.84229	9.81046	9.77325	9.72919	9.67594	9.60965
	0.71128	0.75645	0.79501	0.82847	0.85785	0.88383	0.90692	0.92742	0.94550	0.96129
	+.51438	−.57076	−.62375	−.67371	−.72086	−.76530	−.80710	−.84610	−.88207	−.91473
	+3.4671	3.4908	3.5039	3.5035	3.4925	3.4702	3.4359	3.3905	3.3335	3.2655
	−1.6767	−2.2168	−2.7336	−3.2336	−3.7161	−4.1828	−4.6351	−5.0705	−5.4872	5.8818
	0.93578	.91701	.89569	0.87145	.84370	.81174	0.77438	0.73017	0.67685	0.61028
	0.22446	.34578	.43674	.50969	.57009	.62147	.66606	.70505	.73935	.76951
	.71132	.57128	.45895	.36176	.29361	.19027	.10832	.02512	9.93740	9.84077
	0.94384	~~.93049~~ .93211	.92045	0.90904	~~.90092~~ .89992	.88732	.87742	.86848	.86083	.85469
	9.05616	9.06789	9.07955	9.09096	9.10208	9.11268	9.12258	9.13152	9.13917	9.14531
	7.16848	7.20367	7.23865	7.27288	7.30624	7.33804	7.36774	7.39456	7.41751	7.43593
	8.99815	8.99824	8.99835	8.99846	8.99859	8.99872	8.99887	8.99902	8.99919	8.99937
	6.99445	6.99472	6.99505	6.99538	6.99577	6.99616	6.99661	6.99706	6.99757	6.99811
	+.0014739	+.0015984	+.0017326	+.0018745	+.0020242	+.0021779	+.0023321	+.0024806	+.0026152	+.0027286
	+.0009873	+.0009879	+.0009887	−.0009894	−.0009903	.0009912	.0009922	.0009933	.0009944	.0009957
	+.0004866	885 +.0006105	+.0007439	+.0008851	+.0010339	+.0011887	+.0013399	+.0014873	+.0016208	+.0017329
	6.68717	6.78569	+6.87151	+6.94699	+7.01448	7.07507	+7.12707	7.17240	7.20973	+7.23877
	16912	16527	16116	15682	15222	14737	14826	13689	13123	12530
W_0	8.26927	8.36394	8.44565	8.51679	8.57968	8.63542	8.68831	8.72227	8.75394	8.77705
	6.68717	6.78569	6.87151	6.94699	7.01448	7.07507	7.12707	7.17240	7.20973	7.23877
	.92788	.91010	.88818	.86321	.83452	.80130	.76225	.71557	.65836	.58602
δ_0.	9.02948	9.10877	9.17267	9.22318	9.26198	9.28935	9.30230	9.30095	9.28109	9.23777
	.53996	.54292	.54444	.54450	.54314	.54035	.53604	.53026	.52290	.51394
	7.16848	7.20367	7.23865	7.27288	7.30624	7.33800	7.36774	7.39456	7.41751	7.43593
	7.70844	7.74659	7.78309	7.81738	7.84938	7.87835	7.90378	7.92482	7.94041	7.94987
	6.68717	6.78569	6.87151	6.94699	7.01448	7.07507	7.12707	7.17240	7.20973	7.23877
	0.71128	.75645	.79501	.82847	.85785	.88383	.90692	.92742	.94550	.96129
	7.39845	7.54214	7.66652	7.77546	7.87233	7.95890	8.03399	8.09982	8.15528	8.20006
	+.0025030	+.0034845	+.0046400	+.0059630	+.0074530	+.0090971	+.0108145	+.0125742	+.0142966	+.0158573
	−.0051103	−.0055795	−.0060687	−.0065672	−.0070694	−.0075571	−.0080128	.0084105	~~.7750~~ .0087150	.0089099
	−.0026073	−.0020950	−.0014287	−.0006042	+.0003836	+.0015400	.0028017	+.0041737	+.0055785	+.0069414
	7.41619 n	7.32118 n	7.15494 n	6.78118 n	6.58388	7.18752	7.44727	7.62052	7.74648	7.84145
R_0	8.82917 n	8.73416 n	8.56792 n	8.19416 n	7.99686	8.60050	8.86025	9.03350	9.15946	9.25443

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	Jan 21	Mar 2	Apr 11	May 21	Jun 30	Aug 9	Sept 17
☊'	144 36 40	147 43 50	150 50 16	153 56 00	157 01 05	160 05 35	163 09 31
u'	328 41 44	331 48 54	334 55 20	338 01 04	341 06 09	344 10 39	347 14 35
log sin u'	9.71566n	9.67424n	9.62721n	9.57324n	9.51038n	9.43562n	9.34403n
log sin I	~~24401~~	~~27495~~	~~32979~~	~~9.38397~~	~~9.46556~~	~~54761~~	9.64511
log tang u'	9.78395n	9.72905n	9.67021n	9.60601n	9.53444n	9.45239n	9.35488n
log cos I	9.77944	9.72454	9.66570	9.60150	9.52993	9.44788	9.35037
log tang λ'	,27930	,26644	,32528	,38946	,46105	,54310	,64060
λ'	328 37 30	332 09 43	335 08 59	338 13 26	341 17 02	344 19 58	347 22 14
π+ω'	100 05 08	106 20 26	112 59 34	120 07 44	127 51 16	136 17 24	145 35 06
λ'−(π+ω')	228 52 22	225 43 17	222 09 25	218 05 42	213 25 46	208 02 34	201 47 08
log sin β'	8.87229n	8.83088n	8.78384n	8.72987n	8.66761n	8.59225n	8.50066
log r'	.72929	.73016	.73099	.73177	.73250	.73318	.73380
log cos β'	9.99879	9.99900	9.99920	9.99937	9.99953	9.99967	9.99978
log z' = log r' sin β'	9.60158n	9.56103n	9.51483n	9.46164n	9.39951n	9.32543n	9.23446
log sin(λ'−(π+ω'))	9.87694n	9.85488n	9.82683n	9.79026n	9.74108n	9.67222n	9.56953n
log r' cos β'	.72808	.72916	.73019	.73114	.73203	.73285	.73358
log cos(λ'−(π+ω'))	9.81805n	9.84395n	9.87009n	9.89597n	9.92146n	9.94576n	9.96782n
log cos j' = cos β' cos λ'	9.81684n	9.84295n	9.86920	9.89534	9.92099	9.94543	9.96760n
log r'	.72929	.73016	.73099	.73177	.73250	.73318	.73380
log sin j'	9.87785	9.85583	9.82780	9.79128	9.74216	9.67337	9.57088
log r' cos j'	.54613	.57311	.60019	.62711	.65349	.67861	.70140
−r' cos j'	+3.5167n	3.7427	3.9828	4.2375	4.5029	4.7711	+5.0281
−ρ' cos j'	3.1861	3.0961	2.9960	2.8863	2.7680	2.6428	+2.5128
R	+6.7028	6.8382	6.9788	7.1238	7.2709	7.4139	7.5409
R − ρ' cos j'							
log ρ' sin j' = log Q sin l'	.60714	.58599	.55899	.52305	.47466	.40655	.30468
log Q cos l'	.82626	.83494	.84378	.85271	.86159	.87005	.87742
log tang l'	9.78088	9.75105	9.71501	9.67034	9.61307	9.53650	9.42726
log Q	.89375	.89486	.89554	.89573	.89537	.89433	.89242
log 1/Q	9.10625	9.10513	9.10446	9.10427	9.10463	9.10567	9.10758
log 1/Q³	7.31875	7.31539	7.31338	7.31281	7.31389	7.31701	7.32374
log 1/R	9.27071	9.26984	9.26901	9.26823	9.26750	9.26682	9.26620
log 1/R³	7.81213	7.80952	7.80703	7.80469	7.80250	7.80046	7.79860
1/Q³	+.0020833	.0020672	.0020577	+.0020550	.0020601	.0020750	.0021025
1/R³	.0064883	64495	64126	63781	63460	63163	62893
1/Q³ − 1/R³ = Δ	−.0044050	−.0043823	−.0043549	−.0043231	−.0042859	−.0042413	−.0041868
log Δ	7.64394n	7.64170	7.63898n	7.63580n	7.63204	7.62750n	7.62188
log z'	9.60158n	9.56103n	9.51483n	9.46164n	9.39951n	9.32543n	9.23446n
log w₀ =	9.18247	9.13968	9.09076	9.03439	8.96850	8.88988	8.79334
log Δ	7.64394	7.64170n	7.63898n	7.63580n	7.63204n	7.62750n	7.62188n
log y'	0.60502n	.58404n	.55702n	.52140n	.47311n	.40507n	.30311n
log (1) log S₀	.18591	.16269	.13295	.09415	.04210	9.96952	9.86194
log R	.50326	.49082	.47654	.46034	.44216	.42206	.40016
log 1/Q³	7.31875	7.31539	7.31338	7.31281	7.31389	7.31701	7.32374
log R/Q³	7.82201	7.80621	7.78992	7.77315	7.75605	7.73907	7.72390
log a	7.64394	7.64170n	7.63898	7.63580	7.63204	7.62750	7.62188
log x'	.54613	.57311	.60019	.62711	.65349	.67861	.70140n
log Δx'	8.19007n	8.21481	8.23917	8.26291	8.28553	8.30611	8.32328
Δx'	+.015491	+.016399	+.017345	+.018319	+.019299	+.020235	+.021051
−R/Q³	−.006638	−.006401	−.006165	−.005931	−.005702	−.005484	−.005296
Δx' − R/Q³	+.008853	+.009998	+.011180	+.012388	+.013597	+.014751	+.015755
log(Δx' − R/Q³) log(1)	7.94709	7.99991	+8.04844	+8.09300	8.13344	8.16882	8.19742
log R₀	9.88404	9.93686	9.98539	0.02985	0.07039	0.10577	0.13437

	Jan 21	Mar 2	Apr 11	May 21	Jun 30	Aug 9	Sep 18
	293 52 53	295 05 41	296 18 34	297 31 32	298 44 34	299 57 41	301 10 53
	123 54 09	125 06 57	126 19 50	127 32 48	128 45 50	129 58 57	131 12 09
	9.91907	9.91275	9.90613	9.89919	9.89195	9.88437	9.87644
	.17261	.15291	.13351	.11429	.09531	.07646	.05774
	.16810	.14740	.12800	.10878	.08980	.07095	.05223
	124 14 22	125 27 29	126 40 34	127 53 52	129 07 08	130 20 25	131 33 45
	106 05 50	112 21 08	119 00 16	126 08 26	133 51 58	142 18 06	151 35 48
	18 08 32	13 06 21	7 40 18	1 45 26	355 15 08	348 02 19	339 57 57
	9.11863	9.11231	9.10569	9.09875	9.09151	9.08393	9.07600
	1.00044	1.00025	1.00004	0.99982	99959	99935	99911
	9.99622	9.99633	9.99644	9.99655	9.99666	9.99678	9.99690
	0.11907	0.11256	.10573	.09857	.09110	.08328	.07511
″	9.97785	9.35555	9.12547	8.48664	8.91784n	9.31650n	9.53476n
″	0.99666	.99658	0.99648	0.99637	.99625	.99613	0.99601
″	9.45328	9.98854	9.99610	9.99980	9.99851	9.99047	9.97289
	9.97407	9.98487	9.99254	9.99635	9.99517	9.98725	9.96979
	1.00044	1.00025	1.00004	0.99982	99959	99935	99911
	9.52563	9.41405	9.26422	9.11088	9.17095	9.37797	9.55612
	0.97457	0.98572	0.99258	0.99617	0.99476	0.98660	0.96890
	− 94300	− 96633	− 98306	− 99123	− 98801	− 96962	93090
	+ 3.1861	3.0961	2.9960	2.8863	2.4680	2.6428	2.5128
	− 6.2439	6.5672	6.8346	7.0260	7.1121	7.0534	6.7962
	0.52607	0.41430	0.26426	.11070	.17054	.37732	.53583
	79546	.81738	83471	84671	85200	84840	83227
	9.72961	9.59692	9.42955	9.26399	9.31854	9.52892	9.72386
	.85040	.84851	.84987	.85391	.86122	.87189	.88587
	9.14960	9.15149	9.15013	9.14609	9.13878	9.12811	9.11413
	7.44880	7.45447	7.45039	7.43827	7.41634	7.38433	7.34239
	8.99956	8.99975	8.99996	9.00018	9.00041	9.00065	9.00089
	6.99868	6.99925	6.99988	7.00054	7.00123	7.00195	7.00267
	+.0028106	0028475	0028209	.0027433	0026082	0024229	0021998
	−0009970	9983	9998	10012	10018	10045	10062
	+0018136	+0018492	+0018211	+0017421	+0016064	+0014184	+0011936
	7.25854	7.26698	7.26033	7.24107	7.20585	7.15180	7.07686
	11907	11256	10573	09857	09110	08328	07511
M_0 //	8.79059	8.79252	8.77904	8.75262	8.70993	8.64806	8.56455
	7.25854	7.26698	7.26033	7.24107	7.20585	7.15180	7.07686
	0.48994	0.35213	.12195	9.48301	9.91409n	0.31263n	0.53077n
S_0	9.16146	9.03209	8.99526	8.13706	8.53292n	8.87741n	9.02061n
	50326	49082	47654	46034	44216	42206	40076
	7.44880	7.45447	7.45039	7.43827	7.41634	7.38433	7.34239
	7.95206	7.94529	7.92693	7.89861	7.85850	7.80639	7.74255
	7.25854	7.26698	7.26033	7.24107	7.20585	7.15180	7.07686
	0.97457	.98572	.99258	.99617	.99476	.98660	.96890
	8.23305	8.25210	8.25291	8.23724	8.20061	8.13840	8.04576
	+017102	.017869	.017903	.017268	.015871	.013753	.011111
	−008955	−.008816	−.008452	7918	7219	6403	−005528
	+008147	+009053	+009451	+.009350	+008652	+007350	+005583
	7.91100	7.95679	7.97548	7.97081	7.93712	7.86629	7.74687
R_0	9.32398	9.36977	9.38846	9.38378	9.35010	9.27927	9.15985

	1869 Oct 9	1869 Nov 18	1869 Dec 28	1870 Feb. 6	Mar 14	Apr 27	June 6	July 16	Aug 25	Oct 4
$di = +2\cos\omega W$	-1.686	-1.901	-1.661	-1.024	-0.340	+0.118	+0.307	+0.302	+0.189	+.029
$d\Omega = +(2)\,2\sin\omega\, W_0$	-2.512	-7.214	-11.879	-13.966	-12.731	-9.592	-6.190	-3.382	-1.391	+0.145
(2) (sin v R_0)	-4.312	-4531	-1.403 +0.126	+2.845	~~2.870~~ ~~+1.921~~	4.219 +1.604	~~3.367~~ ~~1.622~~ 1.604	-3.397 ~~-1.322~~	+4.219 ~~+1.641~~	~~+1.674~~ +4.383
(3) (cos 2v + cos E_1) S_0	+15.218	+11.321	~~+12.125~~	-11.279	-15.478	-12.832	-7.804	-3.545	-1.017	-.044
$d\varphi$	+10.906	+6.790	~~-1.282~~ +10.923 -1.282	~~+10.434~~ -9.108	~~-14.363~~ -12.608	~~-12.474~~ -11.911	-9.408	~~-4.867~~ -6.942	~~-2.688~~ -5.236	~~-1.718~~ -4.347
-(4) cos 2 R_0 S	-16.781	-33.838	-42.567	-34.427	-17.015	-3.029	+3.126	+3.614	+1.613	-.581
(5) ($\frac{p}{2}$+1) 2 sin 2 S_0	-23.646	-13.384	-.036	~~-22.912~~	~~-33.146~~	~~-31.925~~	~~-23.183~~	~~-12.018~~	-12.018	-1.564
(6) 2 sin u W_0	-.025	-.071	-.117	-.137	-.125	-.095	-.061	-.033	-.014	+.002
$d\pi$	-50.452	-47.298	-42.720	-6.337	-22.912	-33.146	-31.925	-23.183		
				-40.901	-40.052	-36.270	+28.860	+19.602	+10.419	-2.416
-(7) sin R_0	+0.6330	+.6650	+.2059	-.3187	-.4212	-.1352	+.2354	+.4987	+.6194	+.6317
-(8) $\frac{1}{2}$ S_0	-5.5702	-3.7649	-.0386	+3.6236	+5.2711	+4.8982	+3.5768	+2.1540	+.9818	+0.1172
du	-4.9372	-3.0999	+.1673	+3.3049	+4.8499	+4.7630	+3.8122	+2.6527	+1.6012	+0.7489
-(9) cos R_0	-0.774	-1.560	-1.963	-1.588	-0.785	-0.140	+.144	+.167	+.074	-.039
-(10) 2 R_0	-10.067	-16.501	-18.875	-15.535	-8.742	-1.983	+2.959	+5.952	+7.465	+7.986
+(11) ($\frac{p}{2}$+1) 2 sin 2 S_0	-1.351	-.617	-.002	-.292	-1.057	-1.529	-1.472	-1.069	-.554	-.072
(6) 2 sin u W_0	-.025	-.071	-.117	-.137	-.125	-.095	-.061	-.033	-.014	+.002
dL	-12.217	-18.749	-20.957	-17.552	-10.709	-3.747	+1.570	+5.017	+6.971	+7.887
(12) cos 2 R_0	+16.006	+32.277	+40.604	+32.839	+16.231	+2.889	-2.882	-3.447	-1.538	+0.816
-(10) 2 R_0	-10.067	-16.501	-18.875	-15.535	-8.742	-1.983	+2.959	+5.952	+7.465	+7.996
-(13) ($\frac{p}{2}$+1) 2 sin 2 S_0	+32.094	+12.767	+0.034	+6.045	+21.854	+31.617	+30.452	+22.113	+11.464	+1.492
dM	+38.033	+28.543	+21.763	+23.349	+29.343	+32.523	+30.429	+24.618	+17.391	+10.304

	1870 Nov 13	Dec 28	1871 Feb 1	Mar 13	Apr 22	June 1	Aug 11	Aug 20	Sept 29	Nov 8
di	-0.143	-0.304	-0.446	-0.562	-0.651	-0.713	-0.749	-.761	-0.752	-.725
$d\Omega$	~~+0.190~~ +.498	~~+.249~~ +.686	~~+.190~~ +.545	~~+.059~~ +.177	~~-.110~~ -.340	~~-.296~~ -.941	~~-.484~~ -1.577	~~-.664~~ 2.210	~~-.830~~ -2.810	~~-.977~~ -3.352
$d\varphi$	-3.955	-3.407	-2.800	-2.214	-1.692	-1.245	-.877	-.581	-.354	-.194
	-.153	-.904	-1.984	-3.185	-4.381	-5.496	-6.492	7.346	-8.044	8.598
	-4.108	-4.311	-4.784	-5.399	-6.073	-6.741	7.369	-7.927	-8.403	-8.792
$d\pi$	-2.894	-4.261	-4.988	-5.199	-5.042	-4.624	~~-3.345~~ -4.042	~~-2.596~~ -3.345	-2.596	-1.887
	+6.842	+12.888	+16.815	+18.948	+19.646	+19.226	+17.958	+16.047	+13.667	+10.946
	+.003 5	+.002 68	+.002 5	+.000 1	-.001 3	-.003 8	-.009 16	-.016 22	-.008 29	-.009 33
$d\pi$	+3.953	+8.634	+11.832	+13.750	+14.603	+14.594	+13.900	+12.680	+11.044	+9.076 9.106
du	+.5806	+.5041	+.4110	+.3250	+.2484	+.1828	+.1287	+.0853	+.0519	+.0285
	-.4861	-.8934	-1.1653	-1.3436	-1.4585	-1.5305	-1.5742	-1.5990	-1.6112	-1.6148
	+.0945	-.3933	-.7543	-1.0186	-1.2101	-1.3477	-1.4455	-1.5137	-1.5593	-1.5863
dL	-0.133	-0.196	-.230	-.240	-.233	-.213	-.187	-.154	-.120	-.087
	+7.920	+7.486	+6.846	+6.097	+5.311	+4.515	+3.735	+2.968	+2.236	+1.591
	+.216	+.594	+.776	+.874	+.906	+.887	+.828	+.740	+.630	+.504
	+.002 5	+.002 7	+2 5	+1	-2 3	-8 8	-5 16	-7 22	-8 27	-.010 33
	+8.104	+7.896	+7.397	+6.732	+5.983	+5.188	+4.360	+3.582	+2.718	~~+1.995~~ 1.925
dM	+.2760	+.4064	+.4758	+.4959	+.4809	+.4411	+.3886	+.3190	+.2476	+1.820
	+7.920	+7.486	+6.846	+6.097	+5.311	+4.515	+3.735	+2.968	+2.236	+1.591
	-6.526	-12.294	-16.639	-18.075	-18.740	-18.339	-17.130	-15.307	-13.037	-10.441
	+4.154	-0.744	-4.435	-7.019	-8.620	-9.413	-9.535	-9.149	-8.325	-7.181 ?

Decrease: see next page but one.

d di	−.051	−.059	−.065	−.069	−.070	−.067	−.061	−.052	−35	−.017
dΩ	−.284	−.395	−.521	−.659	−.806	−.957	−1.105	−1.227	−1.328	−1.391
=	−.039	−.019	−.005	+.002	−.003	−.022	−.056	−.108	−.176	−.258
=	−.531	−.652	−.764	−.859	−.929	−.968	−.964	−.915	−.820	−.682
dφ	−.570	−.671	−.769	−.857	−.932	−.990	−1.020	1.023	−.996	−.940
—	−.537	−.439	−.302	−.128	+.080	+.318	+.565	+.813	+1038	+1217
—	+.472	+.346	+.143	−.131	−.460	−.824	−1188	−1512	−1747	−1841
—	−.003	−.005	−.006	−.007	−.008	−.009	−.010	−.012	−.013	−.014
dπ	−.068	−.098	−.165	−.266	−.388	−.515	−.634	−.711	−.722	−.638
—	+.0057	+.0028	+.0007	−.0002	+.0005	+.0032	+.0082	+.0158	+.0259	+.0380
—	−.0952	−.1135	−.1310	−.1472	−.1614	−.1730	−.1800	−.1819	−.1767	−.1633
dμ	−.0895	−.1107	−.1303	−.1474	−.1609	−.1698	−.1718	−.1661	−.1508	−.1253
—	+.025	+.020	−.014	+.005	+.004	+.015	+.026	+.037	+.048	+.056
—	+.446	+.361	+.247	+.104	−.066	−.264	−.475	−.699	−.918	−1119
—	+.022	+.016	+.006	−.004	−.021	−.038	−.055	−.070	−.081	−.083
—	−.003	−.005	−.006	−.007	−.008	−.009	−.011	−.012	−.013	−.014
dL	+.440	+.352	+.233	+.088	−.091	−.296	− ~~.538~~ .515	−.744	−.964	−1.160
—	+.513	+.419	+.288	+.122	−.077	−.303	−.539	−.776	−.990	−1.161
—	+.446	+.361	+.247	+.104	−.066	−.264	−.475	−.699	−.918	−1.119
—	−.450	−.330	−.136	+.125	+.439	+.786	+1.133	+1.443	+1.666	+1.757
dM	+.509	+.450	+.399	+.351	+.296	+.219	+.119	−.032	−.242	−.523

−di	+.003	+.024	+.043	+.058	+.068	+.071	+.067
dΩ	−1.405	−1.361	−1.249	−1.089	−.889	−.669	−.454
—	−.~~283~~ 345	−.435	−.501	−.539	−.533	−.474	−.370
—	−.512	−.329	−.157	−.026	+.041	+.034	−.039
dψ	− ~~.765~~ .860	−.764	−.658	−.565	−.492	−.440	−.409
≠							
—	+1.321	+1.326	+1.207	+.989	+.694	+.373	+.094
—	−1.748	−1.436	−.902	−.211	+.548	+1.243	+1.729
—	−.014	−.013	−.012	−.011	−.009	−.006	−.004
dπ	−.441	−.123	+.293	+.766	+1.233	+1.610	~~1.825~~ +1.819
—	+.0511	+.0638	+.0736	+.0791	+.0782	+.0697	+.0544
—	−.1404	−.1072	−.0642	−.0146	+.0380	+.0880	+.1287
dμ	−.0893	−.0434	+.0094	+.0645	+.1162	+.1577	+.1831
—	+.061	+.061	+.056	+.046	+.032	+.017	+.005
—	−1.281	−1.384	−1.398	−1.332	−1.182	−.959	−.693
—	−.080	−.066	−.042	−.009	+.025	+.057	+.080
—	−.014	−.013	−.012	−.011	−.009	−.006	−.004
dL	−1.314	−1.402	−1.396	−1.306	−1.134	−.891	−.612
—	−1.260	−1.264	−1.152	−.944	−.662	−.355	−.090
—	−1.281	−1.384	−1.398	−1.332	−1.182	0.957	−.693
—	+1.664	+1.370	+.861	+.201	−.522	−1.185	−1.649
dM	−0.877	−1.278	−1.689	−2.075	−2.366	−2.497	−2.432

	1871 Dec 18	1872 Jan 27	Mar 7	Apr 16	May 26	July 5	Aug 19	Sept 28	Nov 2	Dec 12
$di' = +2\cos u\, w_0$	−.682	−.627	−.561	−.459	−.412	−.333	−.256	−.181	−.110	−.047
$d\Omega = (2)\, 2\sin u\, w_0$	−3.819	−4.203	−4.490	−4.679	−4.766	−4.756	4.615	−4.465	−4.196	−3.858
(3) $\sin v\, k_0$	−.075	−.012	+.007	−.015	−.076	−.175	−.312	−.489	−.706	−.962
(5) $(\cos v + \cos E)\, \delta_0$	−8.994	−9.244	−9.342	−9.297	−9.116	−8.804	−8.361	−7.793	−7.107	−6.313
$d\varphi$	−9.069	−9.256	−9.335	9.312	9.192	−8.979	−8.673	−8.282	−7.813	−7.275
−(4) $\cos v\, k_0$	+1042	+0.268	+.479	+1203	+1886	+2538	+3131	+3690	+4161	+4540
(5) $(\frac{e}{2}+1)\, 2\sin v\, \delta_0$	+7.995	+4.904	+1.745	−1.415	−4.514	−7.496	−10.304	−12.877	−15.148	−17.054
(6) $2\sin u\, w_0$	−38	−41	−44	−46	−47	−47	−46	−44	−41	−38
$d\pi$	~~+8.999~~	~~+5.131~~	~~+1.222~~	~~−2.664~~	~~−6.449~~	~~−10.081~~	~~−13.481~~	~~−16.611~~	~~−19.350~~	~~−21.699~~
	+6.916	+4.595	+2.180	−.258	−2.673	−5.005	−7.219	−9.231	−11.028	−12.552
−(7) $\sin v\, k_0$	+.0110	+.0018	−.0010	+.0022	+.0112	+.0257	+.0458	+.0719	+.1036	+.1414
−(8) $\frac{1}{2}\, \delta_0$	−1.6135	−1.6092	−1.6019	−1.5930	−1.5836	−1.5733	−1.5619	−1.5485	−1.5323	−1.5123
$d\omega$	−1.6025	−1.6075	−1.6029	−1.5908	−1.5724	−1.5476	−1.5161	−1.4766	−1.4287	−1.3709
−(9) $\cos v\, k_0$	−.048	−.012	+.022	+.055	+.087	+.117	+.144	+.170	+.192	+.209
−(10) $2\, k_0$	+.866	+.220	−.392	−.985	−1.550	−2.105	−2.635	−3.170	−3.680	−4.176
(11) $(\frac{e}{2}+1)\, 2\sin 2\, \delta_0$	+.369	+.226	+.080	−.065	−.208	−.346	−.475	−.594	−.699	−.787
(6) $2\sin u\, w_0$	−.038	−.041	−.044	−.046	−.047	−.047	−.046	−.044	−.041	−.038
dL	+1.149	+0.393	−0.334	−1.041	−1.718	−2.381	−3.012	−3.638	−4.228	−4.792
(12) $\cos 2\, k_0$	+.994	+.256	−.457	−1.147	−1.799	−2.421	−2.987	−3.520	−3.970	−4.331
−(10) $2\, k_0$	+.866	+.220	−.392	−.985	−1.550	−2.105	−2.635	−3.170	−3.680	−4.176
(13) $(\frac{e}{2}+1)\, 2\sin 2\, \delta_0$	+7.626	−4.678	−1.664	+1.349	+4.306	+7.150	+9.829	+12.283	+14.450	+16.268
dM	−5.766	−4.202	−2.513	~~−3.481~~	~~−7.655~~	~~−11.676~~	~~−15.451~~	~~−18.973~~	~~−22.100~~	~~−24.775~~
				−.783	+.957	+2.624	+4.207	+5.593	+6.800	+7.761

	1873 Jan 21	[illegible]	Apr 11	May 21	June 30	Aug 9	Sept 18
di	+.008	+.053	+.088	+.112	+.124	+.124	+.113
$d\Omega$	−3.464	−3.027	−2.561	−2.084	−1.613	−1.168	−.769
	−1.264	−1.604	−1.981	−2.385	−2.797	−3.185	−3.492
	−5.417	−4.441	−3.406	−2.351	−1.329	−.418	+.273
$d\varphi$	−6.681	−6.046	−5.387	−4.736	−4.126	−3.603	−3.219
	+4.798	+4.892	+4.723	+4.381	+3.647	+2.499	+0.888
	−18.496	−19.397	−19.644	−19.125	−17.727	−15.362	−11.998
	−.034	−.030	−.025	−21	−16	−011	−007
$d\pi$	−13.732	14.535	−14.896	−14.765	−14.096	−12.874	−11.117
	+.1855	+2355	+2908	+3501	+4107	+4675	+.5127
	−1.4850	−1.4486	−1.3979	−1.3270	−1.2275	−1.0878	−0.8930
$d\omega$	−1.2995	−1.2131	−1.1071	−.9769	−.8168	−.6203	~~766~~ −.3803
	+.221	+.226	+.220	+.202	+.168	+.115	+.041
	−4.654	−5.107	−5.527	−5.899	−6.210	−6.432	−6.532
	−.853	−.895	−.906	−.882	−.818	−.709	−.553
	−.034	−.030	−.025	−.021	−.016	−.011	−.007
dL	−5.320	−5.806	−6.238	−6.602	−6.876	−7.037	−7.051
	−4.576	−4.666	−4.553	−4.178	−3.479	−2.384	−0.847
	−4.654	−5.107	−5.527	−5.899	−6.210	−6.432	−6.532
	+17.643	+18.502	+18.737	+18.242	+16.910	+14.654	+11.445
dM	+8.413	+8.729	+8.657	+8.164	+7.221	+5.838	+4.066

ɤ ~~VIII~~	Δ1	Δ2	Δ3	Δ4			
168 56 45.61	* 51	− 4,1,55.4		+15			
168 15 27.53	−41 17.68	− 4 27.44	+ 32″	+12.	−10	19.42	9
	45 45.12		+ 44.36		11	26.28	13
167 29 42.51		− 3 43.08		+9.46			
	49 28.20		53.76		12	22.05	17
166 40 14.61		− 2 49.32		+5.58			
	52 17.52		59.34		13	4.38	21
165 47 57.09		− 1 49.98		+3.76			
	54 7.50		63.04		13	31.88	25
164 53 49.59		− 1 46.94		−1.47			
	54 54.44		61.57		13	43.61	1
163 58 55.15		+ 14.63		−1.76			
	54 39.81		59.81		13	39.95	5
163 04 15.34		+1 14.44		−4.13			
	53 25.37		+ 55.68		13	21.34	9
162 10 49.57		+2 20.12		−[illegible].52			
	+51 15.25		54.16		12	48.81	13
161 19 34.72		3 4.28		−4.56			
	48 10.97		49.60		12	2.74	17
160 31 23.75		3 53.88		5			
	44 17.69		45.0		11	4.27	21
159 47 6.66		+4 39.00					

υ ° ′ ″	′ ″	′ ″					
−0 35 15.59		+2 3.06	−2.7	−4			
−0 31 0.70	+4 14.89	+2 23.96	−6.7	−4	+1	3.72	9
−0 24 21.85	6 38.83	+2 13.24	−10.72	−4.42	1	39.71	13
−0 15 29.76	8 52.09	+1 58.10	−15.14	−3.38	2	13.02	17
−0 4 39.57	10 50.19	+1 39.58	−18.52	−2.11	2	42.55	21
+0 7 50.20	12 29.77	+1 18.95	−20.63	−1.35	3	7.44	25
+0 21 38.92	13 48.72	+0 56.97	−21.98	+0.46	3	27.18	1
+0 36 24.61	14 45.69	+0 35.45	−21.52	−0.15	3	41.42	5
+0 51 45.75	15 21.14	+0 13.78	−21.67	+0.07	3	50.28	9
+1 07 2.06	+15 34.92	− 7.82	−21.64	−0.84	3	53.73	13
+1 22 47.77	+15 27.10	− 30.26	−22.44	−0.6	3	51.77	17
+1 37 44.61	+14 56.84	− 53.36	23.0	−	+3	44.21	21
			23.9	−0.9			

245 7029		+8171		−140		
239 8783	−53246	+9250	+1079	−160	−	13311
2354787	−43996	+10169	+919	−196	−	10999
2320960	−33827	+10898	+729	−226	−	8457
2298031	−22929	+11401	+503	−232	−	5732
2286503	−11528	+11672	+271	−230	−	2882
2286657	+00154	+11913	+41	−216	+	38
2298524	+11867	+11538	−175	−179	+	2967
23 21928	+23405	+11184	−354	−112	+	5851
2356518	+34589	+10718	−466	−228	+	8647
240 1825	+45307	+10024	−654		+	11327
245 7156	+55331	+9102	922		+	13833

h. ~~Nov.~~ 15 ℒ C　　this should come on the previous page for h

	″									
di	-.021	-.022	-.020	-.014	-.005	+.003	+.010	+.019	+.024	+.027
dΩ	-.031	-.085	-.143	-.192	-.224	-.238	-.232	-.208	~~-.169~~ -.175	-.135
—	+.007	+.024	-.013	+.034	+.090	+.124	+.123	+.091	+.044	-.008
—	+.250	+.286	+.238	+.121	-.015	-.117	-.159	-.145	-.096	-.033
dφ	+.257	+.262	+.225	+.155	+.075	+.007	-.036	-.054	-.052	-.041
—	+.027	-.183	-.409	-.542	-.533	-.407	-.239	-.097	-.017	-.002
—	-.554	-.338	-.070	+.068	-.022	-.303	-.652	-.950	-1.134	-1.185
—	-.000	-.001	-.001	-.002	-.002	-.002	-.002	-.002	-.001	-.001
dπ	-.527	-.522	-.480	-.476	-.557	-.712	-.893	-1.049	-1.152	-1.188
—	-.0010	+.0036	+.0020	-.0050	-.0132	-.0182	-.0180	-.0134	-.0064	+.0012
—	+.0918	+.0950	+.0760	+.0390	+.0050	+.0447	+.0730	+.0883	+.0927	+.0888
dμ	-.0928	-.0914	-.0740	-.0440	-.0082	+.0265	+.0500	+.0749	+.0863	+.0886 0900
	~~+.0908~~	~~+.0986~~	~~+.0780~~	~~+.0340~~	~~-.0182~~	~~-.0629~~	~~-.0910~~	~~-.1017~~	~~-.0991~~	~~-.0900~~
—	+.001	-.009	-.019	-.025	-.024	-.019	-.011	-.005	-.001	-.000
—	+.016	-.089	-.181	-.244	-.274	-.267	-.227	-.160	-.077	+.015
—	-.026	-.016	-.003	+.003	-.001	-.014	-.030	-.044	-.052	-.055
—	.000	-.001	-.001	-.002	-.002	-.002	-.002	-.002	-.001	-.001
dL	-.009	-.115	-.204	-.268	-.301	-.302	-.270	-.211	-.131	-.041
—	-.025	+.175	+.390	+.517	+.509	+.388	+.228	+.093	+.016	+.002
—	+.016	-.089	-.181	-.244	-.274	-.267	-.227	-.160	-.077	+.015
—	+.529	+.322	+.067	-.065	+.021	+.288	+.622	+.906	+1.082	+1.130
dM	+.520	+.408	+.276	+.208	+.256	+.409	+.623	+.839	+1.021	+1.147

di	+.027	+.025	+.021	+.015	+.008	+.001	-.011	-.021	-.031	-.041
dΩ	-.044	-.057	-.026	+.005	+.005	-.001	-.022	-.060	-.117	-.191
—	-.056	-.094	-.120	-.136	-.140	-.136	-.124	-.106	-.085	-.061
—	+.025	+.067	+.087	+.081	+.049	-.006	-.083	-.179	-.288	-.408
dφ	-.031	-.027	-.033	-.055	-.091	-.142	-.207	-.285	-.373	-.469
—	-.041	-.117	-.214	-.319	-.418	-.505	-.571	-.611	-.621	-.577
—	-1.116	-.956	-.734	-.481	-.222	+.021	+.230	+.391	+.490	+.519
—	-.001	-.001	-.000	-.000	-.000	-.000	-.000	-.000	-.001	-.002
dπ	-1.158	-1.074	-.948	-.800	-.640	-.484	-.341	-.220	-.132	-.060
—	+.0081	+.0137	+.0177	+.0199	+.0206	+.0199	+.0182	+.0156	+.0124	+.0090
—	+.0793	+.0663	+.0509	+.0341	+.0164	-.0017	-.0202	-.0389	-.0577	-.0766
dμ	+.0874	+.0800	+.0686	+.0540	+.0370	+.0182	-.0020	-.0233	-.0453	-.0676
—	-.002	-.005	-.010	-.015	-.019	-.023	-.027	-.028	-.028	-.028
—	+.111	+.206	+.294	+.374	+.440	+.493	+.527	+.542	+.530	+.503
—	-.051	-.044	-.034	-.022	-.010	+.001	+.010	+.018	+.023	+.024
—	-.001	-.001	.000	.000	.000	.000	.000	.000	-.001	-.002
dL	+.058	+.156	+.250	+.337	+.411	+.471	+.510	+.532	+.529	+.497
—	+.039	+.112	+.205	+.304	+.399	+.481	+.544	+.583	+.592	+.569
—	+.111	+.206	+.294	+.374	+.440	+.493	+.527	+.542	+.535	+.503
—	+1.065	+.912	+.700	+.459	+.211	-.020	-.220	-.373	-.467	-.491
dM	+1.215	+1.230	+1.199	+1.137	+1.050	+.954	+.851	+.752	+.660	+.577

21

		$\omega^2\frac{d\mu}{d\tau}$	'f	''f	i'	'f	Ω	'b	φ	'f
1869										
	Oct 9	−4.9372		−.1460	−1.686		−2.512		+10.906	
			−.0806			+.009		+.207		+.198
1869	Nov 18	½ −3.0999		−.2266	1.801		7.214		+6.790	
			−3.1805			−1.892		−7.007		+6.968
1869	Dec 28	+0.1673		−3.4071	1.661		11.879		−1.282	
			−3.0132			−3.553		−18.886		+5.686
1870	Feb 6	3.3049		−6.4203	1.024		13.966		9.108	
			+0.2917			−4.577		−32.852		−3.422
	Mar 18	4.8499		−6.1286	−.340		12.731		12.608	
			+5.1416			−4.917		−45.583		−16.030
	Apr 27	4.7630		−0.9870	+.118		9.592		11.911	
			+9.9046			−4.799		−55.175		−27.941
	June 6	3.8122		+8.9176	+.307		6.190		9.408	
			+13.7168			−4.492		−61.365		−37.349
	July 16	2.6527		+22.6344	+.802		3.382		6.942	
			+16.3655			−4.190		−64.747		−44.291
	Aug 25	1.6012		+39.0039	+.189		1.391		5.236	
			+17.9707			−4.001		−66.138		−49.527
	Oct 4	0.7489		+56.9746	+.029		−.145		4.347	
			+18.7196			−3.972	+ ~~.498~~	−66.283		−53.874
1870	Nov 13	+0.0945		+75.6542	−.143		+ .498		4.108	
			+18.8141			−~~2.827~~ 4.115		−65.785		−57.982
1870 1871	~~Jan 27~~ Dec 23	−0.3933		+94.5083	−.304		686		4.311	
			+18.4208			−~~3.525~~ 4.419		−65.099		−62.293
1871	~~Mar 7~~ Feb 1	−.7543		112.9291	−.446		545		4.784	
			+17.6665			−~~3.079~~ 4.865		−64.554		−67.077
√	~~Apr 16~~ Mar 13	−1.0186		130.5956	−.562		+ 177		5.399	
			+16.6479			−~~2.517~~ 5.427		−64.377		−72.476
	~~May 26~~ Apr 22	1.2101		147.2435	−.651		− 340		6.073	
			+15.4378			−~~1.866~~ 6.078		−64.717		−78.549
	~~July 5~~ June 1	1.3477		162.6813	−.713		− 941		6.741	
			+14.0901			−~~1.153~~ −6.751		−65.658		85.290
	~~Aug 14~~ July 11	1.4455		176.7714	−.749		−1.577		7.369	
			+12.6446			−~~0404~~ −7.540		−67.235		92.659
	~~Sept 23~~ Aug 20	1.5137		189.4160	−.761		−2.210		7.927	
			+11.1309			+~~.359~~ −8.301		−69.445		100.586
	Nov 2 Sept 29	1.5593		200.5469	−.752		−2.810		8.403	
			+9.5716			+~~1.109~~ −9.053		−72.255		108.989
	Dec 12 Nov 8	1.5873		210.1185	−.725		−3.352		8.792	
			+7.9843			+~~1.834~~ −9.778		−75.607		117.781
1871	Dec 17	1.6025		218.1028	−.682		−3.819		9.079	
			+6.3818			+~~2.876~~ −10.460		−79.426		126.860
1872	Jan 27	1.6075		+224.4846	−.627		−4.203		9.256	
			+4.7743			~~3.143~~ −11.087		−83.629		136.116
	Mar 7	−1.6029		229.2589	−.561		4.490		9.335	
			+3.1714			~~3.704~~ −11.648		−88.119		145.451
	Apr 16	−1.5908		232.4303	−.489		4.679		9.312	
			+1.5806			~~4.193~~ −12.137		−92.798		154.763
	May 26	−1.5724		234.0109	−.412		4.766		9.192	
			+0.0082			~~4.605~~ −12.549		−97.564		163.955
	July 5	1.5476		234.0191	−.333		4.756		8.979	
			~~+1.5558~~ −1.5394			~~4.938~~ −12.882		−102.320		172.934
	Aug 14	1.5161		232.4797	−.256		4.655		8.673	
			~~+3.0719~~ −3.0556			~~5.194~~ −13.138		−106.975		181.607
	Sept 23	1.4766		229.4242	−.181		4.465		8.282	
			~~+4.5485~~ −4.5321			~~5.375~~ −13.319		−111.440		189.889
	Nov 2	1.4287		224.8921	−.110		4.196		7.813	
			~~+5.9772~~ −5.9608			~~5.485~~ −13.429		−115.636		197.702
1872	Dec 12	1.3709		218.9313	−.047		3.858		7.275	
			~~7.3481~~ 7.3317			−13.476		−119.494		204.977
1873	Jan 21	1.2995		211.5996	+.008		3.464		6.681	
			~~8.6476~~ 8.6312			−13.468		−122.958		211.658
	Mar 2	1.2131		202.9684	+.053		3.027		6.045	
			~~9.8607~~ 9.8443			−13.415		−125.985		217.703
	Apr 11	1.1071		193.1241	+.088		2.561		5.387	
			~~10.9678~~ 10.9514			−13.327		−128.546		223.090
	May 21	.9769		182.1727	+.112		2.084		4.736	
			~~11.9447~~ 11.9283			−13.215		−130.630		227.826
	June 30	.8168		170.2444	+.124		1.613		4.126	
			~~12.7616~~ 12.7451			−13.091		−132.243		231.952
	Aug 9	.6203		157.4993	+.124		1.168		3.603	
			~~13.3818~~ −13.3654			−12.967		−133.411		235.555
	Sept 18	−.3803		144.1339	+.113		−.769		−3.219	
			−13.7457			−12.854		−134.180		−238.774
				+130.3882						

Π	′	Ω	′	M	′	
-50.452	-.159	+12.417	+.270	+38.833	+.422	
47.293	-47.452	11.749	-18.479	28.543	+28.965	
42.720	90.172	20.957	39.436	21.763	+50.728	
40.901	131.078	17.552	56.988	23.349	+74.077	
40.052	171.125	10.709	67.697	29.343	103.420	
36.270	207.395	-3.747	71.444	82.523	135.943	
28.860	236.255	+1.570	69.874	80.429	166.372	
19.602	255.857	5.017	64.857	24.618	190.990	
10.419	266.276	6.971	57.886	17.391	208.381	
-2.416	268.692	7.887	49.999	10.304	218.685	
+ 3.953	-264.739	8.104	41.895	+4.154	222.839	
8.634	256.105	7.891	-34.004	-.744	222.095	
11.832	244.273	7.397	-26.607	4.435	217.660	
√ 13.750	230.523	6.732	-19.875	7.019	210.641	
14.604	215.919	5.980	-13.895	8.620	202.021	
14.594	201.325	5.181	-8.714	9.413	192.608	
13.900	187.425	4.360	-4.354	9.585	183.073	
12.680	174.745	3.532	-0.822	9.149	173.924	
11.044	163.701	2.719	+1.897	8.325	165.599	
9.106	154.595	1.925	+3.822	7.181	158.408	
6.915	-147.680	1.149	+4.971	5.766	152.642	
4.595	143.085	+.393	+5.364	4.202	148.440	
+2.180	140.905	-.334	+5.030	2.513	145.927	
-0.258	141.163	1.041	+3.989	-.783	145.144	
√ 2.673	143.836	1.718	+2.271	+.957	146.101	
5.005	148.841	2.381	-0.110	2.624	148.725	
7.209	156.050	3.022	3.132	4.187	152.912	
9.231	165.281	3.638	6.770	5.593	158.505	
11.028	176.309	4.228	10.998	6.800	165.305	
12.552	188.861	4.792	15.790	7.761	173.066	
13.732	202.593	5.320	21.110	8.413	181.479	
14.535	217.128	5.806	26.916	8.729	190.208	
14.896	232.024	6.238	33.154	8.657	198.865	
14.765	246.789	6.600	39.754	8.164	207.029	
14.096	260.885	6.876	46.630 4	7.221	214.250	
√ 12.874	273.755	7.037	53.667	5.838	220.088	— Aug 9
-11.117	-284.876	7.057	-60.718	4.066	+224.154	

	$a^2\frac{du}{dt}$	′f	″f	$\frac{di}{dt}$	h	′f	$\frac{d\Omega}{dt}$	′f	$\frac{d\varphi}{dt}$	′f
1869 Oct 9	−.0928		−.0038	−.021	−.021		−.031		+0.257	
		−.0001				.000		+.002		.000
Nov 18	914		.0039	22	22		85		262	
		−.0915				−22		−.083		+.262
Dec 28	740		.0954	20 14	20		143		225	
		−.1655				42		226		.487
1870 Feb. 16	440		.2609	− 5	14		192		155	
		−.2095				56		418		.642
Mar 16	− 82		4704	+ 3	− 5		224		075	
		−.2177				61		642		717
Apr 27	+ 265		.6881	11	+ 3		238		+ 7	
		−.1912				58		880		724
June 6	550		.8793	19	11		232		− 36	
		−.1362				46		1.112		688
July 12	749		1.0155	24	19		208		54	
		−.0613				−27		1.320		634
Aug 25	863		1.0768	27	24		175		52	
		+.0250				− 3		1.495		582
Oct 4	900		1.0518	27	27		135		41	
		0.1150				+24		1.630		541
Nov. 13	874		.9368	25	27		94		31	
		0.2024				57		1.724		510
Dec 23	800		−.7344	21	25		57		27	
		1.0024				76		1.781		483
Feb. 1	686		+.2680	15	21		26		83	
		1.0710				.97		1.808		450
√ Mar 13	540		1.3390	+ 8	15		− 5		55	
		1.1250				.1.12		1.812		395
Apr. 22	370		2.4640	− 1	+ 8		+ 5		91	
		1.1620				.1.20		1.807		304
June 1	+ 182		3.6260	11	− 1		− 1		143	
		1.1802				.1.19		1.808		+161
July 11	− 20		4.8062	21	11		− 22		207	
		1.1782				.1.08		1.830		−046
Aug 20	233		5.9844	31	21		60		285	
		1.1549				.87		1.890		331
Sept. 29	453		7.1393	41	31		117		373	
		1.1096				56		2.008		704
Nov. 8	676		8.2489	51	41		191		469	
		1.0420				+.15		2.198		1.198
Dec 17	895		9.2905	59	51		284		570	
		0.9525				−36		2.482		1.758
Jan 27	.1.107		10.2434	65	57		395		671	
		.8488				95		2.877		2.474
Mar 7	1.303		11.0852	69	65		521		769	
		.7115				.1.60		3.398		3.183
Apr. 16	1.474		11.7967	70	69		659		857	
		5641				.229		4.057		4.040
✓ May 26	1.609		12.3608	67	70		806		932	
		4032				.299		4.863		4.992
July 5	1.698		12.7440	61	67		957		990	
		2334				.366		5.820		5.962
Aug 14	1.718		12.9974	52	61		1.105		1.020	
		+.0616				.427		6.925		6.582
Sept. 23	1.661		13.0590	35	52		1.227		1.023	
		−1045				.477		8.152		7.645
Nov. 2	1.508		12.9545	− 17	35		1.328		996	
		.2553				.512		9.480		8.601
Dec 12	1.253		12.6992	+ 3	−17		1.391		940	
		3806				.529		10.871		9.551
Jan 21	893		12.3186	24	+3		1.405		860	
		4695				.526		12.276		10.401
Mar 2	− 434		11.8487	43	24		1.361		764	
		5133				.502		13.637		11.105
Apr. 11	+ 94		11.3354	58	43		1.249		658	
		.5039				.459		14.886		11.823
May 21	645		10.8315	68	58		1.089		565	
		.4394				401		15.975		12.388
June 30	1162		10.3521	71	68		889		492	
		.3232				3.33		16.864		12.880
Aug 9	1577		10.0689	67	71		669		.440	
		−.1655				.262		17.533		13.330
Sept. 18	.1831		9.9034	+.067			− 454		− .409	
		+.01[illegible]96	+9.9210			−1.95		−17987		−1.3735

$\frac{d\,th}{dt}$	∫	$\frac{dL}{dt}$	∫	$\frac{d\,ff}{dt}$	∫
~~-.527~~		~~.009~~		~~+.520~~	
	000		+005		+005
-522		115		408	
	-522		-110		413
480		204		276	
	1.002		314		689
476		268		208	
	1.478		582		897
557		301		256	
	2.035		883		1.153
712		302		409	
	2.747		1.185		1.562
893		270		623	
	3.640		1.455		2.185
1.049		211		839	
	4.689		1.666		3.024
1.152		131		1.021	
	5.841		1.797		4.045
1.188		−041		1.147	
	7.029		1.838		5.192
1.158		+058		1.215	
	8.187		1.780		6.407
1.074		156		1.230	
	9.261		1.624		7.637
948		250		1.199	
	10.205		1.374		8.836
√ 800		337		1.137	
	11.009		1.037		9.973
640		411		1.050	
	11.649		.626		11.023
484		471		954	
	12.133		−.185		11.977
341		510		851	
	12.474		+.355		12.828
220		532		752	
	12.694		.887		13.580
~~182~~ 132		529		~~660~~ 660	
	12.826		1.416		14.240
~~130~~ 80		497		577	
	12.906		1.913		14.817
~~88~~ 68		440		509	
	12.974		2.358		15.326
98		352		450	
	13.072		2.705		15.776
165		233		399	
	13.237		2.938		16.175
266		+088		351	
	13.503		3.026		16.526
√ 388		−091		296	
	13.891		2.935		16.822
515		296		219	
	14.406		2.639		17.041
634		515		+119	
	15.040		2.124		17.160
711		744		−032	
	15.751		1.380		17.128
722		964		242	
	16.473		+.416		16.886
638		1.160		523	
	17.111		−.744		16.363
441		1.314		877	
	17.552		2.058		15.486
−123		1.402		1.278	
	17.675		3.460		14.208
+293		1.396		1.689	
	17.382		4.856		12.519
766		1.306		2.075	
	16.616		6.162		10.444
1.233		1.134		2.366	
	15.383		7.296		8.078
√ 1.610		0.891		2.497	
	13.773		8.187		5.581
1.819		−0.612		−2.432	
	−11.954		−8.799		+3.149

Integration for Jan 17 1870

$\iint$ ~~4M~~

	♃	♄
$''f(a+\frac{1}{2})=$	−4.914	−.178
$-\frac{1}{24}f(a+\frac{1}{2})$	−.072	+2
$\iint\frac{d\mu}{dt}$ ~~4M~~	−4.986	−.176 = −5.147

5.176
4.971

	40 dw ♃	♄	di ♃	♄	dΩ ♃	♄	dφ ♃	♄	dπ ♃	♄	dL ♃	♄
$'f(a+\frac{1}{2})$	−3.0132	−1655	−3.553	−042	−18.886	−226	+5.686	+487	−90.172	−1.002	−39.436	−314
$+\frac{1}{24}f'(a+\frac{1}{2})$	+1307	+073	+026	0	−087	−003	−326	−3	+077	0	+142	−3
	−2.8825	−1642										
4M	−0.07206	−00411	−3.527	−042	−18.973	−029	+5.360	+484	−90.095	−1.002	−39.294 −4.966	−317 −176
− ~~5.147~~	−0.07617		−3.569		−19.002		+5.844		−91.097 1 31 10		−39.611 −5 147	
1 22 54.37 ~~343 33 55.03~~ +51.48	807.74150		8 02 50.60		4 56 170		17 28 860		55 56 8 213 +26.27		39 30 47.16 −44.260	
343 33 47.88 ~~343 34 41.57~~	801.66533		8 02 47.03		4 55 42.70		17 28 14.44		55 55 21.03		39 30 ~~7.55~~ 2.41	−4.93 4.93
1 23 40.70												

dM
+50.72
+.06
+50.79
−4.97
+4.82
51.49
5.14
46.35

log b = 3.5500066
ar. w 2.9039932
$\frac{3}{2}$ log a 0.6460134
$\frac{1}{2}$ log a 2153378
log a .4306756
log √a

Ω	4	55	42.70
Ω − n	184	55	42.70
½(Ω − n)	92	27	51.35
i′	8	02	47.03
ε	23	27	22.16
i + ε	31	30	08.78
i − ε	−15	24	35.33
½(i+ε)	15	45	4.36
½(i−ε)	−7	42	17.33

sin ½(Ω − n) 9.9995982
sin ½(i+ε) 9.4337092
sin ½ i′ sin ½(Ω′+a) 9.4333074
sin ½ i″ cos ½(Ω′+a) 8.7607606
tan ½(Ω′+a) 1.6725468
88 46 56.56

cos ½(Ω − n) 8.6334306
sin ½(i′ − ε) ~~9.4243482~~ 9.1273800
8.7607606

sin ½(Ω − n) 9.9995982
cos ½(i′+ε) 9.9833780
9.9829762
cos ½ i′ sin ½(Ω′ − a) 8.6294920
cos ½ i′ cos ½(Ω′ − a) 1.3534842
tan ½(Ω′ − a) − 87 27 46.09

cos ½(Ω − n) 8.6334306
cos ½(i′ − ε) ~~9.9961054~~ 9.9960614
8.6294920

log sin ½ i 9.433 ~~4102~~ 4035
½ i 15 44 ~~24.17~~ 23.72
i 31 28 ~~47.35~~ 47.44
sin i″

½(Ω′ − a)	92	32	13.97
½(Ω′ + a)	88	46	56.56
~~½(Ω′+a)~~	181	19	10.47
Ω′	181	19	10.47
a	356	14	42.65
ϖ	50	59	38.33
ϖ′	54	44	55.68

log sin Ω′ 8.3622730n
log cos i″ 9.9308593
cos Ω 9.9998848n
sin i″ 9.7178357

cos Ω′ 9.9998848
cos i″ sin Ω′ 8.2931323n
tan A ~~8.2930165~~
A 1.7067525n
88 52 28.50
A 91 07 31.50

sin Ω′ 8.3622730n
cos i′ cos Ω′ 9.9307441n
tan B 8.4315288n
B 1 32 51.94
49.94
log b 9.9309026

A + ϖ 145 52 27.18
B + ϖ′ 56 17 47.62
ϖ′ 54 44 55.68

log a 9.9999686
log b 9.9309026
log c 9.7178357

log e = log sin φ 9.4774372
e .3002183
1+e 1.3002183
1−ε .6997817
log(1+ε) .1140163
log(1−ε) 9.8449626

log √(1+ε) .0570081
log √a 0.2153378
log √(1−ε) 9.9224813
log √a(1+ε) .2723459
log √a(1−ε) .1378191

log e 9.4774372 ✓
log Cond − 5.3144251
log e″ 4.7918623

½φ 8 44 7.22
45 − ½φ 36 15 52.78
log tan(45 − ½φ) 9.8654734

1870

37 7.37

+50778 +0.689
+ .063 − .003

+50791 +686
−4.97 −18
−0.82 −150

51.497
5.147
46330

dM

	Jan 20	Jan 22	Jan 24	Jan 26	Jan 28	Jan 30
M	2 03 45.70	2 30 29.03	2 57 12.36	3 23 55.69	3 50 39.02	4 17 22.35
E	2 56 50.00	3 34 59.80	4 13 08.00	4 51 16.10	5 29 23.20	6 07 29.41
log sin E	8.7110988	8.7958478	8.8666829	8.9274997	8.9807674	0281443
log e″	4.7918623	4.7918623	4.7918623	4.7918623	4.7918623	7918623
log e sin E	3.5029611	3.5877101	3.6585452	3.7193620	3.7726297	9.8200065
e sin E	+53 39.1	1 4 58.99	1 15 55.60	1 27 20.37	1 38 44.20	1 50 7.04
E₁	2 56 49.45	3 34 59.02	4 13 07.98	4 51 16.06	5 29 23.22	6 07 29.39
½ E₁	1 28 24.72	1 47 29.51	2 06 33.98	2 25 38.03	2 44 41.61	3 03 44.69
log sin ½ E₁	8.4101895	8.4950308	8.5659462	8.6268585	8.6802364	8.7277349
log cos ½ E₁	9.9998563	9.9997877	9.9997056	9.9996102	9.9995014	9.9993793
log √r sin ½ v	8.6823354	8.7673767	8.8382921	8.8992044	8.9525823	9.0000808
log √r cos ½ v	.1376754	.1376068	.1375247	.1374293	.1373205	.1371984
log tan ½ v	8.5448600	8.6297699	8.7007674	8.7617751	8.8152618	8.8628824
½ v	2 00 29.47	2 26 28.85	2 52 27.22	3 18 24.68	3 44 20.77	4 10 15.48
v	4 00 58.94	4 52 57.70	5 44 54.64	6 36 49.36	7 28 41.54	8 20 30.96
log r	.2758845	.2760024	.2761428	.2763062	.2764918	.2767004
v+A+ω′	149 53 26.12	150 45 24.88	151 37 21.82	152 29 16.54	153 21 8.72	154 12 58.14
v+B+ω′	60 18 46.56	61 10 45.32	62 02 42.26	62 54 36.98	63 46 29.16	64 38 18.58
v+ω′	58 45 54.62	59 37 53.38	60 29 50.32	61 21 45.04	62 13 37.22	63 05 26.64
log sin(v+A+ω′)	~~9.6997451~~ 9.9373068	9.6888789	9.6769452	9.6645813	9.6517639	9.6384666
log r a	.2758531 .7624033	0.2759710	.2761114	.2762748	.2764604	.2766680
log sin(v+B+ω′)	9.9388915	9.9425689	1164 9.9461209	9.9495337	9.9528234	9.9559872
log r b	.2067871	0.2069050	.2070454	.2072088	.2073944	.2076030
log sin(v+ω′)	9.9319910	9.9355059	9.9396853	9.9433314	9.9468454	9.9502306
log r c	9.9937202	9.9938381	9.9939785	9.9941419	9.9943275	9.9945861
X	.9453708	+ .9222585	.8975455	.8726821	.8476650	.8224997
X	~~+.4846609~~	+ ~~.5148622~~	~~+.5444309~~	~~+.5733308~~	+ ~~.6014238~~	~~.6287739~~
x′	.4883384 .4467954	.5297278	.5589666	.5875179	.6153439	.6424094
Y	1.3985520	+1.4108300	1.4228587	1.4346386	1.4461650	1.4574381
Y	−~~.7857069~~	~~.7698417~~	−~~.7525218~~	−~~.7340160~~	−~~.7148901~~	−.69574~~20~~
y′	.7777699	.7611750	.7436346	.7251686	.7057986	.6855489
Z	.8427941	+.8506363	.8583488	.8659110	.8733195	.8805757
Z	−~~.3409191~~	−~~.3339257~~	−~~.3265184~~	−~~.3187057~~	−~~.3104968~~	−~~.3019016~~
z′	−.3374747	−.3302733	.3226622	.3146502	.3062466	.2974617
log Δ cos δ cos α	.1603587 ~~.1599308~~	~~.1574925~~ .1619607	.1633141	.1644123	.1652470	.1658107
log Δ cos δ sin α	9.7929393	9.~~8070167~~ 9.8126827	9.8320131	9.8507340	9.8654467	9.8875551
log tan α	~~9.6330085~~	9.~~6495242~~ 9.6507280	9.6686990	9.6865217	9.7041997	9.7217444
la	9.6325805	~~24 02 46~~.19				
α	23 13 30.78	24 06 18.07	25 00 4.80	25 54 49.70	26 50 31.29	27 47 8.25
	−9.75	9.48	5.24	8.98	8.72	8.47
	23 13 21.03	24 06 08.59	24 59 59.56	25 54 40.72	26 50 22.57	27 46 59.78
log Δ cos δ	.1970613	.2015860	.2060425	.2104340	.2147581	.2190157
log Δ sin δ	9.7035487	9.~~7132531~~ 7163064	9.7289109	9.7413571	9.7536389	9.7657535
log tan δ	9.5064874	9.5147204	9.5228684	9.5309231	9.5388808	9.5467378
δ	+17 47 45.43	+18 06 52.10	18 26 43.4	18 45 20.50	19 04 39.42	19 24 1.48
	−6.00	5.93	5.82	5.73	5.65	5.75
	+17 47 38.43	+18 06 46.17	18 25 58.92	18 45 14.77	19 04 33.77	19 23 55.73
log Δ	.21835	.22366	.22892	.23413	.23927	.24440
G	134 30	134 02	133 35	133 07	132 40	132 14
a	23 26	24 19	25 13	26 08	27 03	27 56
(G+a)	157 56	158 21	158 48	159 13	159 40	160 10
log cos(G+a)	9.9670n	9.9682n	9.9696n	9.9708n	9.9721n	9.9734n
log q	.8085	.8003	.7921	.7836	.7751	.7666
log sin(G+a)	9.5748	9.5670	9.5583	9.5500	9.5407	9.5306
log tan δ	9.5064	9.5147	9.5229	9.5309	9.5389	9.5467
	″					
δ/r	−10.40	−10.12	−9.85	−9.58	−9.32	−9.06
	+ .77	+.76	+.75	+.74	+.73	+.71
α′−α	−9.63	−9.36	−9.10	8.84	−8.59	−8.35
δ′−δ	−5.96	−5.87	−5.77	−5.68	−5.59	5.50

1871

	Mar 14	16	18	20	22	24
U	95 10 02.58	95 36 46.98	96 03 31.88	96 30 15.78	96 57 0.18	97 23 44.18
E	111 11 14.23	111 35 20.50	111 59 24.18	112 23 25.37	112 47 24.00	113 11 20.30
log sin E	9.9696041	9.9684141	9.9671963	9.9659586	9.9646983	9.9634154
log e″	7913584	7913584	4.7913584	7913584	7913584	7913584
log e″ sin E	4.7609625	4.7597698	4.7585547	4.7573170	4.7560567	4.7547738
e sin E	15 01 11.67	15 58 33.50	15 55 52.71	15 53 9.57	15 50 23.86	15 47 35.67
E	111 11 14.25	111 35 20.48	111 59 24.19	112 23 25.35	112 47 24.04	113 11 20.25
½ E	55 35 37.12	55 47 40.24	55 59 42.08	56 11 42.68	56 23 42.02	56 35 40.12
log sin ½ E	9.9164807	9.9175196	9.9185487	9.9195685	9.9205788	9.9215798
log cos ½ E	9.7520934	9.7498619	9.7476176	9.7453602	9.7430895	9.7408056
log √ sin ½ v	.1886722	.1897111	.1907402	.1917600	.1927703	.1937713
log √ cos ½ v	9.8899243	9.8876928	9.8854485	9.8831911	.8809204	.8786365
log tang ½ v	.2987479	.3020183	.3052917	.3085689	.3118499	.3151348
½ v	63 18 51.59	63 29 13.44	63 39 33.06	63 49 50.35	64 00 05.93	64 10 19.17
v	126 37 43.18	126 58 26.88	127 19 06.12	127 39 41.10	128 00 11.86	128 20 38.34
log r	4751710	.4759376	4766994	.4774564	4782082	4789554
v+A+Ω′	209 09 31.96	209 19 03.81	209 30 13.43	209 40 30.92	209 50 46.30	210 00 59.54
v+B+Ω′	272 28 23.55	272 49 7.25	273 09 46.45	273 30 21.47	273 50 52.23	274 11 18.71
v+Ω′	182 53 42.08	183 14 25.78	183 35 5.02	183 55 40.00	184 16 10.76	184 36 37.24
	181 20 51.58	181 41 35.28	182 02 14.52	182 22 49.50	182 43 20.26	183 03 46.74
log sin (v+A+Ω′)	9.9995952n	9.9994743n	9.9993380n	9.9991864n	9.9990199n	9.9988385n
log r a	.4751396	.4759062	.4766680	.4774250	.4781768	.4789240
log sin (v+B+Ω′)	8.7038444n	8.7522571n	8.7960502n	8.8356841n	8.8718682n	8.9051420n
log r b	.4060755	.4068421	.4076039	.4083609	.4091127	.4098599
log sin (v+Ω′)	8.3714180n ~~8.7038444n~~	8.4705053n	8.5508550n	8.6184056n	8.6766490n	8.7278152n
log r c	.1930014	.1937680	.1945298	.1952868	.1960386	.1967858
x	−2.9835607	−2.9879993	−2.9923062	−2.9964906	−3.0005214	−3.0044327
X	+.9888521	+.9926065	+.9951731	+.9965394	+.9967071	+.9956787
x′						
y	−.1286530	−.1442445	−.1598285	−.1754062	−.1909770	−.2065389
Y	−.1001030	−.0685715	−.0369529	−.0052872	+.0263886	+.0580250
y′						
z	−.0366792	−.0461608	−.0556397	−.0651167	−.0745943	−.0840623
Z	−.0434348	−.0297548	−.0160869	−.0022976	+.0114485	+.0251744
z′						
log a cos δ sin α	.2998795n	.3000278n	.3004070n	.3010170n	.3018575n	.3029269n
log a cos δ cos α	9.3593724n	9.3280043n	9.2935841n	9.2569923	9.2164071n	9.1717672n
log tang α	9.0594929	9.0279765	8.9935771	8.9559253	8.9145496	8.8688403
α	186 32 31.84	186 5 16.08	185 37 38.29	185 09 45.44	184 41 44.44	184 13 42.15
a	−6.23	6.05	5.88	5.71	5.54	5.37
	186 32 25.61	186 05 10.03	185 37 32.41	185 09 39.73	184 41 38.90	184 13 36.78
log a cos δ	.3027168	.3024835	.3025051	.3027824	.3033196	.3041106
log a sin δ	8.9037084n	8.8803310n	8.8553775n	8.8287520n	8.8003561n	8.7700260n
log tang δ	8.6009916n	8.5778475n	8.5528724n	8.5259696n	8.4970385n	8.4659154n
δ	−2 17 5.96	−2 09 59.48	−2 2 48.99	−1 55 22.00	−1 47 56.21	−1 40 28.61
	+2.72	2.64	2.56	2.49	2.42	2.34
log Δ	.30307	.30279	.30278	.30303	.30353	.30430
δ	−2 17 03.24	56.84	2 41.43	55 19.51	47 53.79	26.47
G	172 12	172 29	172 45	172 57	173 07	173 13
a	186 19	185 52	185 24	185 57	184 29	184 01
(G+a)	358 31	308 21	358 09	357 54	357 36	357 14
log cos (G+a)	9.9999	9.9998	9.9998	9.9997	9.9996	9.9995
log g	4280	4153	4024	3892	3756	3616
log sin (G+a)	8.4131n	8.4593n	8.5090n	8.5640	8.6220n	8.6837
log tang δ	8.6010n	8.5778n	8.5529n	8.5260n	8.4970n	8.4659n
b I	− 6.15 .02	− 5.97 .02	5.80 .02	5.63 .02	5.46 .02	5.29 0
a′ − a						
δ′ − δ	+2.68	2.60	2.52	2.45	2.35	2.30

26

97 50 28.98
113 35 13.94
9.962 1098
791 3584
4753 4682
15 44 45.00
113 35 13.88
56 47 36.99
9.922 5715
9738 5083
~~9.736 1974~~
.1947630
9.8763392
.3184238
64 20 30.30
128 41 00.60

.4796978

~~210 11 10.67~~
274 31 40.97
184 56 59.50
183 24 5.00
9.9986424n
.4796664

8.9359300n
.4106023

8.7734202n
.1975282

3008 2145
+.9984589

-2220911
+0895911

-0935295
+.0388720

3042222
9.1222159
8.8179937
183 45 45.46
6.20
183 45 40.26

.3051593
8.7876498n
8.4324905n
-1 33 02.25
2.27

.30532
32 55.98

173 15
183 34
356 49

9.9993
.3471
8.7445n
8.4325n

- 5.12
.02

2.23

28

98 17 13.38
113 59 5.28
9.9607814
9.7913584
9.7521398
15 41 51.88
113 58 5.26
56 59 32.63
9.9235539
9.7361974
.1957950
9.8740283
.3217191
64 30 39.33
129 01 18.66

.4804354

~~211 20 19.70~~
274 57 59.03
185 17 17.56
183 44 27.06
9.9984316n
.4804040

8.9645693n
.4113399

8.8145391n
.1182658

-3.0118655
+.9900552

-.2376343
+.1210444

10 29 523
-~~1342944~~
+0525208

3057404
9.0666609
8.7609205
183 18 01.33
0.03
183 17 56.30

.3064613
8.7080462n
8.3965849n
-1 25 39.49
2.19

.30659
25 37.30

178 14
183 06
356 20

9.9991
.3321
8.8039
8.3966n

4.95
.02

2.15

30

98 43 57.78
114 22 54.14
9.9594300
4.7913584
4.7507881
15 38 56.32
114 32 54.18
57 11 27.07
9.9245274
9.7338780
.1967189
9.8717039
0.3250150
64 40 46.32+
129 21 32.65

.4811684

275 12 13.02
185 37 31.55
184 04 41.05
9.9982064n
.4811370

8.9913352n
.4120729

8.8519653n
.1989988

-3015 3896
+.9854761

-2531676
+.1523483

-.1124512
+.0661050

3045034
9.0035438
8.6960404
182 50 35.49
4.86
182 50 30.63

.3080373
8.6660142n
8.3579969n
-1 18 22.48
2.12

.30815
18 20.36

173 09
182 39
355 48

9.9988
.3165
8.8645
8.3580n

-4.78
+.01

2.08

29

98° 30' 35.55"
3 21.64
98 27 13.98
114 08 03
9.560 2760
9.791 3584
4.751 6344
114 08 00.2
57 04 00.1
9.9239190
9.7353296
.156 1105
9.8731605
0.3229500
64 34 27
129 08 54
4807092
2745934
185 24 53
183 52 02

9.9983490n
.4806778
8.9748069n
.4116137
8.8289467n
.1885396

-301319
+.98848

-243456
+.132287

-106534
+.057617

30636n
9.04403n
8.73767
183 07 43

8.68946n
30701
8.38245n

-1 22 55

Integration for Mar. ~~25~~13 1871

$\iint \frac{du\,d\Gamma}{d\Gamma}$		40dμ		di		dΩ		dφ		dπ		dL		dM	
♃	♄	♃	♄	♃	♄	♃	♄	♃	♄	♃	♄	♃	♄	♃	♄
+130.596	+1.339	+17.1572	+1.0980	−5.146	+.104	−64.465	−1.809	−65.776	+0.422	−237.398	−10.609	−23.241	+1.207	+214.150	+9.404
−.085	+.045	+.0189	+.0013	+.009	+.001	+.037	−.001	+.054	+.002	−.115	−.013	+.059	−.007	+.174	+.006
+130.511	+1.384	+17.1761	1.0993	−5.137	+.105	−64.428	−1.910	−65.722	+.424	−237.513	10.622	−23.182	−1.214	+214.324	+9.411
		+4.2940	+.02748											−130.51 +83.81 ~~244.83~~	+1.38 1077
+129.12~~7~~		+18.2754													
+2′ 09.13		+0.45688		−5.032		−66.338		−69.298		−248.135		−24.396		+223.735	
+2 9.13		+0.45688		−5.03		−1 06.34		−1 09.30		−4 08.13		−24.40		+3′ 43.73	
												−2 9.13		+2 9.13	
										−4 8.13		−2 33.53		+5 52.86	
		801.74150	8 02 50.60			4 56 1.70	17 28 8.60			55 56 52.13				94 55 5.78	
		803.19838	8 02 45.57 + 46			4 54 55.36 + 44.49	17 26 59.30			55 52 44.00 + 50.24				~~94 56 40.38~~ 95 00 58.64	
			8 02 46.03			4 55 44.85				55 53 34.24					

dL

−23.182 −1.214
−2 10.511 +1.384
2 33.693 +0.170
2 33.523

+214.324 +9.411
−130.511 +1.384
+83.813 +10.795
94.608

	°	′	″
Ω	4	55	44.85
Ω − n	184	55	44.85
½(Ω − n)	92	27	52.42
i	8	02	46.03
ε	23	27	21.23
i + ε	31	30	07.26
i − ε	−15	24	35.20
½(i + ε)	15	45	3.63
½(i − ε)	−7	42	17.60

log b 3.5500066
log μ 2.9042818
$\frac{3}{2}$ log a 0.6457248
$\frac{1}{2}$ log a .2152416
log a .4304832

sin ½(Ω − n) 9.9995981
sin ½(i + ε) 9.4337017
cos ½(Ω − n) 8.6334830n
cos ½(i − ε) 9.1273340n
log sin ½ i 9.4333979
log e = sin φ = 9.4769333
e .2998702
1 + ε 1.2998702
1 − ε .7001298
log (1 + ε) .1138999
log (1 − ε) 9.8451786

sin ½ i′ sin ½(Ω′ + a) 9.4332998
sin ½ i′ cos ½(Ω′ + a) 7.7608170
tang ½(Ω′ + a) 1.6724828
7.7608170
i′ 15 44 22.96
i′ 31 28 45.92

½(Ω′ + a) 88 46 55.99

log √(1+ε) .0569499
log √a .2152416
log √(1−ε) 9.9225893
log √a(1+ε) .2721915
log √a(1−ε) .1378309

sin ½(Ω − n) 9.9995981
cos ½(i + ε) 9.9833784
cos ½(Ω − n) 8.6334830n
cos ½(i − ε) 9.9960613
cos ½ i′ sin ½(Ω′ − a) 9.9829765
cos ½ i′ cos ½(Ω′ − a) 8.6295443n
8.6295443n
tang ½(Ω′ − a) 1.3534322n
½(Ω′ − a) −87 27 45.00
½(Ω′ − a) 92 32 15.00
½(Ω′ + a) 88 46 55.99

Ω′	181	19	10.99
Δ	356	14	40.99
ω	50	57	49.39
ω′	54	43	8.40

log e 9.4769333
log const 5.3144251
log e″ 4.7913584

½φ 8 43 29.65
45 − ½φ 36 16 30.35
(t 45 − ½φ) 9.8656393

log sin Ω′ 8.3623206n
cos i″ 9.9308613
cos Ω′ 9.9998848n
sin i″ 9.7178304

log cos Ω′ 9.9998848
cos i′ sin Ω′ 8.2931819n
tang A 1.7067024n
A −88 52 28.03
A 91 07 31.97

log sin Ω′ 8.3623206n
sin i″ cos Ω′ 9.9307460n
tang B 8.4315745
B 1 32 50.50

A + ω′ 145 50 40.37 9.9999686
B + ω′ 56 15 58.90 9.9309045
ω′ 54 43 8.40 9.9178304

log a 9.9999686 log b 9.9309045

1869

	°	′	″			
Oct 13	13	09	7.6			
14	12	54	15.9	−14	51.7	+5.7
15	12	39	25.9	14	46.0	7.2
16	12	24	51.1	14	38.8	8.7
17	12	10	21.0	14	30.1	10.1
18	11	56	1.0	14	20.0	11.6
19	11	41	52.6	14	8.4	12.9
20	11	27	57.1	13	55.5	14.2
21	11	14	15.8	13	41.3	15.5
22	11	00	50.0	13	25.8	16.8
23	10	47	41.0	13	9.0	18.0
24	10	34	50.0	12	51.0	19.6
25	10	22	18.6	12	31.4	20.7
26	10	10	7.9	12	10.7	21.8
27	9	58	19.0	11	48.9	23.1
28	9	46	53.2	11	25.8	24.1
29	9	35	57.5	11	1.7	25.2
30	9	25	15.0	10	36.5	26.1
31	9	15	4.6	10	10.4	27.2
Nov 1	9	05	21.4	9	43.2	28.1
2	8	56	6.3	9	15.1	29.2
3	8	47	20.4	8	45.9	29.7
4	8	39	4.2	8	16.2	30.5
5	8	31	18.5	7	45.7	31.2
6	8	24	4.0	7	14.5	31.9
7	8	17	21.4	6	42.6	32.5
8	8	11	11.3	6	10.1	32.9
9	8	5	34.1	5	37.2	33.2
10	8	0	30.1	5	04.0	33.6
11	7	55	59.7	4	30.4	33.8
12	7	52	3.1	3	56.6	34.0
13	7	48	40.5	3	22.6	34.3
14	7	45	52.2	2	48.3	

α

	log a	Abe T			h	m	s	Δ1	Δ2	Δ3
Oct 13	9.99452		8	12	0	52	36.51			
14	99421	−31		12		51	37.06	59.45		
15	99400	−21		12		50	37.99	59.07	.38	
16	99389	−11		11		49	39.41	58.58	.49	.11
17	99390	+1		11		48	41.40	58.01	.57	.08
18	99400	+10		11		47	44.07	57.33	.68	.11
19	99420	20		11		46	47.51	56.56	.77	9
20	99450	30		12		45	51.81	55.70	.86	9
21	99491	41		12		44	57.05	54.76	.94	8
22	99541	50	8	12		44	3.33	53.72	1.04	10
23	99601	60		13		43	10.73	52.60	1.12	8
24	99670	71		14		42	19.33	51.40	1.20	8
25	99750	80		15		41	29.24	50.09	1.31	11
26	99837	87		16		40	40.58	48.71	1.38	7
27	99924	97	8	17		39	53.27	47.26	1.45	7
28	00040	106		18		39	7.55	45.72	1.54	9
29	00156	116		19		38	23.43	44.12	1.60	6
30	00281	125		21		37	41.00	42.43	1.69	9
31	00415	134		22		37	0.31	40.69	1.74	5
Nov 1	00557	142	8	24		36	21.43	38.88	1.81	7
2	00708	151		26		35	44.42	37.01	1.87	6
3	00866	158		28		35	9.36	35.06	1.95	8
4	01031	165		30		34	36.28	33.08	1.98	3
5	01203	172		32		34	5.23	31.05	2.08	5
6	01383	180	8	34		33	36.27	28.96	2.09	6
7	01569	186		37		33	9.43	26.84	2.12	3
8	1 01963	194 200		40		32	44.75	24.68	2.16	4
9	02168	205		43		32	22.27	22.48	2.20	4
10	02379	211		46		32	2.01	20.26	2.22	2
11	02596	217	8	49		31	43.98	18.03	2.23	1
12	02718	222		52		31	28.21	15.77	2.26	3
13	03046	228	8	55		31	14.70	13.51	2.26	0
14					0	31	3.48	11.22	2.28	=

δ

	°	′	″		
Oct 13	+9	40	17.1		
14	9	41	2.9	+45.8	−1.8
15		41	46.9	44.0	1.5
16		42	24.6	42.7	1.1
17		43	11.2	41.6	0.7
18		43	52.1	40.9	−0.1
19		44	32.9	40.8	+0.1
20		45	13.8	40.9	4
21		45	53.7	41.3	7
22		46	37.1	42.0	1.1
23		47	20.2	43.1	1.6
24		48	04.9	44.7	1.7
25		48	51.3	46.4	2.0
26		49	37.7	48.4	2.4
27		50	30.5	50.8	2.8
28		51	24.1	53.6	3.3
29		52	21.0	0 56.9	3.6
30		53	21.5	1 0.5	3.9
31		54	25.9	4.4	4.2
Nov. 1		55	34.5	8.6	4.5
2		56	47.6	13.1	4.8
3		58	5.5	17.8	5.3
4		59	28.7	23.2	5.5
5		0	57.4	28.7	5.9
6		2	32.0	34.6	6.2
7		4	12.8	40.8	6.4
8		6	00.0	47.2	6.6
9		7	53.8	53.8	7.0
10		9	54.6	2 0.8	7.0
11		12	2.4	7.8	7.3
12		14	17.5	15.7	7.3
13		16	39.9	22.4	7.6
14		19	9.[illegible]	30.0	

1870

α

19	22	47	17.8			
Jan 20	23	13	21.0	26	1.2	15.1
21	23	39	37.3	+26	16.3	+ 15.0
22	24	06	8.6	26	31.3	14.8
23	24	32	54.7	26	46.1	14.8
24	24	59	55.6	27	0.9	14.5
25	25	2[illegible]	11.0	27	15.4	14.3
26	25	54	40.7	27	29.7	14.2
27	26	22	24.6	27	43.9	14.1
28	26	50	22.6	27	58.0	13.5
29	27	18	34.4	28	11.8	13.8
30	27	48	00.0	+28	25.6	13.7
31	28	15	39.3	28	39.3	13.5
Feb. 1	28	44	32.1	28	52.8	

21568	
21835	
22101	266
22366	265
22629	263
22892	263
23153	261
23413	260
23671	258
23928	257
24184	256
24440	256

1	31	9.32	1	44.08	
1	32	53.40	1	45.06	+.99
1	34	38.49	1	46.08	1.98
1	36	24.57	1	46.08	1.00
1	37	11.65	1	47.08	98
1	39	59.71	1	48.06	96
1	41	48.73	1	49.02	96
1	43	38.71	1	49.98	95
1	45	29.64	1	50.93	94
1	47	21.51	1	51.87	92
1	49	14.29 30	1	52.79	91
1	51	8.00	1	53.70	~~84~~
1	53	2.65	1	54.55	.84
1	55	58.14	1	55.39	

δ

19	17	38	38.2	9	31.2	+ 1.5
Jan 20	+17	47	39.4	+9	32.7	+ 1.4
21	17	57	12.1	9	34.1	1.4
22	18	06	46.2	9	35.5	1.2
23	18	16	21.7	9	36.7	1.1
24	18	25	57.4	9	37.8	0.8
25	18	35	36.2	9	38.6	0.7
26	18	45	14.8	9	39.3	0.7
27	18	54	54.1	9	40.0	0.6
28	19	04	34.1	9	40.6	0.6
29	19	14	14.7	9	41.2	.5
30	19	23	56.9	9	41.7	5
31	19	33	37.6	9	42.2	5
1	19	43	15.8			

1871

α

Mar 14	186	32	25.6			
15	186	18	51.0	−13	34.6	− 6.4
16	186	05	10.0	13	41.0	5.5
17	185	51	23.5	13	46.5	4.6
18	185	37	32.4	13	51.1	3.8
19	185	23	37.5	13	54.9	2.9
20	185	09	35.7	13	57.8	2.0
21	184	55	39.8	13	59.8	1.2
22	184	41	38.9	14	1.0	− 0.3
23	184	27	37.6	14	1.3	+ 0.5
24	184	13	36.8	14	0.8	1.4
25	183	59	37.4	13	59.4	2.3
26	183	45	40.3	13	57.1	3.2
27	183	31	46.4	13	53.9	3.8
28	183	17	56.3	13	50.1	4.6
29	183	04	10.8	13	45.5	5.3
30	182	50	30.6	− 13	40.2	

30307	+17
30290	+11
30279	− 4
30275	+ 3
30278	+ 9
30287	16
30303	22
30325	28
30353	35
30388	42
30430	48
30478	54
30532	59
30591	68
30659	74
30733	82
30815	

12	26	9.71		
	25	15.40	59.81	42
	24	20.67	54.73	37
	23	25.57	55.10	
	22	30.16	55.41	31
	21	34.50	55.66	25
	20	38.65	55.85	19
	19	42.6[illegible]	55.98	13
	18	46.60	56.07	09
	17	50.51	56.09	+02
	16	54.45	56.05	− 4
	15	58.49	55.98	[illegible]
	15	2.69	55.80	17
	14	07.09	55.60	20
	13	11.75	55.34	26
	12	16.72	55.03	31
	11	22.04	54.68	35

δ

Mar 14	− 2	17	3.2			
15	2	13	31.3	+ 3	31.9	+2.6
16	2	9	56.8	3	34.5	2.2
17	2	6	20.1	3	36.7	2.0
18	2	2	41.4	3	38.7	1.6
19	1	59	1.1	3	40.3	1.3
20	1	55	19.5	3	41.6	1.0
21	1	51	3[illegible]	3	42.6	0.5
22	1	47	53.8	3	43.1	0.5
23	1	44	10.2	3	43.6	+ 0.1
24	1	40	26.5	3	43.7	− 0.2
25	1	36	43.0	3	43.5	0.6
26	1	33	[illegible]	3	42.9	0.8
27	1	29	18.1	3	42.0	1.2
28	1	25	37.3	3	40.8	1.5
29	1	21	58.0	3	39.3	1.7
30	1	18	20.4	+ 3	37.6	

1871phae.proj..432O

1869

Hamilton College Observatory

$\mu = 4f\frac{(x^{0}+\frac{1}{2}h)}{2}+(x'-\frac{1}{2}n)$ Ab.

$\mu' = \frac{1}{2}D_2$

	Oct: 16	20	24	25	31	oct 14	16	17	20
W.M.T	9h 40m 48s	11 52 44	10 04 23	9.47 08	8 44 33	10 47 29			
Aberr. T	8 11	8 11	8 14	8 15	8 22				
Corr. T	9 32 87	11 44 32	9 56 09	9 38 53	8.36 11	10 47 29	7 54 53	10 05 29	8 06 14
″	.39765	48913	41399	40200	.35846			42650	33766
log T	~~9.99380~~ 9.59950	~~9.49441~~ 9.68942	~~9.99652~~ 9.61699	~~9.90782~~ 9.60423	9.55444	9.65287	9.50825	9 ~~4864~~ .62377	9.52848
μ(a)	−874.5	−828.4	+761.2	−741.1	−596.8	−888.9	−874.5	−865.1	−828.4
μ′(a)	+4.3	+7.1	+5.8	+10.3	+13.6	+2.8	+4.3	+5.0	+7.1
μ(δ)	+42.2	+41.1	+45.5	+47.4	+66.5	+44.9	+42.2	+41.3	+41.1
μ′δ	−0.5	+.2	+0.8	+1.0	+2.1	−0.9	−0.5	−0.3	+0.2
log μ(a)	2.94176	2.91824	2.88150	2.86988	2.77583	2.94885	2.94176	2.93707	2.91824
lg μ′(a)	0.63347	0.85126	0.99123	1.07284	1.13353	.44716	.63347	0.69897	~~85126~~ 1.13353
lg μ(δ)	1.62531	1.61384	1.65801	1.67578	1.82281	1.65225	1.62531	1.61595	1.61384
lg μ′(δ)									
Tμ(a)	−5 47.78	−6 45.20	5 15.14	4 57.93	−3 33.93	−6 39.70	−4 41.84	6 03.82 ~~6 52.58~~	~~6 54.00~~
T²μ′(a)	+.68	+1.70	+1.68	+1.66	+1.74	+.57	+.45	~~−4 2[illegible]~~	−4 39.82
Sum	−5 47.10	−6 43.50	−5 13.46	−4 56.27	−3 32.19			.88	+1.55
Tμ(δ)	+16.78	+20.10	+18.84	+19.06	+23.84	+20.19	+13.60	13.37	13.88
T²μ′(δ)	−.08	+.04	+.15	+.17	+.27	−.18	−.06	−.03	+.02
Sum	+16.70	20.14	+18.99	+19.23	+24.11	−6 39.13	−4 41.39	6 02.58	4 38.27
a₀	12 24 51.1	11 27 57.1	10 34 50.0	10 22 18.6	9 15 04.6	12 54 15.9	12 24 51.1	12 10 21.0	11 27 57.1
a(b)	12 19 4.0	11 21 13.6	10 29 36.5	10 17 22.3	9 11 32.4	+20.01	+13.54	17.32	+13.90
	10.4	5.5	29 40.3	22.7	9 11 27.8	+9 41 2.9	9 42 29.6	9 43 11.2	9 45 13.8
δ₀	9 42 29.6	9 45 13.8	9 48 4.9	9 48 51.3	9 54 23.9				
δ(b)	9 42 46.3	45 33.9	9 48 23.9	9 49 10.5	9 54 50.0				
log a ~~a(0)~~ ~~par.~~ a(0)					ab	12 47 36.8	12 20 9.7	12 4 18.1	11 23 18.8
par. a(0)	12 15 10.4	11 21 5.5	10 29 40.3	10 17 22.7	9 11 27.8 a0	12 47 45.6	12 20 11.2	12 4 24.4	11 23 14.5
δ0					δb	+9 41 22.9	9 42 43.1	9 43 23.8	9 45 27.7
pa					δp	41 15.3	42 33.0	43 18.3	20.5
δ	9 42 37.0	9 45 29.4	9 48 20.7	9 49 6.7	9 54 47.8	−8.8	−1.5	−6.3	+4.3
Δ(a)(C−O)	−6.4	+8.1	−3.8	−0.4	+4.6 = +0.4				
Δδ(C−O)	+9.3	+4.5	+3.2	+3.5	±2.2 +4.5	+7.6	+11.1	+5.5	+7.2

Washington

	Oct 29	31	Nov 3	4	5	6	8	11
Sb. T								
Corr. T								
″								
log T	9.55136	9.45897	9.48037	9.49268	9.48286	9.49662	9.56807	9.62246
μa	−649.1	−596.8	−511.1	−481.0	−450.1	−418.6	−353.7	−253.5
μ′a	+12.8	+12.6	+14.8	+15.2	+15.6	+15.9	+16.4	+16.9
μδ	+58.7	+66.5	+80.5	+85.9	+91.6	+97.8	+110.3	131.4
μ′δ	+1.8	+2.1	+2.6	+2.7	+2.9	+3.2	+3.3	+3.6
log μa	2.81231	2.77583	2.70851	2.68215	2.65331	2.62180	2.54864	2.40398
lg μ′a	1.10037	1.10037	1.17026	1.18184	1.19312	1.20140	1.21484	1.22789
lg μδ	1.76864	1.82282	1.90580	1.93359	1.96190	1.99034	2.04257	2.11860
lg μ′δ	0.25527	0.32222	0.41497	0.43136	0.46240	0.50515	0.51851	0.55630
Tμa	−3 51.03	−2 51.71	−2 34.47	−2 29.16	−2 16.83	−2 11.35	−2 10.83	−1 46.28
T²μ′a	+1.60	+1.04	+1.35	+1.47	+1.44	1.56	2.24	+2.97
Sum	−3 49.43	2 50.67	−2 33.12	2 28.09	−2 15.39	2 9.79	−2 8.59	1 43.31
a₀	9 35 51.5	9 15 4.6	8 47 20.4	8 39 4.2	8 31 18.5	8 24 4.0	8 11 11.3	7 55 59.7
a(b)								
Tμδ	+20.89	+19.13	24.33	26.71	27.85	30.69	40.80	+55.09
T²μ′δ	+.23	+.17	+.23	.26	.47	+.31	+.45	+.63
Sum	+21.12	19.30	24.56	26.97	28.32	31.00	41.25	55.72
δ₀ δ(b) ab	9 32 21	9 12 13.9	8 44 47.3	8 36 36.1	8 29 3.1	8 21 54.2	8 8 2.7	7 54 16.4
°ad	9 32 2.6	12 16.8	44 42.9	36 33.7	28 59.7	21 51.4	9 0.3	54 15.1
log a a(0)	9.52 21.0	9 54 25.9	9 58 5.5	9 59 28.7	10 0 57.4	10 02 32.0	10 06 00.0	10 12 2.4
	~~9 51 59.9~~	~~9 54 6.6~~	~~9 57 40.9~~	~~9 59 1.7~~	~~10 0 25.1~~	~~10 02 10~~	~~10 0 18.8~~	
par. a(0)	9 52 42.1	9 54 45.2	9 58 30.1	9 59 55.7	10 0 25.0	10 08 03.0	10 06 41.2	10 12 58.1
Δa(C−o)	52 39.5	43.0	27.8	52.7	21.9	1.4	38.6	54.8
δ(0) Δa(C−o)	+0.5	−2.9	+4.4	+2.4	+3.4	+2.8	+1.8	+1.3 = +1.6
par δ(0)	+2.6	+2.2	+2.3	+3.9	+3.8	+1.6	+2.6	+3.3 = +2.7
Δδ(C−o)								

Alfred Observations — Bielk Observations — Hamburg:

21 ~~Nov. 3~~	31	Nov. 3	3	3	Nov. 7	8	Nov. 5	5
7 2151	7 1638	6 3657	7 3805	7 5521	9.19507	9.07240	9.33913	9.34301
30684	30342	27567	31812	33010				
9.48691	9.48211	9.44039	9.50259	9.51864				
-813.6	-596.8	-511.1	—	— —	352.4			
+7.7	+13.6	+14.8	—	— —	~~418.8~~			
					+16.2			
+41.6	+66.5	+80.5			104.0			
+0.3	+2.1	+2.6			+3.2			
2.91041	2.37583	2.70857			~~2.62211~~ 55373	2.54864	2.65331	
0.88649	1.13353	1.17026			1.20951	1.21484	1.19312	
1.61909	1.82281	1.90580			2.01703	2.04257	1.96190	
					0.50515	.51851	0.46240	
-4 0965	-3 0111	-2 2092	-2 4259	-2 4874	1 0149	4179	-1 3827	1 3916
+72	+1.20	+1.55	+1.50	+1.61	+39	+23	774	
-12.77	-20.18	-22.19	+25.61	+26.57	1 1.10	41.56	1 34.53	
+03	+19	+16	+.23	+.26	+16.30	+13.03	+20.00	20.18
4 893	2 5991	2 1987	2 4109	2 4713	+08	+05		+.14
11 14 15.8	9 15 4.6	8 47 20.4	8 47 20.4	8 47 20.4	16.38	13.08		20.32
+12.80	+20.37	+22.35	+25.84	+26.83	8 17 21.4	8 11 11.3	8 31 18.5	8 31 18.5
9 45 55.1	9 54 25.9	9 58 5.5	9 58 5.5	9 58 5.5				
11 10 6.9	9 12 4.7	8 45 0.6	8 44 39.3	8 44 33.3	8 16 20.3	8 10 25.7	8 29 41.0	
					18.3	10 27.6	8 29 35.5	
11 10 4.7	9 12 2.0	8 44 58.8	8 44 41.7	8 44 30.0				
9 45 07.9	9 54 46.3	9 58 27.8	9 58 31.3	9 58 32.3	10 04 12.5	10 06 00		10 05.74
	47.0	25.8	27.6	29.6	10 4 29.2	10 06 13.1		10 01 17.7
+2.2	-2.3	+0.8	-2.4	+3.3 = (-0.5)	10 4 28.9	8.0		10.7
—	-0.7	+2.0	~~+1.4~~ +3.8	+2.7 = +5.6	+0.3	+5.1		+7.0
					+2.0	+2.1	+5.5	

Madrid — Chicago

	Nov. 9	10	11	12	13	14	Oct 16	16
	9.24615	9.23870	9.23106	9.22365	9.21603	9.20831	9.69022	9.68709
	-320.6	287.2		289.6	185.5	151.0	-882.4	-874.5
	+16.6	+16.8		+17.0	+17.1	+17.3	+3.6	+4.4
	117.3	124.3		138.7	146.2	153.9	+43.5	42.2
	+3.5	+3.5		+3.6	+3.8	+3.9	-.5	-.6
	2.50596	2.45818	2.40398	2.34163	2.26834	2.17926	2.99566	2.94176
	1.22011	1.22531	1.22789	1.23045	1.23300	1.23805	0.55630	0.62531
	2.06930	~~2.14826~~	2.11860	2.14208	2.16495	2.18724	1.63849	1.62531
		.05447	.55630					
	-56.57	-49.76	-43.16	-36.75	-30.51	-24.40	-7 12.40	7 05.45
	+.52	+.50	+.48	+.46	+.45	+.44	+85	+12
	-55.99	-49.26	-42.68	-36.29	-30.06	23.96	-7 11.55	-7 5.33
	8 5 34.1	8 0 30.1	7 55 55.7	7 52 3.1	7 48 40.5	7 45 52.2	12 39 29.4	12 24 51.1
C	8 04 38.1	7 59 40.8	7 55 17.0	7 51 26.8	7 48 10.4	7 45 28.2	12 32 18.4	12 17 45.8
O	34.5	59 34.8	11.4	23.1	4.5	20.4	25.2	53.5
	+~~22.62~~	+22.51	+22.37	+23.21	24.04	+24.86	+21.31	+20.53
	+.10	+.10	+.10	+.10	+.10	+.10	+.18	+.11
		+21.61	+22.47	23.31	24.14	24.96	+21.13	+20.92
		10 9 54.6	10 12 24	10 14 17.5	10 16 35.9	10 19 49	9 41 46.9	9 42 24.6
		10 10 16.2	10 12 24.9	10 14 40.8	10 17 04.0	10 19 38.49	9 42 08.0	9 42 50.0
		11.2	20.3	40.4	0.4	30.3	1.3	45.6
ad(C-O)	+3.6	+6.0	+5.6	+3.7	+5.9	+7.8 (+5.6)	-6.8	-7.7
a√(C-O)		+5.0	+4.6	0.4	+3.6	+4.6 (+3.6)	+6.7	+4.4

H. C. 1871 Alfred

	Jan 27	Jan 28	Jan 19	Jan. 22	~~25~~ 22	25	25	27	27	27
W. M. T.	7 43 13	7 29 02	6 50 04	9 4 52	7 17 82	7 35 01	9 09 02	8 18 40	8 45 09	7 18 49
"	32167	31218	28472	37808	80384	31598	88161	34630	36470	30473
log Do.	9.50741	9.49441	9.45442	9.57793	9.48264	9.49966	9.58162	9.53945	9.56193	9.48391
μ a	+1670.9	1684.9	+1558.7	1598.7	~~1642.5~~ 1558.7	1642.5	1642.5	1670.9	1670.9	1670.9
μ' a	+ 7.0	+ 6.9	+7.5	+7.4	+7.4	+ 7.4	+ 7.1	7.0	7.0	7.0
μ δ	+579.6	580.3	+570.5	574.8	574.8	578.2	578.2	579.6	579.6	579.6
μ' δ	+ 0.3	+0.3	+0.7	.7	.7	.4	.4	.3	.3	.3
log μ a	3.22295	3.22657	3.19137	3.20377	3.20377	3.21548		3.22295		
log μ' a	.84570	.83885	.87506	.86523		.85126		.84510		
log μ δ log μ' δ	2.76313	2.76365	2.75626	2.75952		2.76208		2.76313		
T μ a	+8 57.48	8 46.00	+7 22.38	10 04.93	√ 8 05.75	8 38.97	+10 26.76	~~5~~ 9 38.63	10 09.37	8 29.17
T² μ' a	+.72	+ .66	+.63	+1.06	.56	+.72	+1.05	+ .84	+ .93	+.64
Sum	8 58.2	8 46.7	7 23.0	10 6.0				9 39.5	10 10.3	8 29.8
a₀	26 22 24.6	50 22.6	22 47 19.8	24 06 8.6				26 22 24.6	26 22 24.6	26 22 24.6
a(C)	26 31 22.8	59 9.3	22 54 42.8	24 16 14.6				32 4.1	26 32 34.9	26 30 54.4
a O	26 31 15.4	26 59 1.9	22 54 47.1	2 24 16 16.2	24 16 10.8			26 31 57.5	26 32 28.5	26 30 49.5
Δa(C−O)	+7.4	+7.4	−4.3	−1.6				+6.6	+6.4	+4.9
T μ δ	3 06.44	3 01.16	2 42.44	√ 3 37.51	√ 2 54.64	+3 02.71	3 40.65	3 20.72	3 31.38	+2 56.62
T² μ' δ	+ .03	+ .03	+.08	+.10		+ .04	+.05	+ .05	5	5
Sum	3 6.47	3 01.19	2 42.5	3 37.6		18 34 36.2		14543 20.8	3 31.4	2 56.7
δ₀	18 54 54.1	19 04 34.1	17 38 8.2	18 06 46.2				18 54 54.1	18 54 54.1	18 54 54.1
δ(C)	18 58 0.6	19 07 35.3	17 40 51.7	18 10 23.8		18 38 38.9		18 58 14.9	18 58 25.5	18 58 50.8
δ(O)	18 58 1.8	19 07 41.1	17 40 53.7	18 10 26.3	18 10 27.2	18 28 28.8		18 58 21.6	18 58 26.5	——
Δδ(C−O)	−1.2	−5.8	−2.0	−2.5		+10.1		−6.7	−1.0	~~+3.3~~

Work

	Jan 24	25	26	Feb. 1
~~6 42 38~~	7 34 03	6 42 38	6 59 29	1
~~27960~~	81531	27960	29131	
~~9.446521~~	9.49874	9.44654	9.46437	9.45087
	+1588.8	1642.5	1616.8	1739.6
	+7.5	+ 7.1	+ 7.1	+ 6.7
	+573.1	+578.2	+579.9	582.4
	+.7	+ .4	+ .3	+.2
	3.15970	3.21548	3.21527	3.24039
	0.87506	.85726	.85126	.82607
	2.75823	2.76208	2.76260	2.76522
	+8 19.40	7 39.22	8 02.66	8 ~~06.52~~ 10.64
	+.75	+.56	+.61	+.53
	+8 20.15	7 39.78	8 3.27	8 11.17
	23 39 37.3	25 27 11.0	25 54 40.7	28 44 52.1
	23 47 59.4	25 34 50.8	26 2 44.0	28 52 43.3
	23 47 50.2	25 34 40.5	26 02 38.7	28 52 35.9
	+7.2	+10.3	+5.3	+ 7.4
	+ 3 07.1	+2 41.66	+2 48.64	2 44.28
	+.06	+.04	+.03	+ .03
	3 13	2 41.70	2 48.67	+2 44.31
	17 57 12.1	18 35 36.2	18 45 14.8	19 43 19.8
	18 07 18.4	18 38 17.9	18 48 3.5	19 46 9.1
	18 07 13.0	18 38 20.8	18 48 8.2	19 46 07
	+0.4	−2.9	−4.7	+3.4

1871 Lund   Wash.

m	Mar 14	20	21	22	28	30		Mar 21	24	28	
T	4 49 03	6 00 03	5 50 03	5 28 03	4 07 03	7 05 03		9 53 12	11 16 05	10 37 31	
	16 41	16 40	16 40	16 402	16 49	16 52		16 41	16 43	16 50	
Corr. T	4 32 22	5 43 23	5 33 22	5 11 21	3 50 14	6 48 11		9 36 31	10 59 22	10 20 41	
	.18915	23847	23151	21622	.15987	28347		.40036	45790	43[illegible]	
log T	9.27681	9.37743	9.36457	9.33490	9.20377	9.45251		9.60245	9.66077	9.63452	
τu a	−811.4	−838.8	−840.4	841.1	−827.8	−817.6			−840.1		
u' a	− 3.2	−1.0	− .6	− .1	+2.3	+2.6			+ .7		
u δ	+210.6	222.1	222.9	223.3	220.0	+216.5			+223.6		
u' δ	+1.3	+.05	+ .3	+ .2	−.08	−.08			−.1		
lg τu(a) lg τu'(a)	2.90924	2.92366	2.92449	2.92485	2.91793	2.91254		2.92449	2.92433	2.91793	
lg u δ lg u' δ	2.32346	2.34655	2.34811	2.34889	2.34242	2.33606		2.34811	+2.34947	2.34242	
τu(a)	−2 33.48	+3 20.03	−3 14.56	−3 01.87	−2 12.36	−3 51.77		−5 36.46	−6 24.69	−5 56.82	
τu'(a)	− .15	− .06	− .03	.00	+ .06	+ .25		+ .10	+ .15	+ .41	
	−2 33.6	3 20.1	3 14.6	3 1.9	2 12.3	3 51.5		−5 36.6	−6 24.5	−5 56.4	
a0	186 32 25.6	185 9 39.7	184 55 39.9	184 41 38.9	183 17 56.3	182 50 30.6		184 55 39.9	184 13 26.8	183 17 56.3	
a(c)	186 29 42.0	185 06 19.6	184 52 25.3	184 38 37.0	183 15 44.0	182 46 39.1		184 50 3.3	184 07 12.3	183 11 59.9	
a(0)	35 43.9	12 16.8	58 26.8	44 32.9	21 34.0	52 32.1		184 48 44.3	184 13 11.7	183 17 55.0	
4a(c−0) −	6 01.5	5 57.2	6 1.5	5 55.1	5 50.0	5 53.0	+56.3		5 58.4	5 55.1	+5 56.7
Σu(δ)	+ 398.4	+529.6	+516.0	+482.8	+351.7	+614.6		+1 29.24	+1 42.39	+1 34.83	
τμ u'	+.05	+.03	+.02	+.01	−.02	−.05		+.05	+−.00	−.02	
Sum	+39.9	53.0	51.6	48.3	35.2	1 01.4		+1 29.3	+1 42.4	+1 34.8	
δ0	−2 17 8.2	−1 55 19.5	−1 51 36.9	−1.47 53.8	1 25 37.3	1 18 20.4		−1 51 36.9	1 40 26.5	1 25 37.3	
δ(c)	−2 16 23.3	+1 54 26.5	−1 50 45.3	−1 47 5.5	−1 25 2.1	−1 17 19.0		1 50 7.6	+1 38 44.1	−1 24 2.5	
δ0	−2 19 44.0	1 57 41.9	1 54 7.5	1 50 29.5	1 28 24.2	1 20 39.2		1 53 33.8	1 42 9.0	1 27 21.8	
4δ(c−0)	+3 20.7	+3 21.5	+3 22.2	+3 24.0	+3 22.1	+3 20.2	3 21.8		3 26.2	3 24.9	3 23.3 +3 24.5

Harvard College   B from u = .25125 lg δ0 = 9.40011

	Mar 22	~~22~~	22	25	25	28	28	28	29	29	~~29~~
μa		56.04	560	55.86		55.16			54.79		
uδ		+223.4		+222.1		+219.8			+218.2		
lg μa		1.74573		1.74710		1.74147			1.73870		
lg μδ		2.34908		2.34655		2.34208			2.33885		
τ μ a	140.9	140.8		140.3		138.5			137.7		
a0		~~12 20 40.5~~		12 16 19.93		12 13 33.28			12 12 38.30		
	12 19 7.59	12 19 44.97	12 15 22.08	12 16 33.96	12 16 30.56	12 13 49.13	12 13 47.13	12 13 47.13	12 12 52.08	12 12 52.07	52.07
	12 19 22.08		11.99	11.80	11.80	11.87	11.84	11.87	11.77	—	11.66
Aa(o−c)	− 11.88		12 19 20.09	12 16 22.16	12 16 22.16	12 13 35.26	12 13 35.29	12 13 35.26	12 12 40.30		12 12 40.41
	12 19 20.20										
	184 47 33.0		57 31.3	184 05 02.4		183 23 48.9	49.3	48.9	183 10 4.5		6.1
	184 41 38.9	41 38.9	1 41 38.9	183 59 37.4	59 37.4	183 17 56.3	17 56.3	17 56.3	183 04 10.8	4 10.8	4 10.8
τ μ δ		56.13		55.80		55.23			54.82		
4a(c−0)	5 54.1		5 57.6	5 54.8	5 54.8	5 52.6	5 53.0	5 52.6	5 53.7	—	5 53.3
			5 55.8		5 54.8	5 52.7			5.54.5	=	5.54.4

− 56.13	55.80	55.23	54.82
−1 51 52.8	1 40 42.3	1 29 37.1	1 25 58.0
1 52 48.9	1 41 38.1	1 30 32.3	1 26 52.8
~~+41 27.5~~	1 33.0	1 26.1	1 27.6
1 51 21.4	1 40 05.1	1 29 6.2	1 25 25.2
	36 43.0	25 37.3	28 58.0
1 47 53.8			
3 27.6	3 22.1	3 28.9	3 27.2

	Dat	Δα(c−o)	Δδ(c−o)	Place of observation
1869	Oct 14	~~−8.8~~ −8.8	+7.6	Alfred
	15	~~−6.8~~ −6.8	+6.7	Chicago
	16	−6.4	+8.3	Hamilton College
	16	~~−6.4~~ −7.7	+4.4	Chicago.
	16	~~−7.7~~ −1.5	+11.1	Alfred
	17	~~−1.5~~ −6.3	+1.5	Alfred.
	20	~~−6.3~~ +(8.1)	+4.7	Ham. Coll.
	20	+ ~~8.1~~ (4.3)	+7.2	Alf.
	21	~~+4.3~~ +2.2	—	Alf.
	24	−3.8	+3.2	Ham Coll.
	25	−0.4	+3.5	Ham. Coll.
	29	−0.5	+2.6	Wash.
	31	+4.6	+2.2	Ham Coll.
	31	−2.3	−0.7	Alf.
	31	−2.9 +0.5	+2.2 +2.6	Wash.
	Nov 3 34	+4.4	+2.3	Wash.
	3 34	+0.6	+2.8	Alf.
	4 35	+2.4	+3.0	Wash.
	5 36	+3.4	+3.8	Wash.
	5 36	+5.5	+7.0	Hamburg
	6 37	+2.8	+1.6	Wash.
	7 38	+2.0	+0.3	Bilk
	8 39	+1.8	+2.6	Wash.
	8 39	+2.1	+5.1	Bilk
	9 40	+3.6	+—	Madrid
	10 41	+6.0	+5.0	Mad.
	11 42	+1.3	+3.3	Wash.
	11 42	+5.6	+4.6	Mad.
	12 43	+3.7	+0.4	Mad
	13 44	+5.9	+3.6	Mad
	14 45	+7.8	+4.6	Mad.
1870	Jan 19	~~(4.3)~~	−2.0	A Alfred
	21	+7.2	+0.4	Wash.
	22	−1.6	−2.5	Alf.
	25	+10.3	−2.9	Wash.
	26	+5.3	−4.7	Wash.
	27	+4.4	−1.2	Ham Coll.
	27	+6.0	−3.8	Alf.
	Feb 1 32	+7.4	(+3.4)	~~Alf~~ Wash.
	28	+7.4	−5.8	Ham Coll.
1871	Mar 14	−5′ 61.9″	+3′ 20.7″	Lund.
	20	57.2	21.5	Lund
	21	61.5	22.2	Lund
	21	—	26.2	Wash.
	22	55.1	24.0	Lund
	22	55.8	27.6	Harvard Coll.
	24	58.4	24.9	Wash.
	25	54.8	22.1	Ham. Coll
	28	50.0	22.1	Lund.
	28	55.1	23.3	Wash.
	28	52.7	28.9	Ham. Coll.
	29	54.5	27.2	Ham. Coll
	30	53.0	20.2	Lund.

	Δα(c−o)	Δδ(c−o)
Oct 31	+0.6″	+2.6″
9 15 4.6	+9 54 25.9	
9 15 4.0	9 54 23.3	

Jan 26 +6.7 − 2.8

25 ~~27~~ 11.0 +18 ~~25~~ 26.2

25 ~~27~~ 58 18 25 39.0

25 54 40.7 +18 45 14.8

+6.2 − 2.8

25 54 34.5 +18 45 17.6

Mar 24 −5′ 55.8″ +3 23.9

184 13 36.8 −1 40 26.5

184 19 33.6 −1 43 50.4

Differential Coefficients

Date	1869 Oct 2	1870 Jan 26	1871 Mar 24	1875 Feb 24.5	1869 Oct 31	1870 Jan 26	1871 Mar 24	1873 Aug 17	
t	2	88	511	1948	2	88	511	1388	
log T	0.30103	1.94988	2.70842	3.28959	0.30103	1.94938	2.70842	3.14238	
log 3/2 μ sin 1"	7.76569n	7.76565n	7.76594n	7.76579n	7.76580n	7.76576	7.76600n	7.76577n	
log p x	8.06672n	9.71503n	0.47436n	1.05556n	8.06683n	9.71614n	0.47442n	0.90816n	
log r	28970	27631	47896	39115	28969	27621	.47886	41731	
r	+1.9485	+1.8893	+3.0127	+2.4612	+1.9483	-1.8889	+3.0121	2.6140	
p	+2.4526	+2.4528	+2.4520	2.4546	2.4523	2.4523	2.4517	2.4546	
r+p	+4.4011	+4.3421	+5.4649	4.9158	4.4006	4.3412	5.4638	5.0686	
log(r+p)	0.64356	0.63770	0.73758	.69159	.64351	.63761	.73749	.70489	
E	337 24 05	4 51 16	113 11 21	73 06 43	337 20 10	4 47 44	113 10 28	275 48 37	
log sin E	9.58464n	8.92750	9.96341	9.98085	9.58583n	8.92221	9.96346	9.99776n	
log const (a cos φ)	9.58986	9.58983	9.58998	9.58968	9.58993	9.58992	9.59006	9.58968	
log f y	9.81806n	9.15503	0.29097	.26212	9.81927n	9.14974	0.29101	.29233n	δy
log r²	.59940	.55262	.95792	.78230	.57938	.55242	.95772	.83462	
log aa cos φ	84079	84085	84050	84098	84065	84068	84035	.84098	
log r²/(aa cos φ)	9.73861	9.71177	.11742	9.94132	9.73873	9.71174	.11737	~~9.87736~~ 9.99364	
r²/(aa cos φ)	+.54779	+.51496	+1.31047	.87362	.54794	.51493	1.31030	.75399	.98547
r²/(aa cos φ) − 1	-.45221	-.48504	+.31047	-.12638	-.45206	-.48507	+.31030	-.24601	-.01453n
log do	9.65534n	9.68578n	9.49202	9.10168n	9.65520n	9.68580n	9.49178	9.39095n	8.16226
log f r	0.65534n	0.68578n	0.49202	.10168n	65520n	68580n	.49178	.39095n	9.16226n
log tan φ	9.49789	9.49754	9.49739	9.49607	9.49797	9.49801	9.49746	9.49607	
log cos E	9.96531	9.99844	9.59524n	9.46316	9.96510	9.99848	9.59498n	9.00533	
cos E	+.92324	+.99642	-.39378	+.29051	+.92280	+.99651	-.39352	.10124	
e	+.30019	+.30022	+.29987	+.29904	+.30023	.30026	.29991	.29904	
e + cos E	+1.22343	+1.29664	-.09391	+.58955	+1.22303	1.29677	-.09363	.40028	
log(e + cos E)	.08758n	.11282n	8.97271n	9.77082n	0.08744n	0.11285n	8.97141	9.60236n	
log cos φ	9.97949	9.97949	9.97954	9.97966	9.97949	9.97948	9.97953	9.97966	
log f₀ y	~~.06707~~	.09281	~~8.95215~~	9.75086					
	.10805n	.13333n	8.99317		.10795n	.13337n	8.99188	9.62270n	δr y
log f₀ r₀	.08253n	9.42544	0.46080n	0.47692n	.08380	9.42022n	0.46092n	.49382	δr₀
log cot ψ	9.08253n	8.42544n	9.46080	9.47692	9.08380n	8.42022	9.46092	9.49382n	
ψ	96 53 43	88 28 27	73 53 46	73 18 27	96 54 55	88 29 17	73 52 47	72 46 04 107 18 56	
log sin ψ	9.99685	9.99985	9.98262	9.98130	9.99683	9.99985	9.98258	~~9.97976~~	
log r	28970	27631	47896	39115	28969	27621	47886	41731	
log(aa cos φ)	84079	84085	84050	84098	.84065	84068	84035	.84098	
log 2 sin ψ	0.28655	.27616	.46158	.37245	.28652	.27606	.46144	.39917	
log c'	+0.55417	+0.56469	+.87892	.46853	+.55418	.56462	.37891	.44381	
a'	9 15 05	25 54 34	184 19 33	145 58 40	9 15 02	25 54 35	184 19 37	313 23 23	
Ω₀	1 19 03	1 19 10	1 19 11	1 19 55	1 19 18	1 19 26	1 19 26	1 19 27	
δ	+9 54 26	+18 45 18	-14 3 50	+22 23 37	9 54 27	18 45 18	-14 3 50	-27 51 29	
a − Ω₀	7 56 02	24 35 24	183 00 22	144 38 45	7 55 44	24 35 09	183 00 11	312 03 56	
log cos δ	9.99347	9.97631	9.99980	9.96596	9.99346	9.97630	9.99980	9.94650	
log sin(a − Ω₀)	9.13997	9.61922	8.71968	9.76329	9.13970	9.61915	8.71924n	9.87063n	
log m cos θ	9.13344	9.59553	8.71948n	9.72925	9.13316	9.59545	8.71904n	9.81713n	
log sin δ = log m sin θ	9.23566	9.50721	8.48000n	9.58084	9.23561	9.50721	8.48000n	9.66958n	
log tan θ	0.10222	9.91168	9.76052n	9.85164	0.10245	9.91176	9.76096n	9.85245	
θ	51 40 54	39 12 50	209 56 52	35 23 56	51 41 48	39 13 10	209 58 22	215 26 57	
i₀	31 28 51	31 28 47	31 28 46	31 28 45	31 29 02	31 28 58	31 28 57	31 28 42	
log m	9.34102	9.70685	8.78172		9.34089	9.70630	8.78139	9.90617	
log cos(a − Ω₀)	9.99582	9.95871	9.99940n	9.91102n	9.99583	9.95872	9.99940n	9.82606	
θ − i₀	20 12 03	7 44 03	178 28 06	3 55 11	20 12 46	7 44 12	178 29 25	183 58 15	
log sin(θ − i₀)	9.53821	9.12897	9.99984	8.83479	9.53845	9.12911	8.41912	8.84041n	
log m	9.84102	9.70635	8.78172	9.81803	9.34089	9.70630	8.78139	9.90617	
log cos(θ − i₀)	9.97243	9.99603	8.42656n	9.99898	9.97240	9.99603	9.99985n	9.99896n	
log sin θ = m sin(θ − i)	8.87923	8.83532	8.78156	8.65282	8.87934	8.83541	7.20051n	8.74658n	sin θ
log sin n cos θ	9.31345	9.70238	7.20871	9.81701	9.31329	9.70233	8.78124n	9.90513n	
cos n cos θ	9.98929	9.93502	9.99920n	9.87698n	9.98929	9.93502	9.99920n	9.77256	
tan n	9.32416	9.76736	7.20951n	9.94003n	9.32400	9.76731	8.78204n	0.13257n	
log cos θ	9.99874	9.99899	~~180 05 34~~ 9.99992	9.99956	9.99874	9.99898	10.00000	9.99993	
n	11 54 41	30 20 22	180 05 34	138 56 36	11 54 26	30 20 12	183 27 52	306 23 16	
u − ν + ω'	24 17 32	61 21 45	183 03 47	145 21 13	24 17 20	61 21 58	183 08 11	313 02 38	
u − n	12 22 51	31 01 23	2 58 13	6 24 37	12 22 54	31 01 46	~~0 40 19~~ -0 19 41	6 39 22	
ψ	96 53 43	88 28 27	73 53 46	73 18 27	96 54 55	88 29 17	73 52 47	107 18 56	
u + ψ − n	109 16 34	119 29 50	76 51 59	~~79 38 50~~ 79 43 04	~~84 32 07~~ 109 17 49	119 31 03	73 33 06	~~293~~ 113 58 18	

aa cos φ / 2 sin ψ

cos δ sin(a − Ω)

cos(a − Ω)

	1869 Oct 31	1870 Jan 26	1871 Mar 24	Oct 31	Jan 26	Mar 24	1873 Aug 17	1875 Feb 24.5	
							° ' "	° ' "	
$(u+\psi-n)$	109 16 34	119 29 50	76 51 59	109 17 49	119 31 03	73 33 06	113 58 18	79 58 04	
$u-n$	12 22 57	310 12 23	2 58 18	12 22 54	310 1 46	0 19 41	16 39 22	6 24 37	
log C'	55417	56469	.37892	55413	56462	.37891	44381	46853	
log a	.00415	23413	.30430	.00415	.23401	.30415	.21429	17555	
log r	.28570	.27631	.47896	28969	27621	47886	41731	39115	
log $\frac{c'}{a}$	.55002	.33056	.07462	.54998	.33061	.07476	22952	.29298	.29298
log sin $(u+\psi-n)$	9.97494	9.93971	9.98849	9.97489	9.93962	9.98185	9.96083	9.99929	9.99297
log M	0.52496	0.27027	0.06311	0.52487	0.27023	0.05661	.19035	.29297	.28595
log tan θ	8.87923	8.83532	8.78156	8.87923	8.83532	8.78156	8.74658n	8.65219	8.65282
2 log $\frac{c'}{a}$	55002n	33056n	07462n	54998n	.33061n	.07476n	.22952n	29298n	29298n
log cos $(u+\psi-n)$	9.51867n	9.69230n	9.35645	9.51913n	9.69257n	9.45202	9.60883n	7.78238	9.25057
log M°	8.94792	8.85818n	8.21263n	8.94834	8.85850	8.30834n	8.58493n	6.73455n	8.19784n
log $\frac{r}{a}$	.28555	.04218	.17466	.28554	.04220	.17471	.20302	.21560	21560
log sin $(u-n)$	9.33124	9.71213	8.71448	9.33127	9.71200	7.75745n	9.06412	9.44922	9.04806
log N	9.61679	9.75431	8.88914	9.61681	9.75420	7.93216n	9.26714	9.66482	9.26366
−log $\frac{r}{a}$	28555n	04218n	17466n	.28554n	.04220n	.17471n	.20302n	.21560n	21560n
log tan θ	8.87923	8.83582	8.78156	8.87923	8.83582	8.78156	8.74658n	8.65219	8.65289
log cos $(u-n)$	9.98978	9.93296	9.99942	9.98978	9.93299	10.0000	9.99706	9.98210	9.99744
log N°	9.15456n	8.81046n	8.95564n	9.15455n	8.81051n	8.95627n	8.94666	8.84989n	8.86513n
$M = \frac{dn\cos\theta}{dr}$	+3.349	+1.863	+1.156	+3.3487	+1.8631	+1.1392	+1.5501	+1.9313	
$\frac{M}{N}$ fx	−.039	−.967	−3.447	−.0390	−.9669	−3.3965	+12.5460	−21.9389	
	+.414	+.568	+.077	+.4138	+.5678	−.0085	+.1850	+.1814	
$\frac{dn\cos\theta}{d\log a}$	+.375	−.399	−3.370	+.3748	−.3991	−3.4050	+12.3610	−21.7575	
$\frac{M}{N}$ fy	−2.203	+0.266	+2.260	−2.2087	+.2630	+2.2265	+3.0387	+3.5317	
	+.530	−.772	+.006	−.5306	−.7719	−.0008	+.0776	−.1121	
$\frac{dn\cos\theta}{d\varphi}$	~~−1.673~~	~~+1.038~~	~~+2.254~~	−2.7393	~~.349~~	+2.2257	−3.1163	+3.4196	
	−2.733	−0.506	+2.266		−.5089				
$\frac{M}{N}$ fz	−15.746	−9.088	+3.558	−15.1380	−9.0372	+3.5350	+0.2252	−2.4408	
	+.500	−.151	−.224	+.5019	−.1494	+.0247	+.5767	−.5440	
$10\frac{dn\cos\theta}{dz}$	−19.646	−9.189	+3.334	−14.6361	−9.1866	3.5597	+.3515	−2.9848	
$M° = \frac{d\theta}{dr}$	+.089	+.072	+.016	+.0888	+.0722	~~−.0011~~ −.0253	−.0384	−.0158	
$\frac{M°}{N°}$ fx	−.001	−.037	+.049	−.0010	−.0375	+.0606	+.3112	+.1800	
	−.143	−.065	−.090	−.1427	−.0646	−.0904	+.0884	−.0733	
$\frac{d\theta}{d\log a}$	−.144	−.102	−.041	−.1437	−.1021	−.0258	+.3996	+.1067	
$\frac{M°}{N°}$ fy	−.058	+.010	−.032	−.0586	+.0102	−.0397	+.0754	−.0290	
	+.183	+.088	−.008	+.1830	+.0879	−.0088	−.0371	+.0453	
$\frac{d\theta}{d\varphi}$	~~−.241~~	~~−.078~~	~~−.024~~	+.1244	+.0981	−.0485	+.0383	+.0163	
	+.125	+.098	+.040						
$\frac{M°}{N°}$ fz	−.401	−.350	−.051	−.4014	−.3502	−.0631	+.0056	+.0200	
	+.173	+.017	+.261	−.1731	+.0170	+.2613	+.2759	+.2200	
$10\frac{d\theta}{dz}$	~~−.228~~	−.333	~~+.310~~	−.5745	−.3332	+.1982	+.2815	+.2400	
	−.574		+.210						
log $\frac{r}{a}$	.28555	04218	17466	28554	04220	.17471	20302	.21560	
log sin ω'	9.61425	9.94333	8.72782n	9.61420	9.54334	8.73809n	9.86382n	9.75474	
log cos θ	9.99874	9.99899	9.99992	9.99874	9.99898	10.0000	9.99993	9.99956	
log $\frac{d\theta}{dc'}$	9.89854	9.98450	8.90240n	9.89848	9.98552	8.91280	0.06678n	9.96990	
$\frac{d\theta}{dc'}$	+.792	+.965	−.080	+.7915	+.9672	−.0818	−1.1662	+.9331	
−log $\frac{r}{a}$	28555n	04218n	17466n	.28554	04220	+17471n	20302n	.21560n	
log cos ω'	9.95974	9.68058n	9.99938n	9.95975	9.68052	9.99935n	9.83414	9.91523n	
sin i	9.71785	9.71785	9.71785	9.71787	9.71787	9.71787	9.71782	9.71782	
cos θ	9.99874	9.99899	9.99992	9.99874	9.99898	10.0000	9.99993	9.99956	
log $\frac{d\theta}{d\omega'}$	9.96189n	9.43970n	9.89181	9.96192n	9.43957n	9.89193	9.75491n	9.84821	
$\frac{d\theta}{d\omega'}$	−.916	−.275	+.078	−.9159	−.2751	~~+.0780~~ +.7797	−.5687	+.7050	

	1869 Oct 31	1870 Jan 26	1871 Mar 24	1875 Feb 24	Oct 31	Jan 26	Mar 24	Jan 26	1873 Aug 17
Δα	+0.6″	+6.2″	−355.8″		−1.5″	+0.4	+4.2	−4.5	
Δδ	+4.1	−2.8	+203.9		−0.4	+6.0	−2.9	+4.1	
α−Ω⁰									
sin i⁰	9.71785	9.71785	9.71785	9.71782	9.71789	9.71787	9.71787		9.71782
cos(α−Ω⁰)	9.99582	9.95871	9.99940n	9.91102n 44	9.99583	9.95872	9.99940n		9.82606
sec θ	00126	.00101	.00008		00126	.00102	00.000	102	68
cos N	9.71493	9.67757	9.71733n	~~9.91138~~ 9.62884n	9.71498	9.67761	9.71727n	9.67761	9.54456
sin N	9.93194	9.94422	9.93104	~~9.76257~~ 9.95667	9.93192	9.94421	9.93107	9.94421	9.97154
cos δ	9.99347	9.97631	9.99980		9.99346	9.97630	9.99980	9.97630	
log Δα	9.77815	0.79239	2.55121n		0.17609n	9.60206	0.62325	0.65321n	
log I	9.70356	0.71292	2.48201n		.10273n	9.57359	.55412	0.57474n	
+ 0 sec θ	9.70482	.71353							
log cos N	9.71493	9.67757	9.71733n		9.71488	9.67761	9.71727n	9.67761	
log Δδ	0.61278	0.44716n	2.30942		9.60206	0.77815	0.46240n	0.61278	
log II	0.32771	0.12478n	2.02675n		9.31880n 126	0.45678 102	0.17967	0.29039	
+ sec θ	.32897	.12579n	2.02683n						
I	+0.51	+5.17	−303.42		−1.27	+0.33	+3.58	−3.76	
II	+2.13	−1.33	−106.38		−.21	+2.86	+1.57	+1.95	
di ~~cos θ~~	+2.6	+3.8	−409.8		−1.48	+3.19	+5.09	−1.81	

	Oct 31	Jan 26	Mar 24		Oct 31	Jan 26	Mar 24	Jan 26
− log cos N	9.71493n	9.67757	9.71733		9.71498n	9.67761n	9.71727n	9.67761n
log cos δ	9.99347	9.97631	9.99980		9.99346	9.97630	9.99980	9.97630
log Δα	9.77815	.79239	2.55121n		.17609n	9.60206	~~.55412~~ .62325	.65321n
log I	9.48655n	0.44627n	2.26834n		9.88453 +7	9.25597n	~~0.27019~~ 0.34032	0.30712
log sin N	9.93194	9.94422	9.~~99980~~ 93104		9.93192	9.94421	9.93107	9.94421
log Δδ	.61278	.44716n	2.30942		9.60206n	.77815	.46240n	.61278
log II	.54472	0.39138n	2.24046		9.53398n	.72236	.39347n	.55659
I	−.31	−2.79	−185.5		+.77	−0.18	+2.20	+2.03
II	+3.50	−2.46	+174.0		−.34	+5.28	−2.47	+3.60
dΩ	+3.2	−5.2	−11.5		+0.43	+5.10	−0.27	+5.63

	1869 Oct 30	1870 Jan 26	1871 Mar 24	1873 Aug 17	1875 Feb 24	Feb 24
log sin N	9.93192	9.94421	9.93107	9.97154n	9.76257	9.95667
log cos δ	9.99347	9.97631	9.99980	9.94650	9.96695	9.96596
log Δα	0.07555	9.92942n	9.00000	9.41497	2.09830	2.09830
log I	0.00094	9.84994n	8.93087	9.33301n	1.82692	2.02093
log cos N	9.71498	9.67761	9.71727	9.54456	9.91138n	9.62884n
log Δδ	0.01703n	0.47422	9.30103n	0.02531	1.67852n	1.67852n
log II	9.73201n	0.15183	9.01830n	9.56987	1.58990	1.30816
I	+1.00	−0.71	+0.09	−0.21	+67.12	+104.94
II	+0.54	+1.42	−.10	+0.37	+38.90	+20.33
− di	+0.46	+.71	−.01	+0.16	+106.02	+125.24
− log cos N	9.71498n	9.67761n	9.71727	9.54456n	9.91138	9.62964
cos δ	9.99347	9.97631	9.99980	9.94650	9.96605	9.96605
log Δα	.07555	9.92942	9.00000	9.41497n	2.09880	2.09830
log I	9.78400	9.58334n	8.71707n	~~8.90593~~ 8.90603n	1.97573	1.69399
log sin N	9.93192	9.94421	9.93107	9.97154n	9.76257	9.95667
log Δδ	01703n	47422	9.30103	02531	1.67852n	1.67852n
log II	9.94895n	0.41843	9.23210	9.99685	1.44109n	1.63499n
I	+0.61	−0.38	~~+0.05~~	+0.08	+94.54	+49.43
II	+0.89	+2.62	+0.17	+.99	−27.61	−43.15
dΘ	−0.28	+2.24	+0.12	+0.91	+66.93	+6.26

Δα	~~+1.3″~~	~~−0.74″~~	~~−0.97~~		
Δδ	~~1.53~~	~~+0.77~~	~~−1.57~~		
Δα	+1.19	−0.85	+0.10	−0.26	+12.54″
Δδ	−1.04	+2.98	+0.20	+1.06	−4.73

n a b c d Sum

$0 = +2.6 + 335\,dl_1 + 0.37\,d\log\underline{\omega}\,2.73\,d\varphi - 14.65\,\frac{d\chi}{10} + .00\,di' + .00\,d\Omega'$ −13.66

+3.8 +1.86 −0.40 −0.51 −9.19 −8.24

−409.8 +1.16 −3.37 +2.27 +3.33 +3.39

+3.2 +0.09 −0.14 +0.12 −0.57 +0.79 + 0.52

−0.2 −0.04 −0.10 +0.10 −0.33 +0.96 −0.27

+11.5 +0.05 −0.04 +0.04 +0.21 −0.08 +0.78

log n +0.41497 +0.57978 −2.61257

log a +0.52504 +0.26951 +0.06446

log b +9.56820 −9.60206 −0.52763

log c −0.43616 −9.70757 +0.35602

log d −1.16584 −0.96331 +0.82244

log S −1.13545 −0.91593 +0.53020

+2.6 +495.9 −12.5 −233 −461.7 = +1.0

+3.8 275.3 +13.6 +4.3 −288.6 −1.8

−409.8 −409.8 +271.7 +15.4 +105.3 +114.0 = ~~410.4~~ +0.6

nn na nb nc nd ns

+ − + − + − + − + − + −

7. +8.72 0.96 .709 38.09 .355.0

14 7.07 1.52 313.0

167945 475.26 1381.05 1.93 34.92 1388.03

930.24 ~~861.04~~ ~~3131.2~~

1364.6

167966

167966 15.99 1382.01

475.26 1.5

−459.5 +1380.5 −939.3 −1436.7 −1455.0

aa ab ab ac ac ad ad as as

+ + − + − + − + −

11.22 1.24 ~~0.74~~ .914 49.08 45.76

3.46 0.74 .95 17.09 15.33

1.34 3.91 2.63 3.86 +3.93

+16.02 4.65 10.09 66.17 61.09

1.24 2.63 3.86 3.93

−3.41 −7.46 −62.31 −57.16

bb +bc −bc +bd −bd +bs −bs

1.010 5.42 5.05

0.13 0.20 3.67 3.30

16 7.65 11.22 11.42

11.35

8.66 16.64 16.47

11.64 3.67 3.30

−8.46 −12.97 −13.20

cc +cd −cd +cs −cs

7.45 40.00 + ~~46.9~~ 37.29

26 4.69 4.20

5.15 7.56 7.70

+12.86 +52.25 +49.19

dd +ds −ds

214.62 200.13

~~8.45~~ 75.73

84.46

11.09 11.29

+310.17 +287.15

	a	b	c	d	s	w
(aa)	+16.02	−3.41	−7.46	−62.31	−57.16	−459.5
lg(aa)	1.20466	0.53275 n	0.87274 n	1.79456 n	1.75709 n	2.66229 n
(bb)		+11.64	−8.46	−12.97	−13.20	+1380.5
ab ab/aa		+0.73	+1.59	+13.26	+12.17	+98.0
bb₁		+10.91	−10.05	−26.23	−25.37	+1282.5
log bb₁		1.03782	1.00217 n	1.41880 n	1.40432 n	3.10806
cc			+12.86	+52.25	+49.19	−535.3

cc
ac ae/aa
cc₁
bc₁ bc₁/bb₁
cc₂
lg cc₂

dd
ad ad/aa
ad₁
bd₁ bd₁/bb₁ dd₂
cd₂ cd₂/cc₂
dd₃
lg dd₃

an as aw/aa
sn₁ nn₁
bn₁ bs₁ bn₁/bb₁
sn₂ nn₂
cn₂ cs₂ cn₂/cc₂
sn₃ nn₃
dn₃ ds₃ dn₃/dd₃
nn₄

n
−14
+16
−30
−29
−1

+2931
+28.20
+17.5 −1.11
1.79967 0.04532
9.11394 n 9.11394
2.64077 3.09313 n
44.28
−7.22.3 +8.54

2″ 28.0

Litchfield Obsʸ of Hamilton College
Clinton, N.Y., 1877 Nov. 20.

Prof. Wm. A. Rogers,

My dear Sir,

I have succeeded in getting two observations of (123) Brunhilda, — a very unusual thing of getting any observations at all in the month of November. I give them in detail, in case you will employ re-determinations of the stars.

1877.	Ham. Coll. m.t.	(123) − ★ Δα	Δδ	No. of Comp.	(123) α	(123) δ	log(p.Δ) in α (in arc)	in δ	Comp. ★
Nov. 13.	13ʰ 59ᵐ 28ˢ,6	− 43ˢ,68	+ 36″,2	8	1ʰ 29ᵐ 26ˢ,	+20° 39′ 0″	0,786	0,659	a
" 13.	" "	− 1ᵐ 51,14	+ 27,5		29 25,93	39 0,1	0,786	0,659	b
" 16.	10 32 44,4	− 56,83	+ 8,7	16	27 44,82	22 33,6	0,181	0,540	c

The positions of the comparison stars are assumed as follows:

	α 1877,0	Red. to app.	δ 1877,0	Red. to app.	Authority
a	1ʰ 30ᵐ 5ˢ –	+ 4ˢ,374	+ 20° 37′ 53″ –	+ 30″,28	Du. + 20°.255 [place only approx.]
b	31 12,69	4,381	38 2,4	30,25	W₂ 1ʰ. 672
c	28 37,29	4,363	21 54,5	30,42	W₂ 1ʰ. 607

I do not find any recent determinations of the two last stars, and the star a has not been determined accurately at all. On Nov. 13 the two stars were not together in the same transits of planet. The comparisons are made with the ringmicrometer, and the mean results will not have a prob. error greater than 1″ of arc in both coordinates. The observations of Nov. 16 were made with bright moonlight; but the planet nevertheless was pretty distinct, the sky being very fine. Magnitude estimated 11ᵐ,5.

nn na
10.2 +2.5
26.1 −5.1
132.2 0.9
+168.5 −1.7

2 +8.6 −13.1 +1.8
2 +10.6 −9.1 +1.3
5 −0.8 +11.8 −0.3

$0 = -1.9 + \text{——} + 1.2\, d\Omega'$
$0 = -17.7 - \text{——} + 2.5$
$0 = -19.6 + 0.3\, d\Omega'$
$d\Omega' = +1.51$
di'
$0 = -17 + 1.7\, di' + 16.0$
$di' = +10.7$

	a	b	c	d	s	n
(aa)	+1602	−3.41	−7.46	−62.31	−57.16	−459.5
lg(aa)	1.20466	0.53275_n	0.87274_n	1.79456_n	1.75709_n	2.66229_n
(bb)		+11.64	−8.46	−12.97	−13.20	+1380.5
ab $\frac{ab}{aa}$		+0.73	+1.59	+13.26	+12.17	+98.0
bb_1		+10.91	−10.05	−26.23	−25.37	+1282.5
log bb_1		1.03782	1.00217_n	1.41880_n	1.40432_n	3.10806
cc			+12.86	+52.25	+49.19	−835.3
ac $\frac{ac}{aa}$			+3.47	+29.02	+26.62	+318.0
cc_1			+9.39	+23.23	+22.57	−1153.3
$bc_1 \frac{bc_1}{bb_1}$			+9.26	+24.16	+23.37	−1181.5
cc_2			+0.13	−0.93	−0.80	+28.2
lg cc_2			9.11394	9.96848_n	9.90309_n	1.45025
dd				+310.17	+287.14	−1436.7
ad $\frac{ad}{aa}$				+242.36	+222.33	+1787.3
ad_1				+67.81	+64.81	−3224.0
$bd_1 \frac{bd_1}{bb_1}$				+63.07	+61.00	−3083.5
dd_2				+4.74	+3.81	−140.5
$cd_2 \frac{cd_2}{cc_2}$				+6.65	+5.72	−201.7
dd_3				−1.91	−1.91	+60.2
lg dd_3				0.28103_n		1.77960

	ns	nn
	−1455.0	+167966
an $\frac{as}{aa}$ an	+1639.5	+13180
sn_1 nn_1	−3094.5	+154786
$\frac{bn_1 bs_1}{bb_1}$ bn_1	−2982.4	150770
sn_2 nn_2	−112.1	4016
$\frac{cn_2 cs_2}{cc_2}$ cn_2	−173.5	
sn_3 nn_3	+61.4	
$\frac{dn_3 ds_3}{dd_3}$ dn_3		
nn_4		

log dn_3 1.77960
− lg dd_3 .28103
lg $\frac{dx}{10}$ ~~2.06063~~ 1.49857
$\frac{dx}{10}$ + 31.5
dx = 315 = 6′ 15″

$\frac{d\psi}{10}$ cd_2 +29.31
cn_2 +28.20
Sum +57.5 −1.11
log sum 1.75967 0.04532
− lg cc_2 9.11394 9.11394
lg dψ 2.64573 0.93138_n
dψ 442.8
dψ −7′ 22.3 +8.54

$\frac{d\psi}{10}$ bd_1 −826.74
dψ bc_1 −85.81
bn_1 +1282.5
Sum +370.0
log sum 2.56820
− lg bb_1 1.03782_n
lg dlga 1.53038_n
dlga −33.914

$\frac{d\psi}{10}$ ad −1964.0
dψ ac −63.7
dlga ab +115.6
an −459.5
Sum −2371.6
log sum 3.37504_n
− lg aa 1.20466_n
lg dL 2.17038
dL 148.0 = +2′ 28.0″

$$
\begin{array}{l}
\quad\;\; n \qquad a \qquad\quad b \\
0 = +8.2 + 79\,di' - 92\,d\Omega' \quad -1.3 \\
0 = -5.2 + 86 \quad - 27 \qquad +6.7 \\
0 = -11.5 - 0.8 \quad + 78 \qquad +0.7
\end{array}
$$

0 = ~~11.5 + 0.1~~

nn	na	nb	ns	aa	ab	as	bb
10.2	+2.5	−2.9	−0.4	+.6	−0.7	−0.1	+.8
26.1	−5.1	+1.5	−3.6	+1.0	−0.3	+0.9	+1
132.2	0.9	−9.0	−8.0	+.1	−0.1	−0.1	+.6
+168.5	34 −1.7	−10.4	−12.0	+1.7	−1.1	+0.5	+1.5

0 = +8.2 + 8.6 − 13.1 + 1.8
− 5.2 + 10.6 − 9.1 + 1.3
− 11.5 − 0.8 + 11.8 − 0.3

$0 = -1.7 + 1.7\,di' - 1.1\,d\Omega'$
$0 = -10.4 - 1.1 \quad + 1.5$

$0 = -1.9 + \text{—} - 1.2\,d\Omega'$
$0 = -17.7 - \text{—} + 2.5$

$0 = -19.6 \quad + 0.13\,d\Omega'$

$d\Omega' = +1.51$

di'
$0 = -1.7 + 1.7\,di' - 1.66$
$di' = +$[illegible]7

log (1 − cos i′) 9.16788
log dΩ′ 1.17898
log (1 − cos i′) dΩ′ 0.34686
(1 − cos i′) dΩ′ + 2.22
dχ +5′ 15.0
dπ′ +5′ 17.8
dΩ′ + 15.1
dω′ + 5 02.1

dL = +2′ 28″.0
(1 − cos i) dΩ′ + 2.2
dL′ +2 30.2
dπ′ +5 17.8
dM − 2 47.0

log Const 7.76609n
log dlog a 1.53038n
log dμ 9.29648
dμ +.19791
μ 801.7415
μ 801.9394
log μ 2.9041416
log b 3.5500066
0.6458649
2152883
log a .4305766

log M 4.32335
1.53038n
5.85373
dlog a −.0000717
4306483
4305769

1869 M 339 06 40.2 ~~π 55 56~~ 1.9 ω′ 54 45 43.5
ΔM − 2 47.0
M 339 03 53.2

True Elements.

	Oct 31 1869	Jan 26 1870	Mar 24 1871			
M₀	344 00 38.5	3 23 55.7	97 28 02.82	343 57 57.9	3 21 26.1	97 22 38.7
ΔM	− 2 47.0	− 2 47.0	− 2 47.0	−0.88	−0.88	−0.88
M	343 57 51.5	3 21 8.7	97 25 15.8 X	343 57 51.02	3 21 25.23	97 22 37.82
	+.4	+17.4	+47.1	+.20	+8.89	+51.06
	343 57 51.9	3 21 26.1	97 25 59.9	343 57 51.22	3 21 34.12	97 23 28.88
Ω′	181 19 2.7	181 19 10.5	181 19 11.0	181 19 17.80	181 19 25.60	181 19 26.10
ΔΩ′	+ 15.1	15.1	+ 15.1	−2.94	−2.94	−2.94
Ω′	181 19 17.8	181 19 25.6	181 19 26.1 X	181 19 14.86	181 19 22.66	181 19 23.16
ω′	54 45 43.5	54 44 55.7	54 43 8.4	54 50 45.60	54 49 57.80	54 48 10.50
Δω′	+5 2.1	+ 5 2.1	+ 5 2.1	− 15.17	15.17	15.17
ω′	54 50 45.6	54 49 57.8	54 48 10.5 X	54 50 30.43	54 49 42.63	54 47 55.33
i′	31 28 51.20	31 28 47.4	31 28 45.9	31 29 1.90	31 28 58.10	31 28 56.60
Δi″	+10.7	+10.7	+10.7	−4.86	−4.86	−4.86
i′	31 29 01.9	31 28 58.1	31 28 56.6 X	31 28 57.04	31 28 53.24	31 28 51.74
φ₀	17 28 8.6	17 28 14.4	17 26 59.3	17 28 17.10	17 28 22.90	17 27 7.80
dφ	+8.5	+8.5	+8.5	−16.15	−16.15	−16.15
φ	17 28 17.1	17 28 22.9	17 27 7.8 X	17 28 0.95	17 28 6.75	17 26 51.65
μ	801.7415	801.6653	802.1984	801.93940	801.86320	802.39630
Δμ	+ .1979	.1979	+ .1979	+ .09993	.09993	+ .09993
μ	801.9394	801.8632	802.3963 X	802.03933	801.96313	802.49623
	4306483	4306756	4304832	4305766	4306039	4304115
	717	− 717	717	− 360	− 360	− 360
log a	.4305766	.4306039	.4304115 X	.4305406	.4305679	.4303755
log a	43058	43060	43041			
log cos φ	9.97949	9.97948	9.97953			
log a cos φ	86110	86120	86082			
a cos φ	.84065	.84068	.84035			
a cos φ	.41007	.41008	.40994			
cos² φ	9.95898	9.95896	9.95906			
log a	43058	43060	43041			
	.38956	.38956	.38947			
	24523	24523	24517			

	1869	1870	1871		Prime Elements.		
	Oct 31	Jan 26	Mar 24		Oct 31	Jan 26	Mar 24
log sin Ω'	~~8.3628425~~ 9425	8.3636538	8.3636994		8.3626742	8.3633859	8.3634315
cos i'	9.9308407	9.9308457	9.9308475		9.9308470	9.9308519	9.9308539
cos Ω'	9.9998844	9.9998841	9.9998841		9.9998846	9.9998842	9.9998842
sin i'	9.7178855	9.7178723	9.7178671		9.7178687	9.7178556	9.7178505
− log cos Ω'	9.9998844	9.9998841	9.~~9998475~~ 9998841		9.9998846	9.9998842	9.9998842
cos i' sin Ω'	8.2937852	8.2944995	8.2945469		8.2935212	8.2942378	8.2942854
tan A	1.7061012	1.7053846	~~0.6263006~~ 1.7053372		1.7063634	1.7056464	1.7055988
A ″	88 52 22.41	88 52 15.71	88 52 15.27		−88 52 24.86	88 52 18.16	88 52 17.71
A+ω'	91 07 37.59	91 07 44.29	91 07 44.73		91 07 35.14	91 07 41.84	91 07 42.29
	145 58 23.19	145 57 42.09	145 55 55.23		145 58 05.57	145 57 24.47	145 55 37.62
log a	9.9999684	9.9999684	9.9999684		9.9999685	9.9999684	9.9999685
sin Ω'	8.3629425	8.3636538	8.3636994		8.3626742	8.3633859	8.3634315
cos i' cos Ω'	9.9307251	9.9307298	9.9307316		9.9307316	9.9307361	9.9307381
tan B	8.4322174	8.4329290	8.4329678		8.4319426	8.4326495	8.4326934
B	1 32 58.70	1 33 07.83	1 33 8.39		1 32 55.22	1 33 04.30	1 33 4.86
B+ω'	56 23 44.35	56 23 5.63	56 21 18.89		56 23 25.65	56 22 46.93	56 21 00.17
ω'	54 50 45.60	54 49 57.80	54 48 10.50		54 50 30.43	54 49 42.63	54 47 55.33
log b	9.9308840	9.9308892	9.9308910		9.9308902	9.9308953	9.9308973
log c	9.7178855	9.7178723	9.7178671		9.7178687	9.7178556	9.7178505
log e = sin φ	9.4774541	9.4774~~867~~ 4928	9.4769901		9.4773460	9.4773848	9.4768821
e	.3002300	.3002568	2999094		.3001553	.3001821	.2998849
1+e			1.2999094				
1−e	6997700	6997432	.7000906		.6998447	.6998179	.7001651
log(1+e)	1140202	1140297	.1139130		.1139952	.1140041	.1138881
log(1−e)	9.8449~~560~~ 553	9.8449386	9.8451543		9.8450017	9.8449858	.8457005
log √(1+e)	0570101	0.0570146	.0569565		.0569976	.0570020	.0569440
log √a	2152883	.2153019	0.2152057		2152703	2152839	2151877
log √(1−e)	9.9224776	9.9224693	9.9225741		9.9225008	9.9224925	9.9226002
log √((1+e)a)	.2722984	.2723165	.2721622		.2722679	.2722859	.2721317
	~~75363~~						
log √((1−e)a)	.1377657	.1377712	.1377828		1377711	.1377764	.1377875
log e	9.4774541	9.4774929	.2999094	9.4769901	9.4773460	9.4773848	9.4768821
log const	5.3144251	5.3144251	5.3144251	5.3144251	5.3144251	5.3144251	5.3144251
log e″	4.7918793	4.7919180	5.6143045	4.7914152	4.7917711	4.7918099	4.7913072
φ	17 28 17.1	17 28 22.9	17 27 78				
½φ	8 44 8.55	8 44 11.45	8 43 33.90				
45−½φ	36 15 51.45	36 15 48.55	36 16 26.10				
log tan(45−½φ)	.8654677	8654547	9.8656205				

	—		—		1871 Mar 24		Oct 31	Jan 26	Mar 24
M	343 37 519		3 21 261		97 22 387		343 57 5043	3 21 333	297 23 2809
E	337 20 70.10	9.95	4 47 43.85	4359	113 10 280		337 20 16.16	4 47 52.00	113 10 59.50
log sin E	9.5858267	8270	8.9222806	1678	9.9634624		9.5857958	8.9224098	9.9634340
log e''	4.7918792	8792	4.7919180	9180	4.7914152		4.7917711	4.7918899	4.7913072
log e sin E	4.3777059	7062	3.7141486	1158	4.7548796		4.3775669	3.7142197	4.7547412
e sin E	6 37 41.89	41.97	1 26 17.83	14.45	15 47 45.27		−6 37 34.32	1 26 18.69	15 47 31.41
E	337 20 10.01	9.93	4 47 43.55		113 10 27.07		337 20 16.10	4 47 52.01	113 10 59.50
½ E	168 40 4.90	4.96	2 23 51.77		56 35 13.58		168 40 8.05	2 23 56.00	56 35 29.75
log sin ½ E	9.2933477	71	8.6215479		9.9598236	9.9215435	9.2933147	8.6217606	9.9215654
log cos ½ E	9.9914499n		9.9996196		9.6762732	9.7408858	9.9914512	9.9996152	9.7408387
log √r sin ½ v	9.5656456		8.8938644		.2319858	.1937057	9.5655826	8.8940465	.1936971
log √r cos ½ v	.1292158n		.1373946		9.7590560	9.8786719	.1292223	.1373956	9.8786266
log tan ½ v	9.4364298n	43.01	8.7564933		0.4774298	.3150366	9.4363603	8.7566509	.3150705
½ v	−15 16 42.97	43.16	3 16 0.55		71 34 38 13.64	64 10 00.35	−15 16 34.64	3 16 5.35	64 10 7.19
½ v	164 43 17.03	16.99			64 10 0.70		164 43 25.36		
v	329 26 34.06	33.98	6 32 1.10		128 20 0.70	0.70	329 26 50.72	6 32 10.70	128 20 14.38
log r	2896868		.2761942		.4788624		2896902	.2762050	.4788314
v+λ+ω'	115 24 57.27		152 29 42.65	43.19	274 15 56.93	55.93	115 24 56.29	152 29 35.17	274 15 52.00
v+β+ω'	25 50 18.30	33	62 55 6.19	6.73	184 41 19.59		25 50 16.37	62 54 57.63	184 41 14.57
v+ω'	24 17 15.58		61 21 58.36	58.90	183 08 11.30		24 17 21.5	61 21 53.33	183 08 9.71
log sin(v+λ+ω')	9.9557918		9.6644736		9.9987953n		9.9557927	9.6645059	9.9987960n
log r a	2896552		2761626		4788308		2896587	.2761734	.4787999
log sin(v+β+ω')	9.6393228		9.9495657		8.9124519n		9.6393134	9.9495559	8.9123179
log r b	2205708		2070834		4097534		.2205805	.2070003	.4097287
log sin(v+ω')	9.6141968		9.9433400		8.7380981n		9.6142038	9.9433405	8.7380411
log r c	0075723		9.9940065		.1967295		.0075589	9.9940606	.1966815
x	+1.7597336		+.8722404		−3.0034866		+1.7597519	+.8723270	−3.0032800
x'	−7780880		+.6875179		+.9556787		−7780980	+.6875179	+.9556787
y	+.7242577		+1.4343300		−.2099932		+.7242550	+1.4343535	−.2099165
y'	−.5644970		−.7251686		+.0580250		−.5644970	−.7251686	+.0588250
z	+.4115707		+.8657918		−.0860668				
z'	−.2449340		−.3146502		+.0251744				
log Δ cos δ cos α	9.5515508		9.1642945	2810	.3027228		9.9915585	9.1643069	.3026775
log Δ cos δ sin α	9.2034088		9.8507560	7450	9.1817527n		9.2034736	9.8507596	~~3058728~~
log tan α	9.2115785		9.6864946	4640	8.8790301	42.19	9.2115151	9.6864527	~~.0719559~~ 8.8788560
α C	9 14 37.74		~~78 22 12.14~~		184 19 42.39		9 14 37.39		184 19 35.90
a	24.80		25 54 49.74	38.95	~~184 19 32.6~~	−5.37	24.80		6.27
Ad C ode	9 15 02.5		− 8.58	8.58	− + 6.5	36.82	9 15 2.19		184 19 30.58
log Δ cos δ	.2059146 9.9576270		.1733034 .2103103	2102918 2997	.3039617	3039630			
log Δ sin δ	9.1969398 7.2366425		9.7412943	9.7412631	8.6353852	8.7845517			
log tan δ	~~8.9877930 7.0275044~~		~~9.5679909~~	9.5309713 9.5307840	8.3314235	8.4805887			
δ C	5 33 19.2420 1645		~~20 17 43.52~~		−1 13 43.65				
δ O	9 54 12.03		18 45 28.90	27.48	−1 43 55.65	55.65			
Δδ (C−O)	9.4		− 5.73	5.73	1 ~~43 50.4~~	+ 2.34			
	21.4			21.75	— — 5.2 43	53.8			
C α	9 15 2.5		25 54 30.0		184 19 36.8		9 15 2.2		184 19 30.58
O α	9 15 4.0		34.5		184 19 32.6		9 15 4.0		32.60
Δα (C−O)	− 1.6		− 0.45		+ 4.2		−1.8"		−2.02
δ C	+9 54 21.4		+18 45 21.7		−1 43 53.3				
δ O	+9 54 21.8		+18 45 17.6		1 43 50.4				
Δδ (C−O)	− 0.4		+ 4.0		− 2.9				

n a b c d e f s

0 = −1.5 +.000 dΩ' +.000 di' +3.349 dL, +375 dlog a −2.739 dφ −14.636 dX/10 −13.651 −3153 −340 +2887 +776 −150 = −30
~~−1.8~~ +1.863 −.399 −.509 −9.187 −8.232 −1754 +362 +536 +487 +820 = −49
+ ~~+5.8~~ +1.139 −3.405 +2.226 +3.560 +3.520 −1072 +3052 −2346 −159 +51 = −05

+0.4 −.916 +.791 +0.089 −.144 +.124 −.574 −.630 −.21
+5.6 −.275 +.967 +0.072 ~~+.102~~ +.098 −.333 +.427 +0.4
−0.3 +.780 −.082 −0.020 −.030 −.048 +.198 +.798 −.05

log n	.17609n	~~.50515~~ 25527n	~~.70757~~ ~~.25527n~~	9.60206	~~0.70757~~ .74819 74819	9.47712n
log a	∞	∞	∞	9.96190n	9.43933n	9.89209
log b	∞	∞	∞	9.89819	9.98543	8.91381n
log c	.52492	.27021	.95652	~~0.53212~~ 8.94939	8.85733	8.30103n
log d	9.57403	9.60097n	0.58212n	9.15836n	9.00860n	8.47712n
log e	.43759n	9.70672n	.34753	9.09342	8.99123	8.68124n
log f	1.16542n	0.96317n	0.55145	9.75891n	9.52244n	9.29667
log s	1.13516n	0.91551n	0.54654	9.79934n	7.63043	9.90200

0 = +11.4 − 9.2 dΩ' + 7.9 di'
+5.1 − 2.7 + 9.7
−0.3 + 7.8 − 0.8

0 = −.37 + .85 dΩ' + .72 di'
0 = 1.38 + .07 − .26
0 = −.23 + .52 − .06

0 = +.32 + .72 dΩ' + .63 di'
+4.85 − .26 + .99
+ .02 − .06 + .01

0 = −19.8 + 1.44 − 1.04

dΩ' di'
0 = +5.29 − 1.04 + 1.63
0 = −1.58 + 1.44 − 1.04

0 = +.4 + 1.6 + 3.5 = −1.5
0 = +5.1 + .5 − 4.3 = +1.3
0 = −.03 − 1.4 + .3 = −1.4

0 = −3.11 + 2.92 − 1.63
0 = +2.18 + 1.22 dΩ'
dΩ = −1.78
di' = −4.38

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

nn: 2.250, ~~3.240~~, ~~3.240~~, 26.760, 26.010, .089 — 64.757
−na: ~~5.023~~, .366, 1.402, .234 — −2.002
nb: .316, 4.932, .025 — +5.273
+nc: ~~5.962~~, ~~5.809~~, .036, .367, .006 — 12.180, 5.023, +7.157
−nc: 5.023, 2.050
+nd: 6179, .009
−nd: .562, 1.277, ~~17.266~~, .058, .520 — 19.783, 19.774 + 14.396
+ne: 4108, ~~14.353~~ 14.007, .050, .520, .014 — 16025, 1.629
−ne: 1.629
+nf: 21.954, ~~18.156~~ — 40.110, 31.386, +8.724
−nf: 29.398, 6.408, .230, 1.698, .059 — 31386
+ns: 20.477, ~~17.952~~, 2.178 — 38425, 29.012, ~~19.417~~, + 13.773
−ns: 26.343, 6.336, 25.2, ~~2.178~~, .239 — 29.012

−2.002 +5.273
19.774 7.157
21.776 14.396
8.724
35550
21.776
13.774

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

aa: .838, .076, .608 — +1.522
ab: .725, .266, .064 — −1.055
ac: .082, .020, .016 — −.118
ad: 0.132, .028 — +1.373
ad: .023
ae: .114, .027, .037 — −.178
af: .526, .092, .154 — +.772
as: .577, ~~.117~~, .622 — 1.317, .117, 11.99, +1.080
as: .117

bb bc bc bd bd be be bf bf bs bs

bb: .626, .935, .007 — 1.568
bc: .020, .008, .002 — .141
bd: .1, .002
bd: 0.134, .099 — −.213
be: .098, .095, .004 — .197
bf: .454, .322, .016 — .792
bs: ~~.418~~, .413 — .246
bs: .498, .065 — −.154

cc cd cd ce ce cf cf cs cs

cc: 11.216, 3.471, 1.297, ~~.007~~, .006, .005, .000 — 15.997
cd: 1.256, .001 — 1.257
cd: .743, 3.878, .013, .007 — 4.641, 1.257, −3.384
ce: 2.535, .011, .007, .001 — 2.554
ce: 9123, .948 — 10.121, 2.554, −7.567
cf: 4.055
cf: 49.017, 17.115, .051, .024, .004 — 66.211, 4.055, −62.156
cs: 4.009, .031 — 4.040
cs: 45.718, 15.336, .056, .016 — 61.126, 4.040, −57.086

dd de de df df ds ds ee ef ef es es ff +fs −bf

dd: .141, .159, 11.594, .021, .010, .001 — 11.926
de: .203, .004 — .207
de: 1.027, 7.580, .018, .010, .014 — 8.635
df: 3.655, ~~3.255~~, .091, 34 — +3.781
df: .5489, 12.123, ~~.044~~, .006 — −17.648
ds: 8.285, .091 — +3.376
ds: 5.119, 11.886, .048, .024 — −17.172
ee: 7.502, .259, 4.956, .015, .009, .002 — +12.742
ef: 40.088, 4.676, 7.925, .071, 33, 10
es: 37.390, 4.190, 7.836, .078, .042, .038
ff: 214.240, 84.400, 12.674, 329, 111, .039 — +311.763
+fs −bf: +199.795, 75.628, 12.534, .362, .142, .158 — +288.335

(aa) = +15.997
(ab) ± 3.384
(ac) −7.567
(ad) −62.156
(as) −57.116

(bb) = +11.926
(bc) −8.431
(bd) −13.827
(bs) −13.716

(cc) = +12.742
(cd) +52.575
(cs) +49.319

(dd) +311.763
ds +288.355

	a	b	c	d	s	n	
(aa)	+15.997	−3.384	−7.567	−62.156	−57.116	+7.157	
lg(aa)	1.20404	0.52943n	0.87887n	1.79348n	1.75672n	0.85473	
(bb)		+11.926	−8.431	−13.827	−13.716	−19.774	
lg ab/aa (ab)		+.715	+1.601	+13.148	+12.086	−1.514	
bb1		+11.211	−10.032	−26.975	−25.799	−18.260	
lg bb1		1.04964	1.00139n	1.43096n	1.41157n	1.26150n	
cc		~~+12.742~~	+12.742	+52.575	+49.319	+14.396	
ac/aa (ac)(ad) cc1			+3.580	+29.404	+27.018	−3.386	
bc/bb1 bc1			+9.182	+23.171	+22.301	+19.782	
cc2			+8.977	+24.140	+23.054	+16.340	
			+0.185	−0.969	−0.783	+1.442	
log cc2			9.26717	9.98632n	9.89376n	0.15897	
dd				+311.763	+288.355	+8.724	+8.724
ad/aa ad				+241.503	+221.904	−27.81	−27.808
dd1				+70.260	+66.451	+11.501	+36.532
bd1/bb1 bd1				+64.506	+62.072	+43.937	+43.937
dd2				+5.354	+4.379	−32.432	−7.405
cd2/cc2 cd2				+5.075	4101	−7.583	−7.553
dd3				+.279	+278	−24.879	+0.148
log dd3							

	ns	nn
	+10.503	+64.717
log Ω	~~1.02131~~	~~1.81109~~
an/aa as an	+25.551	
ns1	−15.048	
bn1 bs1 bn1/bb1	+42.018	
ns2	−57.066 61.03	
nn3	3.56	

log dn3 9.17026
− lg dd3 9.44560n
lg dY/π 9.72466n
dY/π −0.53

dY cd2 +0.51
π cn2 +1.44
sum +1.95
lg Ω 0.29003
− lg cc2 9.26717n
lg dφ 1.02286n
dφ −10.54

dY bd1 +1.431
π dφ bc1 +10.574
bn1 −18.26
Sum +10.179
log sum 2.00771
− lg bb1 1.04964n
lg dlga .95807n
dlga −9.08

dY ad +3.297
dφ ac +7.977
dlga ab +30.73
an +7.16
Sum +50.63
log Ω 2.17791
− log aa 1.20404n
lg dL1 .97387n
dL1 −9.42

dY/π = −0.53"
dφ = −10.54
dloga = −9.08
dL1 = −9.42
dΩ' = −1.78
di' = −4.38

	n	a	b	c	d	e	f	s	u
(aa)	−2.140	+1.522	−1.055	−0.118	+137	−178	4792	+1.080	−2.022
log(aa)	0.33041n	0.18242	0.02325n	9.07188n	9.13672	9.25042n	9.88762	0.03342	0.30146n
(bb)		+5.756	+1.568	+0.141	−0.213	+0.197	−792	−154	+5.273 ~~+7.157~~
(ab)(ab)/(aa)		+1.483	+.731	+.082	−.095	+.123	−.535	−.749	+1.388
bb₁		+4.273	+0.837	+.059	−0.118	+.074	−.258	+.595	+3.885
log bb₁		0. ~~63769~~ .63070	9.92272	8.77085	9.07188n	9.86923	9.40993n	9.77452	0.58939
(cc)		−2.122	−2.122	+15.997	−3.384	−7.567	−62156	−57.086	+7.157
ac ac/aa		+.158	+.166	+.091	−.011	+.014	−.060	−.084	+.155
cc₁		−2.280	−2.288	+15.988	−3.373	−7.581	−62096	−57003	+7.002
b₁c b₁c/bb₁		+.306	+.301	+.000	−.008	+.005	−.018	+.042	+.274
cc₂		−2.586	−2.589	+15988	−3.365	−7.586	−62078	−57045	+6.728
log cc₂		0.41263n	.41313n	1.20379	0.52699n	0.88001n	1.79294n	1.75619n	0.82789
dd		−17.830	−17.830		+11.926	−8.431	−13827	−13.792	−19.734
ad ad/aa		−.184	−.193		+.012	−.016	+.069	+.097	−.140
dd₁		−17.646	−17.637		+11.914	−8.415	−13896	−13888	−19.594
b₁d b₁d/bb₁		−.612	−.602		+.017	−.010	+.036	−.084	−.547
dd₂		−17.034	−17.035		+11.897	−8.405	−13932	−13.805	−19.047
c d₂ c d₂/cc₂		+.544	+.545		+.708	+1.596	+13066	+12.006	−1.416
dd₃		−17.578	−17.580		+11.189	−10001	−26.998	−25.810	−17.631
log dd₃		1.24497n	1.24502n		1.04879	1.00004n	1.43133n	1.41179n	1.24628n
ee		+16.990	+16.990			+12.742	+52575	+49.338	+14.396
ae ae/aa		+.239	+.250			+.021	−.090	−.126	+.234
ee₁		+16.751	+16.740			+12.721	+52665	+49.464	+14.162
b₁e b₁e/bb₁		+.384	+.378			+.007	−.023	+.053	+.343
ee₂		+16.367	+16.362			+12.714	+52.688	+49.411	+13.819
ce₂ ce₂/cc₂		+1.227	+1.228			+3.599	+29455	+27.065	−3192
ee₃		+15.140	+15.134			+9.115	+23.233	+22346	+11.011
de₃ de₃/dd₃		+15.676	15.714			+8.939	+24.132	+23.070	+9.759
ee₄		−0.536	−.580			+.176	−0.899	−0.728	+1.252
log ee₄		9.72916n	9.76343n			9.24551	9.95376n	9.85914n	0.09760
ff		+54.493	+54.493				+311.763	+288.335	+8.724
af af/aa		−1.035	−1.085				+.392	+.548	−1.015
ff₁		+55.528	+55.578				+311.371	+287.787	+9.739
b₁f b₁f/bb₁		−1.333	−1.312				+.079	−.183	−1.193
ff₂		+56.861	+56.890				+311.292	+287.970	+10.932
cf₂ cf₂/cc₂		+10.041	+10.053				+241.042	+221.485	−26.124
ff₃		+46.820	+46.837				70.250	+66.485	+37.056
df₃ df₃/dd₃		+42.414	+42.420				+65.144	+62.278	+42.542
ff₄		+4.406	+4.417				+5.106	+4.207	−5.486
ef₄ ef₄/ee₄		+2.738	+2.963				+4.592	+3.693	−6.395
ff₅		+1.668	+1.454				+.514	+.514	+0.909
log ff₅		0.22220	0.16256				9.71096		9.95856

	ns	nn
	+13.773	+64.757
an as/aa	+1420	+2.633
sn₁ nn₁	+15.193	+62.124
b₁n₁ b₁s₁/bb₁	+2.762	+18.033
sn₂ nn₂	+12.431	+44.091
cn₂ cs₂/cc₂	−24.004	+2.831
sn₃ nn₃	+36.435	+41.260
dn₃ ds₃/dd₃	+40.671	+27.786
sn₄ nn₄	−4.236	+13.474
en₄ es₄/ee₄	−5.143	+8.906
sn₅ nn₅	+.907	+4.578
fn₅ fs₅/ff₅		1.58
nn₆		+2.99
	+55.147	+63.11
	−1.444	+2.32
	+56.594	60.88
	+3.087	22.52
	+53.507	+37.86
	+9.226	+0.42
	+44.281	+37.44
	+40.548	27.61
	+3.733	+9.83
	+2.201	+1.67
	+1.532	+8.20
		5.41
		+2.8
	+55.147	+63.11
	−1.518	3.01
	+56.665	+60.10
	+3.038	+21.81
	53.627	38.29
	9.237	.42
	44.390	+37.87
	40.553	27.62
	+3.837	+10.25
	2.383	+1.91
	1.454	+8.34
		4.11
		+4.23

log fn₅ 9.95856
− log ff₅ 9.71096
log dχ/10 .24760n
dχ/10 − 17.67

dχ/10 ef₄ +1.590
en₄ +1.252
sum 2.842
log do 0.45362
− log ee₄ 9.24551
log dφ 1.20811
dφ −16.15

dχ/10 df₃ +47.746
dφ de₃ +61.492
dn₃ −17.631
sum +91.607
log do 2.28241
− log dd₃ 1.04879n
log d log a 1.23362n
d log a −17.124

dχ/10 cf₂ +109.785
dφ ce₂ +122.497
d log a cd₂ +57.625
cn₂ +6.728
sum +296.635
log do 2.47222
− log cc₂ 1.20379n
log dL₁ 1.26843
dL₁ −18.55

dχ/10 bf₁ +0.454
dφ be₁ −1.195
d log a bd₁ +2.021
dL₁ bc₁ −1.095
bn₁ +3.885
sum +4.070
log do 0.60959
− log bb₁ 9.92272
log di′ 0.68687n
di′ −4.86

dχ/10 af −1.365
dφ ae +2.574
d log a ad −2.346
dL₁ ac +2.189
di′ ab +5.130
an −2.002
sum +4.480
log do 0.65128
− log aa 0.18242
log dΩ′ .46886n
dΩ′ − 2.94

dχ/10 = −17.67
dφ = −16.15
d log a = −17.12
dL₁ = −18.55
di′ = −4.86
dΩ′ = −2.94

0 = −1.50 − 62.14 − 64.2 + 44.23 + 25.88 = +0.05 ″ .00 (nn)
+3.20 − 34.56 + 58.83 + 08.22 + 16.25 = −0.06 .00
+5.10 − 21.13 + 58.31 − 35.95 − 6.30 = +0.03 .00

~~0 = +0.4 + 4.45 − 14.6 − 15 + 2.32 − 2.19~~
0 = +0.40 + 2.70 − 3.85 − 7.65 + 2.47 − 2.60 + 1.01 = −0.92 .85
+5.10 + 0.81 − 4.70 − 1.34 + 1.75 − 1.58 + 0.59 = + 0.64 .39
−0.30 − 2.30 + 0.40 + 0.31 + 0.51 + .78 + 0.35 = + 0.89 − .88

2.04

log cos i' 9.93084
cos i' .8528
1 − cos i' .1472
log (1 − cos i') 9.16791
log dΩ' 46886_n
log (1 − cos i') dΩ' 9.63677_n
dχ -0.43_n −17.67
dπ' −18.10
dΩ' −254
dω' −15.17

dL = ~~−1855~~ −1858
(1 − cos i') dΩ' −43
dL' −1898
dπ' −1810
dM ~~−0.88~~ −0.88

log Const. 7.76609_n
log dlog a 1.23362_n
log dμ 8.99971
dμ +.09993
μ 801.93940
802.03933
log μ 2.9041956
log b 3.5500066
log a .4305406

log M 4.32335
log dlog a 1.23362_n
log dlog a 5.55697_n
dlog a −.0000360
4305766
log a .4305406

log cos i' 9.93084
log dΩ' 46886_n
log cos i' dΩ' 0.39970_n
−cos i' dΩ' + 251
dχ −17.67
dω' −15.16

Corrected.

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

nn	+na	−na	+nb	−nb	+nc	−nc	+nd	−nd	+ne	−ne	+nf	−nf	+nδ	−nδ
2.25						5.023		.562	4.108		21.884		20.477	
3.24						3.353	.718		916		16.537		14.878	
26.01					5.809			17.366	11.353		18.156		17.552	
16		−366	312		036			058	050			230		252
31.36		−1.546	5.415		403			571	549			1.865	2.381	
09		234	025		006		009		014			039		235
63.11		−2.140	+5.756			−2.122		−17.830	+16.990		+54.453		+55.147	

log fn5 .16256
log ff5 9.71096_n
log dχ/10 0.45160_n
dχ/10 −28.288

dχ ef4 ~~16258~~ + 2.548
10 ... e4 + .580
Sum +1.963
log do 0.29292
−log ee4 9.24551_n
log dφ 1.04741_n
dφ −11.15

dχ df3 +76.371
dφ/10 de3 +111.547
dn3 −17.580
Sum +170.338
log do 2.23132
−log dd3 1.04879_n
log dlog a 1.18253_n
dlog a −15.22

dχ cf2 +175.608
dφ ce2 +84.610
dlog a cd2 +51.230
dn2 −2.589
Sum +308.859
log sum 2.48976
−log cc2 1.20379_n
log dL 1.28597
dL1 = −19.31

dχ bf1 +.727
dφ be1 −.825
dlog a bd1 +1.786
dL bc1 −1.140
dn1 +4.273
Sum +4.831
log Do 0.68404
−log bb1 9.92272_n
log di' 0.76132_n
di' −.577

dχ af −2184
dφ ae +1.985
dlog a ad −2086
dL ac +2280
di' ab +6.089
an −2.140
Sum +3.944
log do 0.59594
−log aa 18242_n
log dΩ' $.41352_n$
dΩ' −2.59

0 = −1.50 − 64.70 − 5.71 + 30.55 + 41.40 = +.05″

0 = −1.80 − 35.99 + 6.07 + 5.68 + 25.99 = −.05″

0 = +5.10 − 22.00 + 51.84 − 24.83 − 10.07 = +.04″

0 = + 0.40 + 2.73 − 4.57 − 1.72 + 2.19 − 1.38 + 1.63 = −0.72″

+ 5.60 + 0.71 − 5.58 − 1.89 + 1.55 − 1.09 + 0.94 = +0.74

− 0.30 − 2.02 + .47 + .39 + .46 + .53 − .56 = −1.01

log (1 − cos i') 9.16791
log dΩ' 41352_n
log (1 − cos i') dΩ' 9.58143_n
(1 − cos i') dΩ' − 0.38
dχ − 28.29
dπ' − 28.67
dΩ' − 2.59
dω' − 26.08

cos i' 9.93084
dΩ' 41352_n
$.34436_n$
− cos i' dΩ' + 2.21
dχ − 28.29
dω' − 26.08

dL − 19.31
(1 − cos i') dΩ' − 38
dL' = − 19.69
dπ = − 28.67
dM + 8.98

log C = 7.76609_n
log dlog a 1.18253_n
log dμ 8.94862
dμ +0.088843
μ_0 801.939400
μ +802.028243
log μ 2.9041897
3.5500066
0.6458169
2152723
log a .4305446

log M 4.32335
log dlog a 1.18253_n
550588_n
− .0000321
4305766
log a .4305445

log ~~sin cos~~ Ω'	1869 Oct 31	1870 Jan 26	1871 Mar 24
M_0	343 57 51.90	3 21 26.10	97 22 38.70
dM_0	+ 8.50	+ 8.50	+ 8.50
cor for $d\mu$	+ .18	+ 7.90	45.39
M	343 58 00.98	3 21 42.90	97 23 32.99
Ω'_0	181 19 17.80	181 19 25.60	181 19 26.10
$d\Omega'$	− 2.59	− 2.59	− 2.59
Ω'	181 19 15.21	181 19 23.01	181 19 23.51
ω'_0	54 50 45.60	54 49 57.80	54 48 10.50
$d\omega'$	− 26.08	− 26.08	− 26.08
ω'	54 50 19.52	54 49 31.72	54 47 44.42
i'_0	31 29 1.90	31 28 58.10	31 28 56.60
di'	− 5.77	− 5.77	− 5.77
i'	31 28 56.13	31 28 52.33	31 28 50.83
φ_0	17 28 17.10	17 28 22.90	17 27 7.80
$d\varphi$	− 11.15	− 11.15	− 11.15
φ	17 28 5.95	17 28 11.75	17 26 56.65
μ_0	801.93940	801.86320	802.39630
	+ .08884	.08884	.08884
μ	802.02824	801.95204	802.48514
$\log a_0$	.4305766	.4306039	.4304115
$d\log a$	− 321	− 321	− 321
$\log a$	.4305445	.4305718	.4303794
$\log\sqrt{a}$	.2152722	.2152859	.2151897
log sin Ω'	8.3626961n	8.3634175n	8.3634634n
cos i'	9.9308481	9.9308531	9.9308550
cos Ω'	9.9998846n	9.9998842n	9.9998842n
sin i'	9.7178655	9.7178526	9.7178473
− lg cos Ω'	9.9998846	9.9998842	9.9998842
cos i' sin Ω'	8.2935442n	8.2942706	8.2943184
log A	1.7063404n	1.7056136n	1.7055658
A	−88 52 24.64	−88 52 17.86	88 52 17.47
A	91 07 35.36	91 07 42.14	91 07 42.59
lg a	9.9999685	9.9999684	9.9999684
− sin Ω'	8.3626961	8.3634175	8.3634634n
cos i' cos Ω'	9.9307327n	9.9307373n	9.9307392
tan B	8.4319634	8.4326802	8.4327242
B	1 32 55.49	1 33 4.69	1 33 5.26
log b	9.9308914	9.9308965	9.9308971
A+ω'	145 57 54.88	145 57 13.86	145 55 27.01
B+ω'	56 23 15.01	56 23 36.41	56 20 49.68
ω'	54 50 19.52	54 49 31.72	54 47 44.42
log a	9.9999685	9.9999684	9.9999684
log b	9.9308914	9.9308965	9.9308971
lg c	9.7178655	9.7178526	9.7178473

	Oct 31	Jan 26.	Mar 24
sin φ = e	9.4773795	9.4774182	9.4769156
e	.3001784	.3002052	.2998580
4e			
1−ε	6998216	6997948	7001420
lg(1+ε)	.1140029	.1140119	.1138958
lg(1−ε)	9.8449873	9.8449707	9.8457862
lg√(1+ε)	.0570014	.0570059	.0569479
lg √a	.2152722	.2152859	.2151897
lg√(1−ε)	9.9224936	9.9224853	9.9225931
lg√(1+ε) a	.2722736	.2722918	.2721376
lg√(1−ε) a	.1377658	.1377712	.1377828
lg e	9.4773795	9.4774182	9.4769156
lg const	5.3144251	5.3144251	5.3144251
lg e''	4.7918046	4.7918433	4.7913407

1869 1870 1871 1873

9.4756885
.2980189
.1136155
9.8457062
.0568077
.2153245
9.9228531
.2721352
.1381806
9.4756885
5.3144251
4.7901236

1869 1870 1871 1873

8.3639945n
9.9308622
9.9998839n
9.7178282

9.9998839
8.2948567
1.7050272
88 52 12.37
9.9999684
91 07 47.63

8.3639945
9.9307461
8.4332484
1 33 12.00
9.9309057
145 56 27.91
56 21 52.28
54 48 40.28

9.9999684
9.9309057
9.7178282

fr. Nash M.N.

	M	Ω'	ω'	i'	φ	μ	log a
1869	343 58 0.98 + 0.79 + .05 343 58 1.82	181 19 15.21 + 2.71 19 17.92	54 50 19.52 − 7.88 50 11.64	31 28 56.13 + 2.86 28 58.99	17 28 5.95 − 3.80 28 2.15	802.02824 + .02727 802.05551	4305445 − 58 4305387
1870	3 21 42.90 + 0.79 + 2.40 3 21 46.09	19 23.01 + 2.71 19 25.72	54 49 31.72 − 7.88 49 23.84	31 28 52.33 + 2.86 28 55.19	17 28 11.75 − 3.80 28 7.95	801.95204 + .02727 801.97931	4305718 − 58 .4305620
1871	97 23 32.99 + 0.79 + 13.93 97 23 47.71	19 23.51 + 2.71 19 26.22	54 47 44.42 − 7.88 47 36.54	31 28 50.83 + 2.86 28 53.69	17 26 56.65 − 3.82 26 52.85	802.48514 + .02727 802.51241	4303794 − 58 .4303696
1873	292 57 21.11 + 0.79 37.85 292 57 57.75	19 26.63 + 2.71 19 29.34	~~54~~ 48 48.16 − 7.88 48 40.28	31 28 42.40 + 2.86 28 45.26	17 23 59.05 − 3.82 23 55.25	801.69523 + .02727 801.72250	430 6648 − 58 .4306550

	1869 Oct 31	1870 Jan 26	1871 Mar 24	1869 Oct 31.0	1870 Jan 26.0	1871 Mar 20.0	1873 Aug 17.0
	° ′ ″						
M	343 58 09.8	3 71 42.90	57 23 33.00				292 51 59.75
E	337 20 28.14	4 48 06.25	113 11 7.83				275 49 20.89
log sin E	9.5857351n	8.9227693	9.9634266				9.9977537n
log e″	4.7918046	4.7918433	4.7913407				4.7901236
log e sin E	4.3775898n	3.7146105	4.7547673				4.7878773
e sin E	−6 37 32.84	1 26 23.35	15 47 34.82				17 02 38.86
E	337 20 28.16	4 48 6.25	113 11 07.82				275 44 20.89
½E	168 40 14.08	2 24 3.12	56 35 33.91				137 54 40.44
log sin ½E	9.2932514	8.6221183	9.9215711				9.8262570
cos ½E	9.9914538n	9.9996186	9.7408254				9.8704667
log √a sin ½v	9.5655250	8.8944101	.1937087				.0583782
√a cos ½v	.1252196n	.1373898	9.8786082				.0086073
log tan ½v	9.4363054n	8.7570203	0.3151005				.0877449
½v	−15 16 28.01	3 16 15.33+	64 10 12.78				50 52 41.74+
½v	164 43 31.99	6 32 30.67	128 20 25.56				~~128 45 23.49~~
v	329 27 3.98						208 14 36.50
log r	.2896772	.2761959	.4788432				~~.4180575~~ .4172768
u+A+ω′	115 24 58.86	152 29 44.53	274 15 52.56				44 11 44.2
u+B+ω′	25 50 18.99	62 55 7.08	184 41 15.24				314 36 28.79
u+ω′	24 17 23.50	61 22 2.39	183 08 9.98				313 03 16.59
log a sin(u+A+ω′)	9.9557901	9.6644683	9.9987959n				9.8432153
log r a	.2896457	.2761643	.4788116				.4172452
log b sin(u+B+ω′)	9.6393248	9.9496661	8.9123402n				9.8024360
log r b	.2205686	.2070924	.4097403				.3481825
log c sin(u+ω′)	9.6142147	9.9433510	8.4380511n				.8637407
log r c	.0075427	9.9940485	.1966905				.1351050
x	+1.7596884	+.8722338	−3.0033607				
x′	−.7780980	+.5875179	+.8956787				
y	+.7242582	1.4843614	−.2099329				
y′	−.5644970	−.7251686	+.0580250				
z	+.4185597	.8657640	−.0860482				
z′	−.2449340	−.3146502	+.0251744				
log Δ cos δ cos α	9.9519304	.1642788	.3026950n				
log Δ cos δ sin α	9.2034719	9.8508655 31	9.1815805n				
log tan α	9.2115409	9.6866455 44	9.8788855n				
α	9 14 39.39	25 54 42.74	184 19 37.00				
α	24.80	−8.58	−5.37				
Δα							
α C	9 15 4.18	25 54 33.76	184 19 31.63				
α O	9 15 4.00	34.50	32.60				
Δα(C−O)	+.18	−0.74	−0.97				
log Δ cos δ	9.9976076	.2102933	.3039346				
log Δ sin δ	9.2396097	9.7412418	8.7844305n				
log tan δ	9.2420001	9.5309480	8.4804959n				
δ	9 54 10.87	18 45 24.10	−1 43 54.31				
Δδ	+9.40	−5.73	+2.34				
δ(C)	9 54 20.27	18 45 18.37	−1 43 51.97				
δ(O)	21.80	17.60	50.40				
Δδ(C−O)	−1.53	+0.77	−1.57				

1878

	.00131	Jan 26	Mar 24	Aug 17
4ak(-υ)	+0.14	−0.79	−.97	+164.0"
4υ(c-υ)	−1.53	+0.97	−1.57	+25.8
lg sec θ	.00126	.00108	.0000	.00068
lg sin N	9.93192	9.94421	9.93107	9.57154
lg cos υ	9.99846	9.97630	9.99980	9.99650
lg 4a	9.14613	9.86990n	9.18677n	1.80618
lg I	9.07277	9.38393 .79076n	9.91764n	1.72422
lg sec θ	.00126	.00102	.0000	68
lg cos N	9.71458	9.67761	9.71727n	9.54456
lg 4υ	0.18470	9.88650	0.19592n	1.41162
lg II	9.90084n	9.57114 56513	9.91317	0.95618
I	+.12	−.62	−.83	+53.00
II	−.80	+.37	+.82	+9.04
dn	−.68	−.25	−.01	+62.04

−lg cos N	9.71498
" cos υ	9.99846n
" 4a	~~9.18470~~
~~lg I~~	~~8.83457~~
	8.89314
lg sin N	9.93192
lg 4υ	0.18470n
~~lg II~~	9. ~~94052~~
	.11662n
I	− .08
II	− 1.31
dθ	− 1.38

Formulae for
conversion from
Equator to Ecliptic.

Form… …m Equator to Ecliptic

$\cos\frac{1}{2}i'\sin$ … $-\varepsilon)$ ~~$\sin(180-i) = \frac{\sin i'\sin\Omega}{\sin(\Omega-n)}$~~

$\cos\frac{1}{2}i'\cos$ … $\varepsilon)$

$\sin\frac{1}{2}i'\sin$ … $\varepsilon)$

$\sin\frac{1}{2}i'\cos\frac{1}{}$ … $\varepsilon)$

Ω'	121	19	15.21
½ Ω'	60	39	37.60
i'	31	28	56.13
ε	23	27	22.16
i'−ε	8	01	33.97
i'+ε	54	56	18.29
½(i'+ε)	27	28	9.14
½(i'−ε)	4	00	46.98

$\cos\frac{1}{2}(i'-\varepsilon)$	9.9989339
C $\cos\frac{1}{2}(i'+\varepsilon)$	.0519497
$\tan\frac{1}{2}\Omega'$	1.9382671n
$\sin\frac{1}{2}(i'-\varepsilon)$	8.8449968
C $\sin\frac{1}{2}(i'+\varepsilon)$	0.3360431
$\tan\frac{1}{2}(\Omega-n+a)$	1.9891507n
$\tan\frac{1}{2}(\Omega-n-a)$	1.1193070n

½(Ω−n+a) − 89 24 45.25   90 35 14.75

½(Ω−n−a) − 85 39 18.27   94 20 41.73

Ω−n   184 55 56.48

Ω   4 55 56.48

4   356 14 33.02

sin i'	9.7178615		
sin Ω'	8.3626961		
C sin(Ω−n)	1.0656048		
sin(180−i')	9.1461664		
180−i'	187	58	13.10
i'	7	58	13.10
ε	23	27	22.16
i'+ε	31	25	35.26
(i'−ε)	15	29	9.06
½(i'+ε)	15	42	47.63
½(i'−ε)	−7	44	34.53

$\sin\frac{1}{2}\Omega'$ 9.9995712
$\cos\frac{1}{2}(i'-\varepsilon)$ 9.99893~~3~~8
9.9989081
8.0097543
1.9891538
89 24 45.25

$\cos\frac{1}{2}\Omega'$ 8.0617040
$\cos\frac{1}{2}(i'+\varepsilon)$ 9.9480503
8.0097543

4	356	14	33.02
ω'	54	50	19.52
ω	61	04	52.52
Ω	4	55	56.48
π	56	00	49.00

$\sin\frac{1}{2}\Omega'$ 9.9995712
$\sin\frac{1}{2}(i'-\varepsilon)$ 8.8449968
8.8449680
7.7256609
1.1193071
85 39 18.27

$\cos\frac{1}{2}\Omega'$ 8.0617040
$\cos\frac{1}{2}(i'+\varepsilon)$ 9.6639569
~~7.9423970~~
7.7256609

½i' 4 ~~01 27.73~~ 05 21.2
~~8 1 44.24~~
i' 8 2 55.46

1878

	.00131	Jan 26	Mar 24	Aug 17
$4\alpha(c-o)$	+0.14	−0.79	−.09	+164.0"
$4\delta(c-o)$	−1.53	+0.97	−1.57	+25.8

lg sec θ	00126	00108	.0000	00068
lg sin N	9.93192	9.94421	9.93107	9.97154
lg cos δ	9.99846	9.97630	9.99980	9.99650
lg 4α	9.14613	9.86923n	9.88677n	1.80618
lg I	9.07277	9.38393 .79076n	9.91764n	1.72422
lg sec θ	00126	00102	.0000	68
lg cos N	9.71498	9.67761	9.71727n	9.54456
lg 4δ	0.18470	9.88650	0.19590n	1.41162
lg II	9.90094n	9.57114 56513	9.91317	0.95618
I	+ .12	− .62	− .83	+53.00
II	− .80	+ .37	+ .82	+9.04
dα	− .68	+.25	−.01	+62.04

−lg cos N	9.71498n	9.67761	9.71727	9.54456n
" cos δ	9.99846n	9.97630n	9.99980	9.99650
" 4α	~~9.14470~~	9.86923	9.88677n	1.80618
lg I	~~8.85457~~ 8.89314	~~9.71163~~ 9.52314	9.70384n	1.25724n
lg sin N	9.93192	9.94421	9.93107n	9.97154
lg 4δ	.18470n	9.88650	.19590n	1.41162
lg II	~~9.94052~~ .11662n	~~9.77670~~ .83071	.12697n	1.38316
I	− .07	+ .33	− .51	−19.83
II	− 1.31	+ .68	− 1.34	+24.16
dθ	−1.38	+1.01	−1.85	+4.33

Formulae for conversion from Equator to Ecliptic

$$\cos\tfrac12 i\,\sin\tfrac12(\Omega-n+A)=\sin\tfrac12\Omega'\cos\tfrac12(i'-\varepsilon)$$

~~$\sin(180-i)=\frac{\sin i'\sin\Omega'}{\sin(\Omega-n)}$~~

$$\cos\tfrac12 i\,\cos\tfrac12(\Omega-n+A)=\cos\tfrac12\Omega'\cos\tfrac12(i'+\varepsilon)$$

$$\sin\tfrac12 i\,\sin\tfrac12(\Omega-n-A)=\sin\tfrac12\Omega'\sin\tfrac12(i'-\varepsilon)$$

$$\sin\tfrac12 i\,\cos\tfrac12(\Omega-n-A)=\cos\tfrac12\Omega'\sin\tfrac12(i'+\varepsilon)$$

Ω'	181	19	15.21
$\frac12\Omega'$	90	39	37.60
i'	31	28	56.13
ε	23	27	22.16
$i'-\varepsilon$	8	01	33.97
$i'+\varepsilon$	54	56	18.29
$\frac12(i'+\varepsilon)$	27	28	9.14
$\frac12(i'-\varepsilon)$	4	00	46.98

$\cos\frac12(i'-\varepsilon)$	9.9989339
C $\cos\frac12(i'+\varepsilon)$	.0519497
$\tan\frac12\Omega'$	1.9382671n
$\sin\frac12(i'-\varepsilon)$	8.8449968
C $\sin\frac12(i'+\varepsilon)$	0.3360431
$\tan\frac12(\Omega'-n+A)$	1.9891507n
$\tan\frac12(\Omega'-n-A)$	1.1193070n

$\frac12(\Omega'-n+A)$ −89 24 45.25 90 35 14.75

$\frac12(\Omega'-n-A)$ −85 39 18.27 94 20 41.73

$\Omega'-n$	184	55	56.48
Ω	4	55	56.48
A	356	14	33.02

$\sin i'$	9.7178615		
$\sin\Omega'$	8.3626961		
C $\sin(\Omega-n)$	1.0656048		
$\sin(180-i')$	9.1461664		
$180-i'$	187	58	13.10
i'	7	58	13.10
ε	23	27	22.16
$i'+\varepsilon$	31	25	35.26
$(i'-\varepsilon)$	−15	29	5.06
$\frac12(i'+\varepsilon)$	15	42	47.63
$\frac12(i'-\varepsilon)$	−7	44	34.53

$\sin\frac12\Omega'$ 9.9999712
$\cos\frac12(i'-\varepsilon)$ 9.9989338
9.9989051
8.0097543
1.9891508
89 24 45.25

$\cos\frac12\Omega'$ 8.0617040
$\cos\frac12(i'+\varepsilon)$ 9.9480503
8.0097543

A	356	14	33.02
ω'	54	50	19.52
ω	61	04	52.52
Ω	4	55	56.48
π	56	00	49.00

$\sin\frac12\Omega'$ 9.9999712
$\sin\frac12(i'-\varepsilon)$ 8.8449968
8.8449680
7.7256609
1.1193071
85 39 18.27

$\cos\frac12\Omega'$ ~~8.0617040~~
$\sin\frac12(i'+\varepsilon)$ 9.6639569
~~7.9423970~~
7.7256609
$\frac12 i$ 4 01 27.73 ~~05 24.2~~
~~8 1 44.24~~
i 8 2 55.46

Corrected Elements of 3.0 Mar. 1869

$\quad\quad\quad\quad\ \ 54\ \ 39.48$ B. M. T.

$M\quad 343^\circ\ 58\ \ 0.98$

$\pi\quad 56\ \ 00\ \ 49.00$ } $+50.24t$

$\Omega\quad 4\ \ 55\ \ 56.48$ } $+49.49t$ Mean Eq. 1869.0

$i\quad 8\ \ 2\ \ 55.46$ } $+0.46t$

$\varphi\quad 17\ \ 28\ \ 5.95$

$\mu\quad 802.02824$

$\log a\quad .4305445$

$\Omega\quad 4\ \ 55\ \ 56.48$
$\Omega-\omega\ \ 184\ \ 55\ \ 56.48$
$\frac{1}{2}(\Omega-\omega)\ \ 92\ \ 27\ \ 58.24$

$i\quad 8\ \ 02\ \ 55.46$
$\varepsilon\quad 23\ \ 27\ \ 22.16$

$i+\varepsilon\quad 31\ \ 30\ \ 17.62$
$i-\varepsilon\quad -15\ \ 24\ \ 26.70$
$\frac{1}{2}(i+\varepsilon)\quad 15\ \ 45\ \ 08.81$
$\frac{1}{2}(i-\varepsilon)\quad -7\ \ 42\ \ 13.35$

$\sin\frac{1}{2}(\Omega-\omega)\quad 9.9995575$
$\sin\frac{1}{2}(i+\varepsilon)\quad 9.4337404$
9.4333379
8.7610355
0.6723024

$\cos\frac{1}{2}(\Omega-\omega)\quad 8.6307676_n$
$\sin\frac{1}{2}(i-\varepsilon)\quad 9.1272679$
8.7610355

$\sin\frac{1}{2}(\Omega-\omega)\quad 9.9995575$
$\cos\frac{1}{2}(i+\varepsilon)\quad 9.9833753$
9.9829728
8.6298301
1.3531427

$\cos\frac{1}{2}(\Omega-\omega)\quad 8.6307676_n$
$\cos\frac{1}{2}(i-\varepsilon)\quad 9.9960625$
8.6298301

$\frac{1}{2}(\Omega'+\omega)\quad 88\ \ 46\ \ 54.11$
~~87 13 00.88~~
$\frac{1}{2}(\Omega'-\omega)\quad 87\ \ 27\ \ 38.81$
$92\ \ 32\ \ 21.09$
$\Omega'\quad 181\ \ 19\ \ 15.20$
$\omega\quad$ ~~354 55 17.82~~
$356\ \ 14\ \ 33.02$

$\sin\frac{1}{2}i'\quad 9.4334361$
$\frac{1}{2}i'\quad 15\ \ 44\ \ 28.08+$
$i'\quad 31\ \ 28\ \ 56.17$

$56\ \ 00\ \ 49.00$
$4\ \ 55\ \ 56.48$
$51\ \ 04\ \ 52.52$

Integration for May 26.0 1872

dM		ω∫∫dμ		dL₁		40dμ		di		dΩ		dφ		dπ	
J	h	J₁	h	J₁	h	J₁	h	J₁	h	J₁	h	J₁	h	J₀	h
+145.622	+16.684	+234.011	+12.361	+3.130	+2.980	+0.7944	+.4836	−12.343	−0.264	−95.181	−4.460	−159.359	4.506	−142.499	−13.687
−.142	+.006	−.131	−.134	+.056	+.016	−.0018	.0012	−.007	.000	.000	−.013	−.014	+.006	+.198	+.001
+145.480	+16.680	+233.880	+12.227	+3.186	+2.996	+.7926	.4848	12.350	−.264	−95.181	−4.473	−159.373	4.500	−142.301	−13.686
+233.880	+12.227			~~379.360~~	~~28.907~~	+.01981	+.01212	.264		4.473		4.500		13.686	
12.277				233.880	12.227	.01212		12.614		99.654		160.873		155.987	
+379.360	+28.907			237.066	15.223	+.03193									
246.157															

Integration for Aug 9.0 1872 = 2 M T

dM		ω²∫∫dμ		dL₁		40dμ		di		dΩ		dφ		dπ		dω
J₁	h	J₁	h	J₁	h	J₁	h	J₀	h	J₁	h	J₁	h	J₁	h	
+217.169	+6.829	+157.499	+10.069	−50.148	−7.741	−13.0552	−.2443	−13.029	−.297	−132.827	−17.188	−233.753	−13.104	−267.322	−14.578	
+.131	+.005	+.023	−.052	+.007	−.021	−.0182	−.0028	.000	.000	−.035	−.018	−.038	−.004	−.124	−.025	
+217.300	+6.834	+157.512	+10.017	−50.141	−7.762	−13.0734	−.2471	−13.029	−.297	−132.862	−17.216	−233.791	−13.108	−267.446	−14.603	
+157.512	+10.017			157.512	+10.017	−.32683	−.00618									
374.812	+16.851			+107.371	+2.255	−1.33205		−13.326								
				729.626												

+391.663

+6 31.66

−57.903 −.33301 −13.326 −150.078 −246.899 −282.049

−57.903 dμ −.33301 −13.326 −2 30.08 −4 06.90 −4 42.05

343 58 0.88

157.51

344 04 32.64 802.02824 8 2 55.46 4 55 56.48 17 28 8.95 56 00 49.00

306 59 54.91 801.69523 8 02 42.13 4 53 26.90 17 23 59.05 55 56 6.95

+1.84 +3 17.96 + 3 20.96

291 04 27.55 801.69523 8 02 43.97 4 56 44.36 17 23 59.05 + 55 59 27.91

27.55

Ω 4 56 44.36
Ω−u 184 56 44.36
½(Ω−u) 92 28 22.18

i 8 02 43.97
ε 23 27 20.31
i+ε 31 30 4.28
i−ε −15 24 36.34

½(i+ε) 15 45 2.14
½(i−ε) −7 42 18.17

sin ½(Ω−u) 9.9995954
sin ½(i+ε) ~~9.6349364~~
9.4336906
~~tg ½ Ω~~
9.4332860
9.7622793
tg ½(Ω′+a) 1.6710067
½(Ω′+a) 88 46 41.01

cos ½(Ω−u) 8.6349364
sin ½(i−ε) 9.1273429 n
9.7622793

sin ½(Ω−u) 9.9995954
cos ½(i+ε) 9.9833793
9.9829747
tg
8.6309976
tg ½(Ω′−A) 1.3519771
½(Ω′−a) −87 27 14.38
92 32 45.62
½(Ω′+a) 88 46 41.01
Ω′ 181 19 26.63
a 356 13 55.39
ω 51 02 43.55
ω′ 54 48 48.16

cos ½(Ω−u) 8.6349364
cos ½(i−ε) 9.9960612
8.6309976

sin ½ i′ 9.4333848
½ i′ 15 44 21.20
i′ 31 28 42.40

lg sin φ = lg e 9.4757240
e .2990363
1+ε
1−ε .7009637

lg(1+ε) .1136213
lg(1−ε) 9.8456955

lg √1+ε 0568106
lg √a 2153324
lg √1−ε 9.9228477

lg √(1+ε)a 2721430
lg √(1−ε)a 1381801

lg e 9.4757240
lg e 5.3144251
lg e″ 4.7901491

cos φ = 9.97966
cos² φ 9.95932
lg a .43066
.38998

sin Ω′ 8.3637477 n
cos i′ 9.9308659
cos Ω′ 9.9998840 n
sin i′ 9.7178184

lg cos Ω′ 9.9998840
~~8.3637477~~
cos i′ sin Ω′ 8.2946136 n
tang A .0691341
~~1.9052704~~
A −8852 1464
91 07 45.36
lg a 9.9999683

−sin Ω′ 8.3637477
cos i cos Ω′ 9.9307499 n
tang B 8.4329978
B 1 33 06.89
lg b 9.9309094

A+ω′ 145 56 33.52 lg a 9.9999683
B+ω′ 56 21 54.05 lg b 9.9309094
lg c 9.7178184
ω′ 54 48 48.16

lg a 9.9040094
lg b 3.5800066
~~.3540028~~
.6459972
2153324
4306648

W. M. T.

	Aug ~~13~~ 9	~~15~~ 11	~~17~~ 13	~~19~~ 15	~~21~~ 17	~~23~~ 19	~~25~~ 21	~~27~~ 23	~~29~~ 25	27
M	291 04 27.55	291 31 10.94	291 57 54.08	292 24 37.72	292 51 21.11	293 18 4.50	293 44 47.89	294 11 31.28	294 38 14.67	295 04 58.06
E	273 58 55.40	274 26 15.16	274 53 38.58	275 21 5.92	275 48 37.31	276 16 12.80	276 43 52.39	277 11 36.07	9.9961107	278 07 15.93
sin E	9.9989502	9.9986962	9.9984137	9.9981028	9.9977630	9.9973942	9.9969960	9.9965687	9.9961107	9.9956228
log e	4.7901491	4.7901491	9.7901491	4.7901491	4.7901491	4.7901491	4.7901491	4.7901491	4.7901491	4.7901491
log e sin E	4.7890993	4.7888453	4.7885628	4.7882519	4.7879121	4.7875433	4.7871451	4.7867174	4.7862598	4.7857719
e sin E	−17 05 31.76	−17 04 55.77	−17 04 15.79	−17 03 31.81	−17 02 43.78	−17 01 51.69	−17 00 55.50	−16 59 55.21	−16 58 50.76	−16 57 42.13
E	273 58 55.79	274 26 15.17	274 53 38.54	275 21 5.91	275 48 37.33	276 16 12.81	276 43 52.39	277 11 36.07	277 39 23.91	278 07 15.93
½E	136 59 27.90	137 13 7.58	137 26 49.26	137 40 32.95	137 54 18.66	138 8 6.40	138 21 56.19	138 35 48.03	138 49 41.95	139 03 37.96
sin ½E	9.8338558	9.8319983	9.8301212	9.8282245	9.8263078	9.8243708	9.8224132	9.8204349	9.8184354	9.8164144
cos ½E	9.8640644	9.8656679	9.8672625	9.8688483	9.8704252	9.8719937	9.8735528	9.8751084	9.8766452	9.8781783
√a sin ½v	.1059988	.1041413	.1022642	.1003675	.0984508	.0965138	.0945562	.0925779	.0905784	.0885574
√a cos ½v	.0022445	.0038480	.0054426	.0070284	.0086053	.0101738	.0117329	.0132835	.0148253	.0163584
tan ½v	.1037543	.1002938	.0968216	.0933391	.0898455	.0863400	.0828233	.0792944	.0757531	.0721990
½v	−51 46 47.57	−51 33 27.86	−51 20 04.23	−51 06 36.66	−50 53 5.12	−50 39 29.57	−50 25 50.00	−50 12 06.37	−49 58 18.64	−49 44 26.74
v, u	128 13 12.43	128 26 32.14	128 39 55.79	128 53 23.35	129 06 54.88	129 20 30.49	129 34 10.00	129 47 53.63	130 01 41.36	130 15 33.26
v	256 26 24.86	256 53 4.28	257 19 51.58	257 46 46.70	258 13 49.76	258 41 0.98	259 08 20.00	259 35 47.26	260 03 22.72	260 31 6.52
log r	.4215508	.4204982	.4194414	.4183798	.4173140	.4162438	.4151692	.4140904	.4130072	.4119196
u+Ω+ω	42 22 58.38	42 49 37.80	43 16 25.70	43 43 20.22	44 10 23.28	44 37 34.50	45 04 53.52	45 32 20.78	45 59 56.24	46 27 40.04
u+β+ω′	312 48 21.91	313 15 1.33	313 41 48.63	314 08 43.75	314 35 46.81	315 02 58.03	315 30 17.05	315 57 44.31	316 25 19.77	316 53 3.57
u+ω′	311 ~~755 726~~ 311 15 13.02	311 41 52.44	312 08 39.74	312 35 34.86	313 02 37.92	313 29 49.14	313 57 8.16	314 24 35.42	314 52 10.88	315 19 54.68
sin (u+Ω+ω)	9.8287126	9.8323742 ~~9.8492109~~	9.8359969 ~~9.8509875~~	9.8395808	9.8431261	9.8466334	9.8501021	9.8535331	9.8569265	9.8602824
log r a	.4215191	.4204656	.4194097	.4183481	.4172823	.4162121	.4151375	.4140587	.4129755	.4118879
sin (u+β+ω′)	9.8654935	9.8623509	9.8591414	9.8558664	9.8525233	9.8491096	9.8456253	9.8420669	9.8384331	9.8347217
log r b	.3529602	.3514076	.3503508	.3492892	.3482234	.3471532	.3460786	.3449998	.3439166	.3428290
sin (u+ω′)	9.8761013	9.8731244	9.8700856	9.8668837	9.8635172	9.8605839	9.8572832	9.8539126	9.8504706	9.8469560
log r c	.1393692	.1383166	.1372598	.1361982	.1351324	.1340622	.1329876	.1319088	.1308256	.1297380
x	~~+1.6517855~~	+1.7899453	+1.8005560	+1.8110415	+1.8214130	+1.8316629	+1.8417877	+1.8517902	+1.8616669	+1.8714159
X	~~+1.7792282~~ −.7423671	~~.7423671~~	−.7863508	−.8070202	.8267729	.8455826	−.8634233	.8802713	.8961042	.9109020
x′	+1.0368611	~~−.7647911~~ +1.0251542	+1.0142052	+1.0040207	+.9946401	.9860803	.9783644	.9715189	.9655627	.9605139
y	~~+1.6517855~~	−1.6359029	−1.6199150	−1.6038200	−1.5876205	−1.5713141	−1.5549050	−1.5383909	−1.5217724	−1.5050491
Y	+.6327527	+ ~~.6327527~~ .6098518	+.5858168	+.5605820	.5352083	.5092081	.4826248	.4554845	.4278194	.3996684
y′	−1.0190326	−1.0265211	−1.0340982	−1.0432380	1.0524172	1.0621060	1.0722802	1.0829064	1.0939539	1.1053858
z	−1.0362842	−1.0266939	−1.0170571	−1.0073538	.9975843	.9877480	.9778461	.9678798	.9578469	.9477998
Z	+.2745432	+ ~~.2745432~~ .2644034	+.2539629	+.2432321	.2322217	.2209435	.2094097	.1976338	.1856293	.1734117
z′	− ~~.7569869~~ .7617210	−.7622505	−.7630942	−.7641217	.7653628	.7668045	.7684372	.7702460	.7722176	.7743381
log sec δ cos ω	~~.0151315~~	.0107891	.0061258	.0017431	9.9976659	9.99~~46461~~ 39123	9.9905006	9.9874514	9.9847804	9.9825037
log a cos δ sin α	.0157206 .0051881	.0113679	.0147717	.0183834	.0221879	.0261678	.0303083	.0345909	.0389998	.0435139
log tan α	~~9.9925933~~	.0005788	.0086459	.0166403	.0245220	.0322555	.0398077	.0471395	.0542194	.0610102
9924675 A	44 30 11.33	−45 02 17.15	−45 34 13.02	−46 05 50.62	−46 37 0.17	47 07 32.72	47 37 19.98	48 06 12.36	48 34 02.23	−49 00 40.75
α	315 29 48.27	314 57 42.85	314 25 46.98	313 54 9.38	313 22 59.83	312 52 27.28	312 22 40.02	311 53 47.64	311 25 57.77	310 59 19.25
	22.05	22.40	22.73	23.06	23.37	23.67	23.98	24.27	24.56	24.84
	315 30 10.72	314 58 5.25	14 26 9.91	313 54 32.44	313 23 23.20	312 52 50.95	312 23 4.00	311 54 11.91	311 26 22.33	310 59 44.09
log a sin δ	9.8817960	9.8821205	9.8825782	9.8831626	9.8838674	9.8846846	9.8856083	9.8866295	9.8877397	9.8889306
log a cos δ	.1625020	.1615948	.1610068	.1607376	.1607879	.1611534	.1618304	.1628128	.1640929	.1656595
	9.7192540	~~9.7211057~~ ~~−27 45 03.54~~ 9.7205262	~~9.7202173~~ ~~−28 14 56.98~~ 9.7215714	9.7224250	~~275780~~ 9.7230755	9.7235312	9.7237775	9.7238167	9.7236468	9.7232701.57
	−27 39 9.06	−27 43 09.84	−27 46 34.37	−27 49 21.64	−27 51 30.00	27 52 58.65	−27 53 47.10	27 53 54.72	27 53 21.36	27 52 07.59
	+ 1.14	+1.09	1.04	1.02	.95	.90	.84	.79	.74	.68
log Δ	.21517	.21453	.21418	.21409	.21429	.21474	.21548	.21647	.21771	.21920
−	−27 39 7.92	−27 43 8.75	−27 46 33.33	−27 49 20.64	−27 51 29.05	−27 52 59.75	−27 53 46.26	−27 53 53.93	−27 53 20.62	−27 52 6.91
log ω	321 08		321 30		321 50		322 08		322 26	
log a	315 30		314 26		313 23		312 23		311 26	
ω+α	276 38		275 56		275 13		274 31		273 52	
log cos (ω+α)	9.0626		9.0144		8.9587		8.8962		8.8289	
log Δ	.9837		.9942		1.0041		1.0134		1.0222	
log sin (ω+α)	9.9971		9.9977		9.9982		9.9986		9.9990	
log tan δ	9.7193		9.7216		9.7281		9.7288		9.7236	
log I	0.7001		0.7135		.7254		.7358		7448	
I	+ 5.01		5.17		5.31		5.44		5.56	
	+17.21		17.72		18.21		18.68		19.14	
(α′−α) (12h)	22.22	22.56	22.89	23.21	23.52	23.82	24.12	24.41	24.70	24.98
α′−α (0h)	22.05	22.40	22.73	23.06	23.37	23.67	23.98	24.27	24.56	24.84
α	315 29 48.67									
δ′−δ (12h)	+1.11	1.06	+1.01	0.97	+0.92	.87	+.81	.76	+.71	.65
δ′−δ (0h)	1.14	1.09	1.04	1.02	.95	.90	.84	.79	.74	.68

Sept. 10	12	14	16	18	20	22	24	26
29812 180	29838 4519	29905 2858	29932 1197	29958 5536	30025 3875	30052 2214	30119 553	
281 24 1910	281 52 4549	282 21 1628	282 49 3150	283 18 3118	283 47 1530	284 16 4042	284 44 57.28	
9.9913382	9.9905979	9.9898245	9.9890177	9.9881771	9.9873024	9.9863930	9.9854486	
4.7901491	4.7901491	4.7901491	4.7901491	4.7901491	4.7901491	4.7901491	4.7901491	
4.7814873	4.7807470	4.7799736	4.7791668	4.7783262	4.7774515	4.7765421	4.7755977	
-16 47 4267	-16 45 5969	-16 44 1229	-16 42 2047	-16 40 2418	-16 38 2340	-16 36 1810	-16 34 825	
281 24 19.13	281 52 45.50	282 21 16.29	282 49 51.50	283 18 31.18	283 47 15.35	284 16 4.04	284 44 57.28	
140 42 956	140 56 2215	141 10 3814	141 24 3575	141 39 1559	141 53 3767	142 08 201	142 22 2864	
~~219 17 5044~~ 9.8016403	9.7994361	9.7972013	9.7949537	9.7926749	9.7903704	9.7880399	9.7856828	
9.8886678	9.8901318	9.8915572	9.8930341	9.8944723	9.8959020	9.8973231	9.8987358	
.0737833	.0715791	.0693503	.0670967	.0648179	.0625134	.0601829	.0578258	
.0268479	.0283119	.0297674	.0312142	.0326524	.0340821	.0355032	.0369159	
.0469354	.0432672	.0395829	.0358825	.0321655	.0284313	.0246797	.0209099	
-48 05 24.17	-47 50 57.74	-47 36 26.13	-47 21 51.39	-47 07 11.40	-46 52 26.80	-46 37 37.57	-46 22 43.17	
131 54 35.83	132 09 2.26	132 23 33.17	132 38 8.61	132 52 48.60	133 07 33.20	133 22 22.43	133 37 16.83	
263 49 11.66	264 18 4.52	264 47 6.34	265 16 19.22	265 45 37.20	266 15 6.90	266 44 44.86	267 14 33.06	
.4041926	.4030728	.4019490	.4008214	.3996902	.3985557	.3974170	.3962750	
49 45 45.18	50 14 38.04	50 43 39.86	51 12 50.74	51 42 10.72	52 11 39.92	52 41 18.38	53 11 6.58	
320 11 8.71	320 40 1.57	321 09 3.39	321 38 14.29	322 07 34.25	322 37 3.40	323 06 41.91	323 36 30.11	
318 37 59.82	319 06 52.68	319 35 54.50	320 05 5.38	320 34 25.36	321 03 54.56	321 33 33.02	322 03 21.22	
9.8827373	9.8857986	9.8888233	9.8918117	36 9.8947640	9.8976795	9.9005589	9.9034027	
.4041609	.4030411	.4019173	.4007897	.3996585	.3985237	.3973853	.3962433	
9.8063840	9.8019695	9.7974551	9.7928380	9.7881150	9.7832827	9.7783378	9.7732754	
.3351020	.3339822	.3328584	.3317308	.3305996	.3294648	.3283264	.3271844	
9.8201290	9.8159413	9.8116690	9.8073000	9.8028819	9.7982613	9.7935851	9.7887992	
.1220710	.1208912	.1197674	.1186398	.1175086	.1163738	.1152354	.1140934	
+1.9359683	+1.9446424	1.9531725	1.9615590	1.9698000	1.9778949	1.9858400	1.9936367	
-.9842475	-.9902622	-.9957280	-.9988349	1.0013727	1.0027346	1.0029159	1.0019142	
.9517208	~~.9542755~~	+.9580445	.9627241	.9684283	.9751603	.9829241	.9917225	
1.3851156	1.3675767	1.3499069	1.3321982	1.3143600	1.2964254	1.2783524	1.2602590	
+.1916659	.1607886	.1297189	.0984922	.0671455	.0357167	+.0042452	-.0272305	
1.1934497	1.2067881	1.2202160	2337068 8432180	1.2472152	1.2607088	1.2741472	~~1.2330291~~	1.2874896
-.8752476	.8646342	.8539580	~~.8324161~~	.8324161	.8215521	.8106259	.7996361	
+.0831619	+.0697660	.0562862	.0427380	.0291371	.0155003	+.0018441	-.0118143	
-.7920851	.7948682	.7976719	.8004800	.8032790	.8060518	.8087818	~~.7878222~~ 8114508	
9.9785091	9.9797213	9.9813856	9.9835019	9.9860669	9.9893760	9.9925201	9.9963902	
.0768039	.0816312	.0864394	.0912119	.0959414	.1006148	.1052195	.1097436	
.0982944	.1019095	.1050518	.1077100	.1098745	.1115388	.1126994	.1138534	
-51 25 48.30	51 39 41.40	51 51 47.00	52 01 59.77	52 10 18.05	52 16 40.77	52 21 7.44	52 23 37.64	
308 34 14.70	308 20 18.60	308 08 13.00	307 58 0.28	307 49 41.95	307 43 19.23	307 38 52.56	307 36 22.36	
26.56	26.77	26.98	27.18	27.38	27.58	27.78	27.98	
308 34 40.26 ~~183~~	308 20 45.37	308 08 39.98	307 58 27.41	307 50 9.33	307 43 46.81	307 39 20.34	307 36 50.34	
9.8987721	9.9002950	9.9018243	9.9033505	9.9048664	9.9063630	9.9078313	9.9092622	
.1836866	.1871159	.1907182	.1944829	.1983957	2024446	2066156	2108959	
9.7150855	9.7131791	9.7111061	9.7088676	9.7064707	9.7039184	9.7012157	9.6983663	
-27 25 29.61	27 19 19.52	27 12 39.00	27 05 27.31	26 57 46.50	26 49 37.49	26 41 01.49	26 31 59.57	
+.47	.44	41	40	41	.42	44	46	
23547	23849	24166	24495	24838	25189	25553	25923	
-27 25 29.14	27 19 19.48	27 12 38.59	27 05 26.91	26 57 46.09	26 49 37.07	26 41 1.05	26 31 59.11	
323 33		323 52		324 13		324 34		
308 34		308 08		307 49		307 39		
272 17		272 00		272 01		272 13		
8.6003		8.5428		8.5464		8.5875		
1.0520		1.0584		1.0648		1.0701		
9.9997		9.9997		9.9957		9.9957		
9.7151		9.7111		9.7065		9.7012		
.7668		.7652		.7706		.7710		
580		588		520		558		
.2087		2120		2188		2190		
2666	26.87	2708	27.28	27.48	27.68	27.88	2808	
2656	26.77	2698	27.18	27.38	27.58	27.78	2798	
+.45	42	.40	40	41	43	.45	47	

	ℓ	a	′	″				
Aug 9		315	30	10.72	16	3.45		
10		315	14	7.24	16	2.02	1.43	
11		314	58	5.25			2.65	1.26
12		314	42	5.72	15	59.93	3.32	.63
13		314	26	9.71	15	56.01	4.40	1.08
14		314	10	18.10	15	51.61	5.95	1.55
15		313	54	32.48	15	45.66	6.94	.99
16		313	38	53.72	15	38.72	8.20	1.26
17		313	23	23.20	15	30.52	9.26	1.06
18		313	8	1.94	15	21.26	10.27	1.01
19		312	52	50.55	15	10.85	11.18	.91
20		312	37	57.14	14	59.81	12.67	1.49
21		312	23	4.00	14	47.14	13.81	1.14
22		312	08	30.67	14	33.33	14.57	.76
23		311	54	16.91	14	18.76	15.57	1.00
24		311	40	8.72	14	3.19	16.80	1.23
25		311	26	22.33	13	46.35	17.79	.99
26		311	12	59.03	13	28.80	18.86	.99
27		310	59	44.09	13	10.64		

−32	5.47		
		+9.53	
−31	55.54		+8.34
		+18.29	
31	37.27		+9.76
		+28.03	
−31	09.24		+8.96
		+36.99	
−30	32.25		+8.31
		+45.30	
−29	46.95		+9.56
		+54.86	
−28	52.09		+7.65
		+62.51	
−27	49.68		+8.83
		+71.34	
−26	38.24		

h	m	s	m s	
21	2	0.71		
21	0	56.48	−1 4.23	+10
20	59	52.35	4.18	16
20	58	48.38	3.97	24
20	57	44.65	3.73	28
20	56	41.20	3.45	39
20	55	38.16	3.04	47
	54	35.58	2.58	55
	53	33.55	2.03	61
	52	32.13	1.42	69
	51	31.40	−0.73	74
	50	31.41	+0.09	84
	49	32.26	0.85	93
	48	34.04	1.78	97
	47	36.79	2.75	104
	46	40.58	3.79	112
	45	45.49	4.91	118
	44	51.58	6.09	127
	43	58.94	7.36	

Sept 10	308	34	41.26	308 34	41.26			
11		28	57.04	27	29.60	7	11.66	
12	308	20	45.37	20	45.87	6	44.23	27.43
13		14	56.68	14	28.68	6	16.69	27.54
14	308	8	39.58	8	39.58	5	48.70	27.99
15		3	47.93	3	19.47	5	20.51	28.19
16	307	56	27.41	58	27.41	4	52.06	28.45
17		54	32.78	54	3.96	4	23.45	28.61
18	307	50	9.33	50	9.33	3	54.63	28.82
19		47	12.55	46	43.59	3	25.94	28.89
20	307	43	46.51	43	46.51	2	56.78	28.96
21		41	48.08	41	19.08	2	27.73	29.05
22	307	39	20.34	39	20.34	1	58.74	28.99
23		38	20.83	37	50.83	1	29.51	29.23
24	307	36	50.34	36	50.34	1	0.49	29.02

−13	55.89		
		+1 50.50	
−12	05.39		
		+1 52.82	+1.32
−10	12.57		
		+1 54.49	+1.67
−8	18.08		
		+1 55.56	+1.07
−6	22.52		
		+1 56.05	+0.49
−4	26.47		
		+1 56.47	+0.42
−2	30.00		

20	34	18.75		
20	33	48.97	28.78	
20	33	22.02	26.95	1.83
	32	57.91	25.11	1.84
	32	34.67	23.24	1.80
	32	13.30	21.37	1.87
	31	53.83	19.47	1.96
	31	36.26	17.57	1.90
	31	20.62	15.64	1.90
	31	06.91	13.71	1.93
	31	55.12	11.79	1.92
	30	45.27	9.85	1.94
	30	37.36	7.91	1.94
	30	31.39	5.97	1.94
	30	27.36	4.03	1.54

Aug 9	−27	39	7.92	−2	4.88	+8.93	9
10	27	41	12.80	1	55.95	+9.10	10
11	27	43	8.75	1	46.85	9.12	11
12	27	44	55.60	1	37.73		12
13	27	46	33.33	1	28.45	9.28	13
14	27	48	01.78	1	18.86	9.59	
15	27	49	20.64	1	9.12	9.74	
16	27	50	27.74	0	59.29	9.83	
17	27	51	29.05	0	49.33	9.96	
18	27	52	18.38	0	39.37	9.96	
19	27	52	57.75		29.34	10.03	
20	27	53	27.09	−	19.17	10.15	
21	27	53	46.26	−	8.96	10.27	
22	27	53	55.21	+	1.28	10.23	
23	27	53	59.93		11.58	10.30	
24	27	53	42.35		21.73	10.15	
25	27	53	20.62		31.84	10.11	
26	27	52	48.78		41.89	+10.03	
27	−27	52	6.91				

−4	0.83		
		+36.25	
3	24.58		
		37.27	+1.02
2	47.31		
		38.90	1.63
2	8.41		
			.81
		39.71	
1	28.70		
			48
		40.19	
0	48.51		
			65
		40.84	
−0	7.67		
			+14
		40.98	
+	32.81		
			−.58
		+40.40	
1	13.71		

Sept 10	−27	25	29.14	3	0.61		
11	27	22	28.53	3	8.75	8.14	
12	27	19	19.78	3	16.69	7.94	
13	27	16	3.09	3	24.50	7.81	
14	27	12	38.57	3	32.12	7.62	
15	27	9	6.47	3	39.56	7.44	
16	27	5	26.91	3	46.80	7.24	
17	27	1	40.11	3	54.12	7.32	
18	26	57	46.04	4	01.14	7.02	
9455 19	26	53	44.76	4	07.88	6.94	
20	26	49	37.07	4	14.68	6.80	
2239 21	26	45	23.39	4	21.34	6.66	
22	26	41	1.05	4	27.78	6.44	
23	26	36	33.27		34.16	6.38	
24	26	31	59.11				

+6	9.36	+	
		31.83	
6	40.19		
		30.49	−1.34
7	11.68		1.35
		29.14	
7	40.82		.94
		28.20	
8	9.02		1.20
		27.00	
8	36.02		1.08
		25.92	
9	1.94		

W. M. T.

9 Aug 17.0 313 23 23.20 −27 51 29.05
10 C − O + 1 ~~04.05~~ + 2~~5~~.8
11 ° ′ ″ ° ′ ″
12 Ephem 313 22 ~~18.25~~ −27 51 54.8
19.20

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

.46 −1.264 −2280 −250 1.863 +9953 9.282
06 277 466 ~~2280~~ .100 + 127 2.297 2.058
90 1.443 911 ~~.166~~ .034 −022 −036 −038
38489.90 2.464 96.164 766870 193.320 ~~21.794~~ .77842 .250
1.90 1.264 ~~1.264~~ −1.092 ~~1.616~~ ~~9.6162~~ 199 .171 792 .869
1.02 .977 +.073 123 ~~2.058~~ −.103 .099 .336 .431
3.42 277 .152 037 .055 .089 .966 1.476
18.76 1.443 5.049 164 .164 1.732 ~~164~~ 1.164 1.217 10.461
2.464
~~1.264~~
~~385763~~ −2.920 −5012 −98.770 +765488 +195.141 ~~+10.311~~ ~~9.689~~ +842.918
+3874.52 168 10.689

59.99 .84
57.15 .93
58.22 .97
57.25 .97
56.21 1.04
55.09 1.12
53.91 1.18
52.64 1.29
1.36

(aa) (ab) (ac) (ad) (ae) af as
+1.522 −1055 −118 +137 −178 +792 +1.080
+ 324 + .663 − .022 + .228 + .022 + .160 +1.375
+1.846 +0.392 −.140 +.365 −.156 +.932 +2.455

(bb) (bc) (bd) (be) bf bs
+1.568 +141 −213 +197 (−792) −154 ~~+1.080~~
+1.359 −.044 +.466 +.044 +.327 +2.817
+2.927 +.097 +.253 +.241 −.465 +3.897
+2.663

(cc) (cd) (ce) (cf) cs
+15997 334 −7.567 −62.156 −57.086
+2.404 −19.174 −4.831 + .533 −21.135
+18.401 −22.558 −12.398 −61.623 −78.221

(dd) (de) (df) ds
+11.926 −8.431 −13827 −13.792
+152.950 +38.532 −4.227 +168.775
+164.876 +30.101 −18.054 +154.983

(ee) (ef) es
+12.742 +52.575 +49.338
+9.711 −1.083 +42.394
+22.453 +51.492 +91.732

ff fs
+311.763 +288.335
+ .202 − 4.086
+311.965 +284.261
.249

−.68
−.25
−.01
+62.04
−1.38
+1.01
−1.85
+4.33

Comparison with Ephemeris

		Δα(C−O)	Δδ(C−O)
N. Co.	Aug 17	+1′ 4.02	+ 25.8
Wash.	Aug 22	1 10.55	+ 33.6
	24	1 7.05	+ 28.2
Σ		+1 7.20	+ 29.3

α(C) 313 23 23.20 δ(C) −27 51 29.05
+1 7.20 + 29.3
α(O) 313 22 16.00 δ(O) −27 51 58.3

s
−13.576
~~2.416~~
−1.054

a b c d e f

$0 = \cancel{+62.04} + .000\, d\Omega' + .000\, di' + 1.550\, dL - 1.236\, d\log a + 3.116\, d\phi + 3.51\, d\chi$

$0 = +4.33 - .569 - 1.166 - .038 + .400 + .038 + .281$ 10

log aa	9.83251	9.39794	8.0000	1.79267	0.13988	0.00432	0.26717	0.63649
log a	α	α	α	α	9.96190	9.43933	9.89209	9.75511
log b	α	α	α	α	9.89819	9.88543	8.91381	0.06670
log c	.52492	.27021	.05652	.19033	8.94939	6.85733	8.30103	8.54977
log d	9.57403	9.60097	.53212	1.09205	9.15836	~~9.55860~~	8.47712	9.60206
log e	.43759	9.20672	.34713	0.49360	9.09842	8.99123	8.66	8.57978
log f	1.16542	.96317	.55145	9.54531	9.75891	9.52244	9.2966	9.49871
log S	1.13516	.91551	.54654	1.13277	9.79939	9.63043	9.80	.38310

02821

δK = log b

	a	b	c	d	e	f	δ	n
(aa)	+1.846	−.0392	−.140	+.365	−.180	+.932	+2.455	−2.920
log(aa)	.26623	9.59329n	9.14613n	9.56229	9.19312n	9.96942	0.39005	0.46538n
(bb)		+2.927	+.097	+.253	+.241	−.465	+2.663	−5.012
ab(ab)/(aa)		+.083	+.030	−.078	+.033	−.198	−.521	+.620
bb1		+2.844	+.067	+.331	+.208	−.267	+3.184	−5.632
log bb1		0.45393	8.82607	9.51983	9.31806	9.42651n	0.50297	0.75066n
cc			+18.401	−22.558	−12.358	−61.623	−78.221	−98.770
ac ac/aa			+.011	−.028	+.012	+.071	−.186	+.221
cc1			+18.390	−22.530	−12.410	−61.552	−78.035	−98.991
bc1 bc1/bb1			+.002	+.008	+.005	−.006	+.075	−.133
cc2			+18.388	−22.538	−12.415	−61.546	−78.111	−98.858
log cc2			1.26453	1.35292n	1.09395n	1.78920	1.89271n	1.99501n
dd				+164.876	+30.101	−18.054	+154.988	+765.768
ad ad/aa				+.072	+.031	+.184	+.485	−.577
dd1				+164.804	+30.132	−18.238	+154.498	+765.745
bd1 bd1/bb1				+.038	+.024	−.031	+.371	−.656
dd2				+164.766	+30.108	−18.207	+154.127	+766.401
cd2 cd2/cc2				+27.625	+15.217	+75.438	+95.742	+121.172
dd3				+137.141	+14.891	−93.645	+58.385	+645.229
log dd3				2.13717	1.17292	1.97148n	1.76632	2.80971
ee					+22.453	+51.492	+91.732	+195.141
ae ae/aa					+.013	−.079	−.207	+.247
ee1					+22.440	+51.571	+91.939	+194.894
be1 be1/bb1					+.015	−.019	+.233	−.412
ee2					+22.425	+51.590	+91.706	+195.306
ce2 ce2/cc2					+8.382	+41.555	+52.739	+66.747
ee3					+14.043	+10.035	+38.967	+128.559
de3 de3/dd3					−1.617	−10.168	+6.340	+70.059
ee4					+12.426	+20.203	+32.629	+58.500
log ee4					1.09433	1.30542	1.51360	1.76716
ff						+311.961	+284.249	−10.689
af af/aa						+.470	+1.240	−1.474
ff1						+311.495	+283.009	−9.215
bf1 bf1/bb1						+.025	−.299	+.529
ff2						+311.470	+283.308	−9.744
cf2 cf2/cc2						+206.005	+261.450	+330.880
ff3						+105.465	+21.858	−340.634
df3 df3/dd3						+63.943	−39.869	−440.580
ff4						+41.522	+61.727	+99.946
ef4 ef4/ee4						+32.848	53.051	+95.115
ff5						+8.674	+8.676	~~+686.099~~ +4.831
log ff5						0.93822		0.68404

	nδ	nn
	+842.518	3874.52
an aδ an	−3.883	+4.62
δn1 nn1	+846.801	+3869.90
bn1 bδ1 bn1	−6.305	+11.15
δn2 nn2	+853.106	+3858.75
cn2 cδ2 cn2	+419.940	+531.49
δn3 nn3	+433.166	+3327.26
dn3 dδ3 dn3	+274.400	3035.40
δn4 nn4	+158.466	+291.56
en4 eδ4 en4	153.615	275.42
fn5	+4.851	+16.14
fn5 fδ5		2.69
nn6		13.45

log fn5 .68404n
− log ff5 .93822
log dχ 9.74582n
dχ/10 −.5570
dχ −5.57″

dχ/10 ef4 −11.25
en4 +58.50
sum +47.25
log dε 1.67440
− log ee4 1.09433n
log dφ .58007n
dφ −3.80

dχ/10 df3 −56.62
dφ de3 +52.16
dn3 +645.23
sum +640.77
log dε 2.80670
− log dd3 2.13717n
log dlog a 0.66953n
dlog a −4.67

dχ/10 cf2 +34.28
dφ ce2 +47.21
dlog a cd2 +105.30
cn2 −98.86
sum +87.93
log sum 1.94414
log dφ′ 1.26453n
dφ′ .67961n
−4.78

dφ bf1 +.15
dφ be1 −.79
dlog a bd1 −1.55
dφ′ bc1 −.32
bn1 −5.63
sum −8.14
log sum .91062
log bb1 .45393
log di′ .45669n
di′ + 2.86″

dχ/10 af −.52
dφ ae +.59
dlog a ad −1.70
dφ′ ac +.67
di′ ab −1.12
an −2.92
sum −5.00
log sum 0.69897n
log aa .26623n
log dΩ′ .43274
dΩ′ +2.71

log(1 − cos i′) 9.16791
log dΩ′ .43274
log dΩ′(1 − cos i′) 9.60065
dΩ′(1 − cos i′) +.40
dχ −5.57
dπ′ −5.17
dΩ′ + 2.71
dω′ − 7.88

log cos i′ 9.93084
log dΩ′ .43274
− log cos i′ dΩ′ .36358n
− cos i′ dΩ′ − 2.31
dχ − 5.57

dχ″ −4.78
dΩ′(1 − cos i′) +.40
dχ −4.38
dπ −5.17

dω′ −7.88 dM +0.79

0 = −.68 − 16.01 + 1.75 + 10.42 + 8.15 = +.13″
−.25 − 8.91 + 1.86 + 1.94 + 5.12 = −.24
−.01 − 5.45 + 15.91 − 8.47 − 1.88 = +.00″
+62.04 + 7.41 − 57.75 − 11.85 + .20 = +.05

0 = −1.38 − 2.48 + 2.26 − .43 + .67 − .47 + .32 = −1.57″
+1.06 − .74 + 2.77 − .34 + .48 − .37 + .18 = +2.94
+1.85 + 2.12 − .23 + .09 + .14 + .16 − .11 = 0.27
+4.33 − 1.54 − 3.34 − .18 + .187 + .16 + .14 = +1.44

2.46
8.99
.06
2.07
13.58

log φ 7.76609n
log dlog ω .66953n
log dμ 8.43562
dμ + .02727
μ0 802.02824
μ 802.05551

log μ 2.9042044
3.5502266
.6458022
2152674
4305348

log M 4.32335
log dlog ω .66953
4.99288n
−.0000098
4305445
.4305347

(aa)	(ab)	(ac)	(ad)	(ae)	(af)	(as)
+1.522	−1.058	−118	+137	−178	+772	+1.080
+324	+.663	+.022	−.228	−.022	−.160	+.600
+1.846	−.392	−.096	−.091	−.200	+.612	+1.680

(bb)	bc	bd	be	bf	bs
+1.568	+141	−213	+197	−752	−154
+.324	+.663	+.022	−.228	−.022	−.600
+1.359	+.044	−.466	−.044	−.327	+1.229
+2.927	+.185	−.679	+.153	−1.119	+1.075

(cc)	cd	ce	cf	cs
+15.997	−3.384	−7.567	−62.156	−57.086
+2.404	−19.174	−4.831	+ .533	−21.003
+18.401	−22.558	−12.398	−61.623	−78.089

(dd)	(de)	df	ds
+11.926	−8.431	−13.827	−13.792
+152.950	+38.532	−4.227	+167.387
+164.876	+30.101	−18.054	+153.595

(ee)	ef	es
+12.742	+52.575	+49.338
+9.711	−1.083	+42.263
+22.453	+51.492	+91.601

(ff)	fs
+311.763	+288.335
+202	−5.061
+311.565	+283.274

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

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

+.46
+.06
+.03
3848.80
1.80 1.264
1.02
3.42
18.76

.277 .977 −1.082
1.443 .152
2.469 5.049

2.280
466
011
96.164
123
073
037
164

.255
.100
.034
766.870
199
103
055
1.732

3874.52 −2.920 −5.012 +98.770 −765.168 1.863 9.953 +9.282
127 2.297 2.058

.46
.06
.00
3848.80
1.80 +1.264
1.02 +.277 .977
3.42 +1.443 .152
18.76 2.464 5.049

−1.082

−2.280
466
011
96.164
.123
073
037
—
.164

.100
034
199
055
1.732

−.255
766.870
103

099
089
164

.022
193.320
171
~~76.64~~
21.276
~~76.842~~
.552
1.217

.036
.336
.366

.035
842.250
869
431
1.976
4.564

3874.52 −2.920 −5.012 +96.274 −3.044 +2.120 −767.228 +2.342 −193.513 +34.035 −.738 +12.64 851.084

+96.274
3.044
+93.230

−767.228
+2.120
−765.108

−193.513
+2.342
−191.171

+34.035
738
+35.297

848.825

851.084
12.640
−835.685

	a	b	c	d	e	f	s	n
(aa)	1.846	-352	-096	-091	-200	+612	+1.680	-2.920
log(aa)	.26623	9.59329n	8.98227n	8.95904n	9.30103n	9.78675	0.22531	0.46538n
(bb)		+2.527	+185	-679	+153	-1.119	+1.075	-5.012
ab ab		+.083	+.620	+.019	+.043	-0.130	-.354	+.620
aa bb1		+2.844	+.165	-.698	+.110	-.989	+1.432	-5.632
log bb1		0.45393	9.21748	9.84386n	9.04139	9.99520n	0.15594	0.75066n
cc			+18.449	-22.558	-12.358	-61.623	-78.085	+93.230
ac ac			+.005	+.005	+.010	-.932	-.081	+.152
aa cc1			+18.396	-22.563	-12.408	-61.591	-78.002	+93.078
bc bc1			~~+.171~~	~~-.029~~	~~+.243~~	~~+.351~~	+.083	-.327
bb1 cc2			+.009	-.040	+.006	+.057		
log cc2			+18.387	-22.523	-12.414	-61.534	-78.084	+93.405
			1.26451	1.35263n	1.09391n	1.78912n	1.89256n	1.97037
dd				+164.876	+30.101	-18.059	+153.595	-765.108
ad ad				+.005	+.010	-.030	-.083	+.144
aa dd1				+164.871	+30.091	-18.024	+153.678	-765.252
bd1 bd1				+.171	-.027	+.243	-.351	+1.382
bb1 dd2				+164.700	+30.118	-18.267	+154.029	-766.634
cd2 cd2				+27.590	+15.207	+15.378	+95.650	-114.418
cc2 dd3				+137.110	+14.911	-93.645	+58.378	-652.216
log dd3				2.13707	1.17351	1.97149n	1.76623	2.81438n
ee					+22.453	+51.492	+91.601	-191.171
ae ae					+.022	-.066	+.182	+.316
aa ee1					+22.431	+51.558	+91.783	-191.487
be1 be1					+.005	-.038	+.055	-.218
bb1 ee2					+22.426	+51.596	+91.728	-191.705
ce2 ce2					+8.381	+41.545	+52.719	-63.063
cc2 ee3					+14.045	+10.051	+39.009	-128.642
de3 de3					+1.622	-10.184	+6.348	-70.930
dd3 ee4					+12.424	+20.236	+32.660	-57.712
log ee4					1.09426	1.30612	1.51402	1.76127n
ff						+311.965	+283.273	+35.297
af af						+.203	+.557	-.968
aa ff1						+311.762	+282.716	+36.265
bf1 bf1						+.344	-.498	+1.958
bb1 ff2						+311.418	+283.214	+34.307
cf2 cf2						+205.937	+261.320	-312.600
cc2 ff3						+105.481	+21.894	+346.907
df3 df3						+63.961	-39.871	+445.465
dd3 ff4						+41.520	+61.765	-98.558
ef4 ef4						+32.960	53.197	-94.000
ee4 ff5						8.560	+8.568	-4.558
log ff5						0.93247		0.65877n

.93247n	+1077	-4986	-32.77	-.53	+.33
.65877n	-5772	+56.35	-46.91	+.42	-.76
~~.27370~~	-4695	-652.22	-1060.7	-3.29	-.43
9.72630	1.67164n	-645.73	+93.40	+0.83	-.48
	1.09426n	2.81005n	-92.35	-5.63	-1.13
dx +5.32"	.57738	2.13707n	1.96544n	~~-8.20~~	-2.92
	dφ +3.78"	log dh_a .67298	1.26451n	.91381n	-5.39
		dh_a +4.70	dγ' .70093	.45388n	.73159n
			+ +5.02	45988	.26623n
				di 2.88	dΩ' .46536
					+2.92

0 = -.68 + 16.82 + 1.77 - 10.35 - 7.79 = -0.23"
-.25 + 9.36 - 1.88 - 1.82 - 4.89 = -.58
-.01 + 5.72 - 6.04 + 8.41 + 1.90 = +.02
+62.44 + 7.78 - 58.22 - 11.78 + .19 = +.01
-.274 + 2.28 + .45 - .68 + .47 - .30 = -1.90
0 = -1.38 - 1.66 - 3.36 - .19 + 1.89 + .14 + .10 = +3.06
+1.01 - .80 + 2.78 + .36 - .48 + .37 - .18
~~-3.35~~
+4.35 - 1.66 - 3.36 - .19 + 1.89 + .14 + .15 = +1.32

log(1-cos i') 9.16781
log dΩ' 46536
9.63327
dΩ'(1-cos i') .43
dχ +5.32
dπ +5.75
dΩ' +2.92
dω' +2.83
log cos i' 9.93084
log dΩ' 46536
-log cos i' dΩ' .39620n
-2.49
dχ +5.32
dω' = 2.83

dφ +5.02
dφ(1-...) +.48
dφ' +5.50
dπ +5.75
dM -0.25
log 7.96609n
log dh_a 67298
log dμ 8.64390 7n
dμ = .02748
μ 802.02824
μ 802.00076
log μ 2.9041748
3.5500066
.6458318
.1527727
.4305545

log dM 4.32335
log dh_a 67298
4.99633
.000099
4.30544
4.305544
log 3 0.17609
log 2.90417
log sin 1" 4.68557
7.76583
6.38
6.43881

	1869 Oct 31.0	1870	1871	1873
M_0	343 58 0.98	3 21 42.90	97 23 32.99	292 51 21.11
dM	−.25	−.25	−.25	−.25
corr.	−.03	−2.41	−14.04	−28.13
M	343 58 0.68	3 21 40.24	97 23 18.70	292 50 42.73
Ω'_0	181 19 15.21	19 23.01	19 23.51	181 19 26.63
$d\Omega'$	+2.92	+2.92	+2.82	+2.92
Ω'	181 19 18.13	19 25.93	19 26.43	181 19 29.55
ω'_0	54 50 19.52	54 49 31.72	54 47 44.42	54 48 48.16
$d\omega'$	+2.83	+2.83	+2.83	+2.83
ω'	54 50 22.35	49 34.55	47 47.25	54 48 50.99
i''_0	31 28 56.13	31 28 52.33	28 50.83	31 28 42.40
di''	+2.88	+2.88	+2.88	+2.88
i''	31 28 59.01	28 55.21	28 53.71	31 28 45.28
φ_0	17 28 5.95	28 11.75	26 56.65	17 23 59.05
$d\varphi$	+3.78	+3.78	+3.78	+3.78
φ	17 28 9.73	28 15.53	27 0.43	17 24 2.83
μ_0	802.02824	801.95204	802.48514	801.69523
$d\mu$	−.02747	−.02747	−.02747	−.02747
μ	802.00077	801.92457	802.45767	801.66776
$\log a_0$	.4305440	.4305718	.4303794	.4306648
$d\log a$	+99	+99	+99	+99
$\log a$	.4305544	.4305817	.4303893	.4306747
$\log\sqrt{a}$	.2152772	.2152908	.2151946	
$\log\sin\Omega'$	9.3629727n	9.3636839n	8.3637270n	8.3640136n
$\cos i'$	9.9308445	9.9308493	9.9308513	9.9308621
$\cos\Omega'$	9.9998844n	9.9998841n	9.9998842n	9.9998839n
$\cos i'$	9.7178754	9.7178624	9.7178572	9.7178283
$\log\cos\Omega'$	9.9998844	9.9998841	9.9998841	9.9998839
$\cos i'\sin\Omega'$	8.2938172	8.2945332	8.2945783	8.2948757n
$\tan A$	8.2937016	8.2944173	1.7053088	1.7050082n
	1.7060672	1.7053505		
$2A$	88 52 22.09	88 52 15.40	88 52 14.97	88 52 12.19
A	91 07 32.91	71 07 44.60	91 07 45.03	91 07 47.81
$\log a$	9.9999684	9.9999684	9.9999684	9.9999684
$\log\sin\Omega'$	8.3629727	8.3636839	8.3637270	8.3640136
$\log\cos i'\sin\Omega'$	9.9307289	9.9307384	9.9307354	9.9307460
$\cot B$	8.4322438	8.4329505	8.4329916	8.4332676
B	1 32 59.09	1 33 08.17	1 33 8.70	1 33 12.25
$\log b$	9.9308878	9.9308928	9.9308949	9.9309056
$A+\omega'$	145 58 0.26	145 57 19.15	145 55 32.28	145 56 38.80
$B+\omega'$	56 23 21.44	56 22 42.72	56 20 55.95	56 22 3.24
ω'	54 50 22.35	54 49 34.55	54 47 47.25	54 48 50.99
$\log a$	9.9999684	9.9999684	9.9999684	9.9999684
$\log b$	9.9308878	9.9308928	9.9308949	9.9309056
$\log c$	9.7178754	9.7178624	9.7178572	9.7178283
$\log\sin\varphi = \log e$	9.4774048	9.4774435	9.4769409	9.4757578 9.4757495
e	.3001960	.3002227	.2998754	.2990597
$1-e$	.6998040	.6997773	.7001246	.7009403
$\log(1+e)$	.1140089	.1140178	.1135017	.1136291
$\log(1-e)$	9.8449764	9.8449598	9.8451754	9.8456810
$\log\sqrt{1+e}$	.0570044	.0570089	.0569508	.0568146
$\log\sqrt{a}$	9.9224882	9.9224799	9.9225877	.2153373
$\log\sqrt{1-e}$				9.9228405
$\log\sqrt{(1+e)a}$	.2722816	.2722957	.2721454	=.2721509
$\log\sqrt{(1-e)a}$	.1377654	.1377707	.1377823	=.1381778 96
$\log e'$	9.4774048	9.4774435	9.4769409	9.4757495
$\log k$	5.3144251	5.3144251	5.3144251	5.3144251
$\log e''$	4.7918299	4.7918686	4.7913660	4.7901746
φ				17 24 2.83
$\frac{1}{2}\varphi$				8 42 1.42
$45-\frac{1}{2}\varphi$				36 17 58.58
$\log\tan(45-\frac{1}{2}\varphi)$				9.8660289

Wy. m. T. New Elements

Oct 31 1869	1870 Jan 26	Mar 24 1871	1873
343 58 0.68	3 21 40.24	97 23 18.70	292 50 42.73
−35.40	−35.40	−35.40	−35.40

Wash. M. 9'

	1869 Oct 31.5	1870 Jan 26	1871 Mar 24 wrong	1873 Aug 17	
M	343 58 06.8	3 21 40.24	47 23 18.70	14 27.3	
E'	337 20 25.45	4 48 2.99	113 10 58.00	275 47 52.8	275 47 54.04
E in	9.5857467	8.9222683	9.9634354	9.9977729	9.9977723
e sin E'	4.7918299	~~4.771 865~~	4.7913660	4.7901746	4.7879469
e sin E'	4.3775766		4.7548014	4.7879554	17 02 4168
E	337 20 25.86	4 48 2.88	113 10 58.00	−17 02 49.90	275 47 54.04
½E	168 40 12.93	2 24 1.44	56 35 29.00	275 47 52.83 137 53 56.41	137 53 57.02
sin ½E	9.9914533	8.6220339	9.9215643	*9.8263596	9.8263581
cos ½E	9.2332635	9.9996188	9.7408411	*9.8703830	9.8703843
log √ sin ½v	9.5655451	8.8943366	.1537059	.0985115	.0985090
log √ cos ½v	.1292187	.1393885	9.8786234	.0085608	.0085639
tan ½v	9.4363264	8.7569441	0.3150863	.0899507	.0899457
½v	−15 16 30.54	3 16 13.25	64 10 10.12	50 53 29.68	50 53 28.28
½v	164 43 29.46		~~130 44 49.88~~ 128 20 24.24	129 06 30.32	129 06 31.72
v	329 26 58.92	6 32 26.54	~~261 39 37.70~~	258 13 00.64	258 13 3.44
log r	.2896782	.2761946	.4788506	.4173514	.4173512
u+ω'	11 24 59.18	152 29 45.66	274 15 52.52	44 09 39.44	44 09 42.24
u+B+ω'	225 50 20.36	62 55 9.46	184 41 16.19	314 35 3.88	314 35 6.68
u+ω'	24 17 21.27	61 22 1.09	183 08 7.49	313 01 57.63	313 01 54.43
sin(u+ω')	9.9557898	9.6644635	9.9987959n	8430341 ~~9.9542537~~	9.8430371
log a	.2896466	.2761630	.4788190	.4173198	.4173196
sin(u+B+ω')	9.6393307	9.9495684	8.9123646	9.8526123n	9.8526066n
log b	.2205660	.2040874	.4097455	.3482540	.3482568
sin(u+ω')	9.6142043	9.9433497	8.9379555	9.8639081	9.8639026
log c	.8755536	9.9940570	.1967078	.1351797	.1351793
+				+.1821179	+.1821958
X	.596905	+.8722210	−.30034118	−.8267729	−.8267729
	.80980	+.5875179	+.9956787	+.9943990	+.9944229
+1	+.742637	+1.4343525	−.2099472		
y	−.544970	−.7251686	+.0580250	−.1580689	−.1580473
y				+.5352033	+.5352033
y'				−1.0528656	−1.0528440
z	+.4115602	+.8657784	−.0860327	−.9979020	−.9978880
z	−.2449340	−.3146502	+.0251744	+.2322217	+.2322217
z'				−.7656863	−.7656663
log a cos δ cos α	9.9919318	.1642757	0.3024060	9.9975606	9.9975412
log a cos δ sin α	~~.1642748~~	9.8808589	9.1816213	.0223729n	.0223641
log tan α	9.2034862 9.2115580	9.6864888	9.8789153	.0248123n	.0247929
α	9 14 40.39	25 54 42.63	~~87 06 51.22~~	46 38 9.0	46 38 4.43
α	24.40	−8.88	184 19 35.87	313 21 51.00	313 21 55.57
aα	9 15 5.19	25 54 33.65		23.37	23.37
C α	9 15 4.00	34.50	184 19 32.70	313 22 14.37	22 18.94
O α	+ 1.17	−0.85	32.60	313 22 19.20	22 19.20
Δα(C−O)			+0.10		− 0.26
log a cos δ	9.9976087 2077639	2102896	3039458 ~~9.4010113~~	1608342	8342 ~~1632650~~
log a sin δ	9.2396154	9.7412527	8.7843198	9.8840395	9.8840390n
log tan δ	9.2420062	9.5309631	8.4803740	9.7232053	9.7207745n
δ	9 54 11.36	18 45 26.37	−1 43 52.56	27 51 54.69	−27 43 58.42
aδ	+9.40	−5.73	+ 2.34	95	
C δ	9 54 20.76	18 45 20.58	−1 43 50.22	−27 51 53.74	
O δ	9 54 21.80	18 45 17.60	−1 43 50.40	−27 51 54.80	
Δδ(C−O)	− 1.04	+ 2.98	+0.20	+ 1.06	

examined

log cos 4 9.99906
d'' .45988
log I .45894

I + 2.88
II + .10
d'' +2.98
i₀ 8 02 55.46
i' 8 02 58.44

− log sin 4 8.81753
sin i'' 9.71783
dΩ' .46536
log II 9.00072

log sin i' 9.71783
cos a 9.99506
dΩ' 46536
log I 0.18225
I + .15 +1.521
II − .19 − .189
I+II − .04 +1.332
log I+II 8.60206 0.12450
log sin i' 9.14621 9.14621
log dΩ 9.45585 0.97829
dΩ + 9.51
4 55.55 56.48

4 55 ~~56.20~~
4 56 5.99

log sin 4 8.81753
4i'' 4588
log II 9.27741n

log cos i' 9.99570
cos i' .9902
1−cos i' .0098
log (1−cos i') 7.99123
log dΩ 4.6536
4.03
dX 5.32
dπ + 5.35
dΩ + 9.51
dω
51 04 52.32
dω − 4.16
ω 51 04 48.16

Reduction to the Ecliptic

Ω' ~~181 19 25.55~~ 181 19 18.13
$\tfrac{1}{2}\Omega'$ ~~90 39 44.77~~ 90 39 39.06

i' ~~31 28 45~~ 31 28 59.01
ε 23 27 22.16
$i'+\varepsilon$ 54 56 21.17
$i''-\varepsilon$ 8 01 36.85
$\tfrac{1}{2}(i'+\varepsilon)$ 27 28 10.58
$\tfrac{1}{2}(i''-\varepsilon)$ 4 00 48.42

sin ½ Ω'	9.9999711	cos ½ Ω'	8.0619706	sin ½ Ω'	9.9999711	cos ½ Ω'	8.0619706n
cos ½ $(i'-\varepsilon)$	9.9989337	cos ½ $(i'+\varepsilon)$	9.9480488	sin ½ $(i'-\varepsilon)$	8.8450400	sin ½ $(i'+\varepsilon)$	9.6639627
	9.9989048		8.0100194		8.8450111		7.7259333
	8.0100194n		n		7.7259333		
	1.9888854		8.0100423		1.1190778		8.8462624
	89 24 43.95				85 35 10.06		4 01 29.21
$\tfrac{1}{2}(\Omega+\omega)$	90 35 16.05				94 20 49.94		8 02 58.42
$\tfrac{1}{2}(\Omega-\omega)$	94 20 49.94						
4	356 14 26.11						
ω	54 50 22.35						
ω	51 04 48.46						
$\omega+\Omega$	184 56 5.99						

New Elements 1869
Epoch Oct 31.0 Berlin Mean time

M ~~344 01 20.18~~ 343 54 39.18
Ω 4 56 5.99
ω 51 04 48.46
i 8 02 58.43
φ 17 28 9.73
μ 812.0077
log a .4305544

$\omega = \pi - \Omega$
$\pi = \omega + \Omega$
$= 56\ 00\ 54.45$

31.0 Wash.	343	58	06.8
	3	21.50	
		39.18	
31.0 Ber.	343	54	~~52.37~~
		6	41.00
31.5	344	01	~~33.37~~
	344	01	20.18

Berlin Wash 25124 days
9.4000888

(109)

Equations for 1875 Feb 24

″
$0 = +12.52$
$0 = +1.63$

	a	b	c	d	e	f	s
$0=+0.46$	$+.000\,di'$	$+.000\,d\Omega'$	$+3.349\,dL$	$+.375\,d\log a$	$-2.739\,d\varphi$	-14.636	-13.651
$+0.71$			$+1.863$	$-.399$	$-.509$	-9.187	-8.232
-0.01			$+1.159$	-3.405	$+2.226$	$+3.560$	$+3.520$
$+0.16$			$+1.550$	-12.361	-3.116	$+0.351$	-13.576
$+125.24$			$+1.931$	-21.757	$+3.420$	-2.985	-19.391
-0.28	$+.792\,di'$	$-.916$	$+.089$	$-.144$	$+.124$	$-.574$	-0.629
$+2.24$	$+.967$	$-.275$	$+.072$	$-.102$	$+.098$	$-.333$	$+0.427$
$+0.12$	$-.082$	$+.780$	$-.028$	$-.026$	$-.048$	$+.198$	$+0.799$
$+0.91$	-1.166	$-.169$	$-.038$	$+.406$	$+.038$	$+.281$	-1.054
$+6.26$	$+.933$	$+.705$	$-.016$	$+.107$	$+.016$	$+.240$	$+2.985$

	n	9.6627578	9.8512583	8.0000000n	9.2041200	2.0977431	9.4471580n	0.3502480
di'	a	—	—	—	—	—	9.8987252	9.9854265
dΩ'	b	—	—	—	—	—	9.9618955n	9.4393327n
dφ/dt1	c	0.8249157	2702129	.0565237	.1903317	2857823	8.9493900	8.8573325
d log a	d	9.5740313	9.6009729n	.5321171n	1.0920536n	1.3375990n	9.1583625n	9.0086002n
dφ	e	4375920n	9.7067178n	.3475252	4935974n	~~9.0934217~~ 534026	~~8.9912261~~ 9.0934217	~~8.6812412~~ 8.9912261
dμ/μ0	f	1.1654224n	.9631737n	.5514500	9.5453071	.4749443n	9.7589119n	9.5224442n
	s	1.1351645n	9.75-5054n	.5465427	1.1327718n	1.2876002n	9.7986506n	9.6304279

nn	na +	na −	nb +	nb −	nc +	nc −	nd +	nd −	ne +	ne −	nf +	nf −
2.12	~~0.000~~		~~0.000~~		1.541	~~1.260~~	0.173	~~6.733~~		1.260		6.733
.504	~~.173~~		0.000		1.323			0.283		361		6.523
.011	.000	~~1.260~~	.000			.011	.034			.022		.036
.026	.000	6.733	.000		.248			1.978	~~.499~~	.499	.056	
15685.570	.000	6.279	.000		241.839			2724.847	428.321			373.842
.098	.222			.256	.025			.040	.035			.161
5.017	2.166			.616	.161			.228	.219			.746
.014		.010	.093			.002		.003		.000	.024	
.828												
39.188		1.061		.518		.034	.364		.034		.256	
	5.840		4.413			.100	6.680		.100		1.502	
15730.937	8.228	1.071	4.506	1.390	245.137	.147	7.251	7.251 2727.379	428.709	2.148	1.838	388.041
	1.071		1.390		.147		~~.147~~	428.809	2.148			1.838
	+7.157		+3.116		+244.990		−7.104	2298.571	+426.561			−386.203
								−2720.128				

	a	b	c	d	e	f	s	n
(aa)	+2.716	+2.66	−.111	+.900	−.185	+.836	+.442	+7.157
log (aa)	0.~~4771377~~ .4339298	9.4248816	9.0453230n	9.9566486	9.2671717n	9.9222063	0.6461095	0.8547310
(bb)		+3.424	+.174	+.073	+.164	−.950	+3.151	+3.116
ab ab/aa		+.026	−.011	+.088	−.018	+.082	+.434	+.708
bb1		+3.398	+.185	−.016	+.182	−1.032	+2.717	+2.485
log bb1		0.5312234	9.2671717	8.2041200n	9.2600714	0.0136797n	0.4340896	0.3829171
cc			+22.130	−64.588	−5.794	−67.391	−115.580	+244.990
ac ac/aa			+.005	−.037	+.007	−.034	−.181	−.292
cc1			+22.125	−64.551	−5.801	−67.357	−115.399	+245.282
bc1 bc1/bb1			+.010	−.001	+.010	−.056	+.148	+.131
cc2			+22.115	−64.550	−5.811	−67.301	−115.547	+245.151
log cc2			1.3446869	1.8098962n	0.7642579n	1.8280215n	2.0627589n	2.3894337
(dd)				+639.383	−44.291	+47.147	+578.629	−2720.128
ad ad/aa				+.301	−.062	+.279	+1.475	+2.385
dd1				+639.082	−44.229	+46.868	+577.154	−2722.513
bd1 bd1/bb1				+.000	−.001	+.005	−.013	−.011
dd2				+639.082	−44.228	+46.863	+577.167	−2722.502
cd2 cd2/cc2				+188.411	+16.961	+196.440	+337.263	−715.555
dd3				+450.671	−61.189	−149.577	+239.904	−2006.947
log dd3				2.6538595	1.7866734n	2.1748649n	2.3800392	3.3025359n
ee					+34.149	+41.287	+25.380	+426.561
ae ae/aa					+.013	−.457	−.302	−.488
ee1					+34.136	+41.344	+25.632	+427.049
be1 be1/bb1					+.010	−.055	+.145	+.129
ee2					+34.126	+41.399	+25.487	+426.920
ce2 ce2/cc2					+1.527	+17.684	+30.361	+64.416
ee3					+32.599	+23.715	−4.874	~~+362.50~~ 0.491336
de3 de3/dd3					+8.308	+20.308	−325.73	+2724.895 2272.489
ee4					~~−80.487~~ +24.291	~~−178.370~~ +3.407	+27.699	+70.015 218.847
log ee4					1.3854454	0.5323721	1.4424641	0.340 1405 ~~1.954 3144~~
ff						+320.933	+341.862	−386.203
af af/aa						+.257	+1.363	+2.203
ff1						+320.676	+340.499	−388.406
bf1 bf1/bb1						+.313	−.825	−.734
ff2						+320.363	+341.324	−387.672
cf2 cf2/cc2						+204.812	+351.636	−746.037
ff3						+115.551	−10.312	+358.379
df3 df3/dd3						+49.644	−79.624	+666.103
ff4						+65.907	+69.312	−307.724 307724
ef4 ef4/ee4						+.478	+3.885	+~~12.625~~ +30.695
ff5						+65.429	+65.427	−320.349 338.419
log ff5						1.81577		~~2.5056~~2n 2.512946n

	ns	nn
	2424508	1573094
an as as/aa	+ 11.670	+ 18.86
sn1 nn1	2436178	+1571.08
bn1 bs1 bn1/bb1	+ 1.931	+ .72
sn2 nn2	2438109	+1570.36
cn2 cs2 cn2/cc2	−1280.872	+2417.56
sn3 nn3	1157.237	+1297.80
dn3 ds3 dn3/dd3	−~~1235~~	+893.743
sn4 nn4	−88.882	+405.437
en4 es4 en4/ee4	~~+1021.4~~	1971.60
sn5 nn5	+249.551	2082.77
fn5 fs5 nn6	−338.433	175.00
		332.71

+0.44 +5.442 +18.2 +26.66 −75.70 = +1.70
+0.71 +4.95 +30.27 −47.53 +1.93 = +13.53
+0.01 +18.51 −16.57 −27.67 +18.41 = +1.25
+0.16 +25.18 −59.93 +30.33 +1.82 = −2.44
0 = +125.24 −15.44 −133.30 −20.54 +31.38 = +2.40
−0.28 −4.66 −0.46 +1.45 −.70 −1.21 −2.97 = −8.83
+2.24 +1.72 −0.90 −0.49 +1.17 −0.84 −5.70 = −2.10
+0.12 +1.02 +0.47 −0.14 −.32 +.39 +.48 = +2.02
+0.91 +6.87 −.29 −.62 +1.94 −.37 +1.45 = +10.07
+6.24 +1.24 +.15 +5.17 −.26 +.36 −5.50 = +7.42

9.0791812 . 9.9590414 . 0.7965743
8.9138139n 0.0666986n 9.9698816
9.8920946 9.7551123n 9.8481891
8.3010300n 8.5797836n 8.2041200n
8.4623980n 9.6020600 .0281644
~~8.5797836~~ 8.5797830 8.2041200
8.6812412n
9.2966652 9.4487063 9.3802112

9.9025468 .0228406n .4690883

(109)

aa +.870 bb +.497 cc −.000 dd +.001 ee +.000 ff +.038
ab +.658 bc −.011 cd −.002 de +.002 ef +.004
ac −.015 bd +.075 ce −.000 df +.024
ad +.100 be +.011 cf −.224
ae +.015 bf +.169
af +.224

as +1.882 bs +1.399 cs −.037 ds +.0212 ~~+.256~~ es +.032 fs +.476 ~~.707~~

cc +3.729 dd +473.368 ee +11.696 ff +8.9100
cd −42.013 de −74.408 ef −10.209
ce +6.604 df +64.945 ~~−66.317~~
cf −5.764 74.409

cs −37.444 ds +421.890 es −66.317 fs +57.882

cc +3.729 dd +474.500 ee +11.696 ff 8.968
cd −42.030 de −74.392 ef −10.205 ~~+.768~~
ce +6.604 df +65.201 ~~57.940~~
cf −5.768 + ~~57.158~~
cs −37.481 ds +425.029 es −66.291 fs ~~+58.811~~
.324 57.940
+58.589

ns +
nv
6.279
6.845
.035
.2172
2428.829
.176
~~.216~~
+.956
.096
.959
18.430
19.487 2443.995
19.487
−2424.508

(aa) (ab) (ac) (ad) (ae) (af) (as)
+1.846 −0.392 −.096 −.091 −.200 +.612 +1.611
+.870 +.658 −.015 +.100 +.015 +.224 +1.882
+2.716 +.266 −.111 +.009 −.185 +.836 ~~+.4427~~
+3.532

(bb) (bc) (bd) (be) (bf) (bs)
+2.927 +0.185 −0.679 +0.153 −1.119 +1.075
+.497 −.011 +.075 +.011 +.169 +1.399
+3.424 +.174 +.093 +0.164 −.950 ~~+2.151~~
−.604 +2.474

(cc) (cd) (ce) (cf) cs
+18.401 −22.558 −12.398 −61.623 −78.089
+3.729 −42.015 +6.604 −5.768 −37.476
+22.130 −64.573 −5.794 −67.391 −115.565

(ee) (ef) (es)
+22.453 +51.492 +91.601
+11.696 −10.205 −66.286
+34.149 +41.287 +25.315

(ff) (fs)
+311.965 +283.273
+8.968 +58.358
+320.933 +341.631

(dd) (de) (df) (ds)
+164.876 +30.101 −17.054 +153.595
+473.380 −74.407 +64.901 +422.102
~~+639.383~~ ~~−44.297~~ ~~+47.147~~ ~~+578.629~~
+638.256 −44.306 +46.915 +575.697

log bω 2.52946
−log bb 1.81577n
0.71369
dx/ω + 5.1720

dx ef + 1762
log ω +21885
δ +23647
log s 2.37378
−log ee 1.38545n
log dφ 0.98833n
dφ − 9.73

dx df3 −77366
log φ de3 +59567
dm3 −2006.95
δ −218499
log s 3.33994n
−log dd3 2.6558n
log dlog a 0.68558
dlog a + .485

dx ef2 − 34810 −34810
log φ e2 + 5657 + 5657
dlog a ed2 − 3262 −31296
en2 +24515 +24515
δ
log s −7900 −35934
−log ee1 1.89763 2.55551n
log dℓ1 1.34469n 1.34469n
log dℓ1 .55294 1.21082
dℓ1 +3.57 + 16.25

dx bf − 5.34 −5.34
log φ be1 − 1.77 −1.77
dlog a bd1 − 0.01 − 0.08
dℓ be1 + .66 + 3.06
bn1 +2.41 +2.41
δ −4.05 −1.72
log s 0.60745 9.23553n
−log bb1 .53122n .53122n
log dΩ' 0.07623 9.70431
+dΩ' + 1.19 + 0.51″

dx af +4.32 +4.32
dφ ae +1.80 +1.80
dlog a ad1 +0.46 +4.39
dℓ ac −0.40 −1.80
dπ ab +0.32 +0.13
an +7.16 +7.16
δ +13.66 +16.00
log s 1.13545 1.20412
log aa 43393n 43350n
log di'' 0.70152n 0.77019n
di'' ~~−5.03~~ −5.89

log(1−cos i') = 9.16791
log dΩ' 9.70431
8.87222
dΩ'(1−cos i') + .08
dx +51.72
dπ' +51.79
dΩ' + .57
dω' +51.28

log cos i'' 9.93084
log dΩ' 9.70431
9.63515
−dΩ' cos i' − .43
dx +51.72
dω' 51.29

dℓ = +16.25″
dΩ'(1−cos i') + .07
dℓ' + 16.32
dπ' + 51.72
dM − 35.40

log b. 7.76609n
log dlog a .68558
8.45167n
log dμ .028293
μ 802.00077
μ 801.97248
log μ 2.9040594
3.5500066
0.6458472
.2152824
.4305648

New Elements

M = 343 54 39.18 log sin φ 9.4773386
− 35.40 e
343 54 3.78 1+e
° ′ ″ 1−e
Ω' 18 1 19 18.13 log(1+e)
+ 0.51 log(1−e)
18 1 19 18.64 log(1+e)
log √a
ω' 54 50 22.35 log √(1−e)
51.29 log √a(1+e)
54 51 13.64 log √a(1−e)
i' 31 28 59.01 ½φ 8 44 00
− 5.89 (45−½φ) 41 16 00
i' 31 28 53.12 9.9432428

b = 17 28 9.73
− 9.73

log dM 4.32335
log dlog a .68558
5.00893
dlog a + .0000102
4305544
dlog a 4305646

Ta 1875.

Feb. 24.5 M_0	Ω'	ω'	i'	φ	μ	log a
56 43 45.82	181 19 54.62	54 49 54.53	3128 45.28	17 23 11.79	801.90242	
− 35.40	+ 0.51	51.29	− 5.89	− 9.73	− .02829	
1971 dμ − 55.11						
56 42 15.31	181 19 55.13	54 50 45.82	31 28 39.39	17 23 2.06	801.87413	.4306002

73 04 55.0
36 32 27.5
~~9.33481~~
9.50495
.04688
.04318
.00370
45 14 40
90 29 20
19 5 50
.39110

236 28 16
146 53 48
145 20 06

~~9.92096~~n
39107
~~9.74222~~
~~9.53732~~
32201
9.75494
10891
~~2.4608~~

~~2.0990~~

−20523
+ 9045
+ 11564
− 3698
+ 73090
− 16044

05987
989024
9.83033
34 04 57
145 55 03
145 55 09
9.71623

sin φ = 9.4753410
e .2987728
1−e .7012273
log(1+e) .1135335
log(1−e) 9.8458588
log √(1+e) .0567665
log √a 2153001
log √(1−e) 9.9229294
log a(1+e) 1.2720666
log √(a(1−e)) 8.1382295

log e 9.4753410
8.3144257
log e″ 4.7897661

$\frac{1}{2}\varphi$ 8 41 31.03
36 18 28.97

~~9.9433775~~4
8661628

sin Ω′ 8.3663336n
cos i″ 9.9308698
cos Ω′ 9.9998826
sin i″ 9.7178081
9.9998826
− sin Ω′ ~~8.3663362~~
cot i′ cos Ω′ 8.2972060n
tang A ~~.0691302~~
A 1.7026766
log a −88 51 02.3
8.3663362
− cos Ω′ ~~9.9998226~~
− cot i′ cos Ω′ 9.9307514
tang B ~~0.0691302~~
B 8.4356838
B 1.33 42.0
log b ~~108 26 17.0~~

A + ω′ 145 58 56
B + ω′ 56 24 28
ω′ 54 50 46

log a 9.99997
log b 9.93091
log c 9.71781

Discussion of (112) Iphegenie.

~~1870~~

ε 1870.0 22.30
ε 1871 21.83
ε 1872 23 27 21.36
ε 1873 20.88

Assumed Elements.

1872 T. Sb. 115 B. M. T.

M 156 16 20.7

ϖ = 13 51 34.1

Ω = … 50 28.2

i =

φ =

μ … 1

log a

M Eq. 1870

$\omega = \pi - \Omega$

13 51 24
324 00 45 } 1872
2 36 38

Iphigenie (112)
See here for Comp of
A B ~~C~~ C

	°	′	″		°	′	″
Ω	323	58	54.1	i	2	36	34.40
$\Omega - n$	143	58	54.1	ε	23	27	22.06
$\frac{1}{2}(\Omega - n)$	71	59	27.05	$i + \varepsilon$	26	03	56.46
				$i - \varepsilon$	−20	50	47.66
				$\frac{1}{2}(i+\varepsilon)$	13	01	58.23
				$\frac{1}{2}(i-\varepsilon)$	−10	25	23.83

$\sin\frac{1}{2}(\Omega - n)$ 9.9781840 $\cos\frac{1}{2}(\Omega - n)$ 9.4901958
$\cos\frac{1}{2}(i+\varepsilon)$ 9.9886664 $\cos\frac{1}{2}(i-\varepsilon)$ 9.9927131
$\cos\frac{1}{2}i' \sin\frac{1}{2}(\Omega' - a)$ 9.9668504 9.4829083
$\cos\frac{1}{2}i' \cos\frac{1}{2}(\Omega' - a)$ 9.4829083
$\tan\frac{1}{2}(\Omega' - a)$ 0.4838841
$\frac{1}{2}(\Omega' - a)$ 71 49 51.37
$\frac{1}{2}(\Omega' - a)$ 71 49 51.37
$\frac{1}{2}(\Omega' + a)$ 104 37 4.44
Ω' 176 26 55.81
A 32 47 13.07
ϖ 13 51 34.10
ω' 341 04 21.03

$\cos\frac{1}{2}i$ 9.9890623

sin Ω' 8.7919700
cos i′ 9.9550888
cos Ω' 9.9991650
sin i′ 9.6357314

−cos Ω'
cos i′ sin Ω'
log of A

67 52 10.06
~~57 8 8.20~~
~~41 04 21.03~~
345 00 33.56
41 04 21.03

log a 9.9998443
log b 9.9552802
log c 9.6357314

	°	′	″
$A + \omega'$ =	67	52	10.06
$B + \omega'$	357	8	8.20
ω'	341	04	21.03

log e = log sin φ 9.1021484
e .1265168
$1+\varepsilon$ 1.1265168
$1-\varepsilon$ .8734832
log$(1+\varepsilon)$ .0517376
log$(1-\varepsilon)$ 9.9412546

log $\sqrt{1+\varepsilon}$ .0258688
log $\sqrt{a}$ .1931615
log $\sqrt{1-\varepsilon}$ 9.9706273

log $\sqrt{a(1+\varepsilon)}$ .2190303
log $\sqrt{a(1-\varepsilon)}$ ~~.99438~~ .1637888

φ 7 16 6.1 log e
$\frac{1}{2}\varphi$ 3 38 3.05 log b
$45 - \frac{1}{2}\varphi$ 41 21 56.95 log e″
log$(45 - \frac{1}{2}\varphi)$ 9.~~9422134~~ 9447584

log e 9.1021484
log b. 5.3144251

log e″ 4.4165735

M Tsb. 115 1872 = 156 16 20.70
Red (5094d) = 132 06 37.89
M Suppl. 205 1870 = 24 09 42.81

Discussion of (112) Iphigenie.

1870

ε 1870.0 22.30
ε 1871 21.83
ε 1872 23 27 21.36
ε 1873 20.88

Assumed Elements.

1872 T. Sb. 115 B. M. T.

M 156° 16′ 20″.7

M Eq. 1870

ϖ = 13 51 34.1

Ω = 323 58 54.1   π 337 50 28.2

i = 2 36 34.4

φ = 7 16 6.1

μ 934.3770 log. 2.9705221

log a 0.3863230

$\omega = \pi - \Omega$

13 51 24
324 00 45
2 36 38 } 1872

Ω 323° 58′ 54″.1
Ω − n 143 58 54.1
½(Ω − n) 71 59 27.05

i 2° 36′ 34″.40
ε 23 27 22.06
i + ε 26 03 56.46
i − ε −20 50 47.66
½(i + ε) 13 01 58.23
½(i − ε) −10 25 23.83

sin ½(Ω − n) 9.9781837
sin ½(i + ε) 9.3531649
sin ½ i′ sin ½(Ω′ + a) 9.3313486
sin ½ i′ cos ½(Ω′ + a) 8.7476788 n
tan ½(Ω′ + a) 0.5836698 n
½(Ω′ + a) −75 22 55.56
½(Ω′ + a) 104 37 04.44

sin ½ i′ 9.3456398
½ i′ 12 48 18.38
i′ 25 36 36.76

cos ½(Ω − n) 9.4901958
sin ½(i − ε) 9.2574839 n
8.7476788 n

sin ½(Ω − n) 9.9781840
cos ½(i + ε) 9.9886664
cos ½ i′ sin ½(Ω′ − a) 9.9668504
cos ½ i′ cos ½(Ω′ − a) 9.4829683
tan ½(Ω′ − a) 0.4838821
½(Ω′ − a) 71 49 51.37
½(Ω′ − a) 71 49 51.37
½(Ω′ + a) 104 37 4.41
Ω′ 176 26 55.81
a 32 47 13.07
ϖ 13 51 34.10
ω′ 341 04 21.03

cos ½(Ω − n) 9.4901958
cos ½(i − ε) 9.9927731
9.4829683

cos ½ i′ 9.9890623

sin Ω′ 8.7919700
cos i′ 9.9550888
cos Ω′ 9.9991653
sin i′ 9.6357314 n

− cos Ω′ 9.9991653
cos i′ sin Ω′ 8.7470588
log A 1.2521065
A 86 47 49.03

− sin Ω′ 8.7919700 n
− cos i′ cos Ω′ 9.9542541 n
tan B 8.8377159 n
B +3 56 13.83
~~B 176 03 47.17~~
356 03 47.17

A + ω′ 67 52 10.06
~~B + ω′ 157 8 8.20~~
B + ω′ ~~341 04 21.03~~
345 00 33.86
ω′ 341 04 21.03

log a 9.9998443
log b 9.9552802
log c 9.6357314

A + ω′ = 67° 52′ 10″.06
B + ω′ 337 8 8.20
ω′ 341 04 21.03

log e = log sin φ 9.1021484
e .1265168
1 + ε 1.1265168
1 − ε .8734832
log(1 + ε) .0517376
log(1 − ε) 9.9412546

φ 7 16 6.1 log e
½φ 3 38 3.05 log b
45 − ½φ 41 21 56.95 log e″
tan(45 − ½φ) 9. ~~942 21 ...~~
9.9447584

log e 9.1021484
log b 5.3144251
log e″ 4.4165735

log √(1 + ε) .0258688
log √a .1931615
log √(1 − ε) 9.9706273

log √(a(1 + ε)) .2190303
log √(a(1 − ε)) ~~...438~~ .1637888

M. T. Sb. 115 1872 = 156 16 20.70
Red (850 d) = 132 06 37.89
M Sept. 20.5 1870 = 24 09 42.81

493 2

1 02 17.57

1870

		Sept. 20.5	24.5	28.5	Oct 2.5	6.5	10.5	14.5
	M	24 09 42.81	25 12 .32	26 14 17.83	27 16 35.84	28 18 52.84	29 21 10.35	30 23 27.86
	E	27 30 36.72	28 40 43.85	29 50 44.90	31 00 40.10	32 10 29.03	33 20 11.53	34 29 47.48
	sin E	9.6645541	9.6814078	9.6969393	9.7119798	9.7263221	9.7400116	9.7530897
	log b	4.4165735	4.4165735	4.4165735	4.4165735	4.4165735	4.4165735	4.4165735
		4.0811276	4.0979823	4.1135128	4.1285533	4.1428956	4.1565856	4.1696632
	Rad.	3 20 53.90	3 28 43.49	3 36 27.12	3 44 47.7	3 51 36.19	3 59 1.17	4 6 19.62
	E	27 30 36.71	28 40 43.76	29 50 44.95	31 00 40.11	32 10 29.03	33 20 11.54	34 29 47.48
	½ E	13 45 18.35	14 20 21.88	14 55 22.47	15 30 20.05	16 05 14.51	16 40 5.77	17 14 53.74
	sin ½ E cos ½ E	9.3761613	9.3938655	9.4108098	9.4270510	9.4426408	9.4576266	9.4720481
	√r sin ½ v	9.9873627	9.9862546	9.9850999	9.9838988	9.9826512	9.9813571	9.9800165
	√r cos ½ v	9.5952915	9.6128958	9.6298597	9.6460812	9.6616810	9.6766548	9.6910985
	tan ½ v	151 15 15	.1500434	.1488887	.1476876	.1464400	.1451459	.1438058
	½ v	9.4440500	9.4628524	9.4809610	9.4984036	9.5182450	9.5315189	9.5472702
	v	15 32 10.00 ~~28 27 15.02~~	16 11 17.54	16 50 21.05	17 29 16.60	18 08 05.28	18 46 46.70	19 25 20.89
	v	31 04 20.00	32 22 35.08	33 40 42.10	34 58 33.20	36 16 11.56 10.42	37 33 33.40	38 50 41.78
	log r	.1673170						
	r	.3346340	.3352264	.3358430	.3364786	.3371338	.3378086	.3385022
	v+A+ω'	98 56 30.06	100 14 43.60	101 32 52.16	102 50 43.26	104 08 20.48	105 25 43.46	106 42 51.84
16 04 53.86	v+B+ω'	~~118 12 28.20~~	9 30 17	10 48 50.30	12 06 41.40	13 24 18.62	14 41 41.60	15 58 49.98
12 8 41.03	v+ω'	~~12 8 41.03~~ 12 8 41.03	13 26 45.7	14 45 3.13	16 02 54.23	17 20 31.45	18 37 54.43	19 55 2.81
9.9946887	sin(v+A+ω')	9.9946897	9.9930187	9.9911188	9.9889929	9.9866401	9.9840599	9.9812523
3344783	log r a	.3343226	.3350709	.3356873	.3363229	.3369781	.3376529	.3383465
9.1546195	sin(v+B+ω')	9.1546195n	9.2181804	9.2732811	9.3218360	9.3651803	9.4042695	9.4398235
2895142	log r b	.2431544	.2905066	.2911232	.2917588	.2924140	.2930888	.2937824
9.3230083	sin(v+ω')	9.3230083	9.3665693	9.4058867	9.4416154	9.4748268	9.5044506	9.5317786
9.9703654	log r c	9.6606968	9.9709580	9.9715744	9.9722100	9.9728652	9.9735400	9.9742336
+2.1338700	x	2.1331054 ~~+1.4816133~~	~~2.1331540~~ 2.1285780	2.1285818	0.8862247 ~~2.1222568~~	2.1150263	2.1067752	2.0975522
-1.0027497	X	-1.0027497	-1.0019629	+2.1227886 -.9964086	±2.1650263 .9862250	+2.1067752 0.9913353	+2.0975522 .9518569	2.0873665 .9273648
+ ~~0.5253037~~ + 1.0360027	y	- 2510811 -0.1898290	+.3225970 ±.0269419	+.3667789 -.0897602	±.4107663 ±.1521366	+.4545633 ±.2137708	.4981480 -.2748827	.5415092 -.3336992
+ 278313	z	+ 0.0360827	~~+.27~~					
+.1965050	η	+0.1336770	+.2175340	+.2384850	+.2593137	±.2800219	~~32104~~ ±.3006011	+.3210423
+.0156228	ζ	+.0156228	-.0116864	-.0389433	-.0660102	±.0927581	±.1190043	-.1447892
	x'	+.4488636						
.0535088	y'	-.1532463						
4573662	z'	+.1482958						
0.053508	log a cos δ cos α	9.6521144	.0517736	.0514442	.0526176	.0551643	.0590691	.0642715
9.7664947	log a cos δ sin α	9.1853900	9.4707854	9.4425090	9.4126784	9.3816429	9.3497928	9.3176664
~~8.7067859~~	tan α	9.5332756	9.4190118	9.3910348	9.3600608	9.3264786	9.2907237	9.2533949
9.4439680	α	-18 51 1.40	14 42 16.20	13 49 24.21	12 54 17.30	11 58 23.91	11 03 48.8	10 09 39.14
8574	α	341 08 58.60 15 31 46.40	35.48	49 40.13	54 33.71	58 40.68	3 21 68	9 56.00
	log a cos δ	.0696684	.0662395	.0642385	.0637277	.0647169	.0671880	.0711369
	log a sin δ	9.8265976	9.3135459	9.3005515	9.2862375	9.2724608	9.2559886	9.2461368
	log tan δ	9.2569772	9.2473254	9.2357932	9.2225121	9.2077439	9.1918	9.1749999
	δ	10 14 32.40 38.12	10 01 21.64 27.52	9 45 54.79 46 1.29	9 28 35.48 41.90	9 09 54.57 10 1.23	7902 8 50 23.66 30.15	8 30 34.80 41.32
	log a	.0766369	.0729183	.0705771	.0696953	.0702968	.0723878	.0759446
	log 493.2	2.69302	2.76604	2.76360	2.76272	2.76332	2.76541	2.76883
	Ab. T	2.769658 9m 48	9 44	9 44	9.39	9 40	9 43	9 48
	b	13 13	12 45	12 23	12 05	11 52	11 42	11 34
	a	15 32	14 42	13 49	12 54	11 58	11 03	10 10
	b+a	28 45	27 27	26 12	24 59	23 50	22 45	21 44
	log q	9027	9099	9171	9244	9320	9396	9476
	sin (b+a)	9.6821	9.6636	9.6449	9.6256	9.6065	9.5874	9.5685
	tan √	9.2569	9.2472	9.2358	9.2225	9.2077	9.1918	9.1750
	log I a	9.8417	9.8206	9.7978	9.7725	9.7462	9.7188	9.6911
	I	+ 70	.66	63	59	56	52	49
	t	17.83	18.16	18.49	18.83	19.17	19.51	19.91
	Δ a	+18.53	18.82	19.12	19.42	19.43	20.06	20.40
	log q cos δ	9.9429	9.9481	9.9529	9.9573	9.9613	9.9648	9.9680
	log I	9027	9099	9171	9244	9320	9396	9476
	I = Δ √	0.8456	.8580	.8700	.8817	.8933	.9044	.9156
		+ 7.01	7.21	7.42	7.62	7.82	8.03	8.23

18.5	22.5
31 25 45.37	31 28 28.7
35 39 16.66	36 48 38.91
9.7655925	9.7773504
4.4165735	4.4165735
4.1821660	4.1941269
4.4 13 31.29	4 20 36.05
35 39 16.66	36 48 38.92
17 49 38.33	18 24 19.46
9.4859331	9.4998276
9.9786295	9.9771959
9.7049833	9.7183578
.1424883	.1409847
9.5625450	9.5773931
20 03 46.37	20 42 ~~06.66~~ 5.17
40 07 33.34	41 24 ~~13.32~~ 10.34
.3392144	.3399644
107 59 45.30 45.90	109 16 23.38
17 15 43.44 41.94	18 32 21.52
21 11 56.27 58.57	22 28 34.35
9.9782164	9.9749517
.3390595	.3397887
9.4723801	9.5023660
.2944984	.2952246
9.5582077	9.5824039
9.9749496	9.9756758
20762282	20641460
−.8994883	−.8666602
.5846214	+.6274376
−.3914423	−.4473225
.3413371	+.3614761
−.1698404	−.1940851
.0706991	.0782631
9.2859600	9.2555501
9.2152609	9.1772870
9 19 20.61	8 33 14.17
37.27	30.45
.0764733	.0831281
9.2342554	9.2237321
9.1577824	9.1496110
8 11 00.51	7 52 13.00
7.23	19.40
.0809183	.0872313
50.50	21.90
2.77354	2.78020
9 54	10 53
11 30	11 28
9 19	8 33
20 49	20 01
.9557	9642
9.5507	9.5344
9.1578	9.1406
9.6642	9.6392
46	.44
20.29	20.69
28.75	21.13
9.9707	9.9730
9507	9642
9264	.9372
8.44	8.64

	°	'	''					''	
Sept. 20.5	15	31	46.4					+14.57	+28.3
21.5	15	19	48.6	−11	57.8	−16.6		14.70	
22.5	15	07	84.2	12	14.4	15.5	1.1	14.91	
23.5	14	56	04.3	12	29.9	14.2	1.3	15.09	
24.5	14	42	30.2	12	44.1	12.9	1.3	+15.28	30.1
25.5	14	29	23.2	12	57.0	12.1	0.8	15.45	
26.5	14	16	14.4	13	9.1	11.2	1.2	15.62	
27.5	14	2	53.8	13	20.3	10.0	0.9	15.77	
28.5	13	49	24.2	13	29.6	8.3	1.6	+15.92	30.3
29.5	13	35	46.3	13	37.9	6.7	1.2	16.05	
30.5	13	22	1.7	13	44.6	5.5	1.3	16.18	
Oct. 1.5	13	08	11.6	13	50.1	4.2	1.2	16.30	
2.5	12	54	17.3	13	54.3	3.0	1.5	+16.41	31.3
3.5	12	40	20.0	13	57.3	1.5	1.5	16.51	
4.5	12	26	21.2	13	58.8	−0.2	1.3	16.62	
5.5	12	12	22.2	13	58.6	+.7	0.9	16.70	
6.5	11	58	23.9	13	58.3	2.0	1.3	+16.77	31.8
7.5	11	44	27.6	13	56.3	3.6	1.6	16.81	
8.5	11	30	34.9	13	52.7	4.8	1.2	16.85	
9.5	11	16	47.0	13	47.9	5.8	1.4	16.87	
10.5	11	3	4.9	13	42.1	7.0	1.2	+16.89	32.2
11.5	10	49	29.8	13	35.1	8.3	1.2	16.89	
12.5	10	36	3.0	13	26.8	9.5	1.2	16.89	
13.5	10	22	45.7	13	17.3	10.7	1.2	16.88	
14.5	10	09	39.1	13	06.6	11.8	1.0	+16.86	32.2
15.5	9	56	44.02	12	54.8	12.8	1.0	16.82	
16.5	9	44	2.2	12	42.0	13.8	1.0	16.78	
17.5	9	31	34.1	12	28.2	14.6	0.7	16.72	
18.5	9	19	20.6	12	13.5	15.5	1.3	+16.66	33.0
19.5	9	7	23.0	11	57.6	16.7	0.8	16.58	
20.5	8	55	42.1	11	50.9	17.7	1.0	16.49	
21.5	8	44	18.7	11	23.2	18.5	0.8	16.39	
22.5	8	33	14.2	11	4.7	19.5		+16.28	26.9
23.5				10	45.2	20.3			

Sept. 20.5	+10	14	32.4				+5.87	+10.9
21	10	11	28.8	−3	3.6			11.1
22	10	8	15.6	3	13.2	−9.6		11.3
23	10	4	53.3	3	22.3	9.1		11.5
24	10	1	22.0	3	31.3	9.0	+6.80	+11.8
25	9	57	42.3	3	39.7	8.4		12.0
26	9	53	54.2	3	48.1	8.4		12.1
27	9	49	58.2	3	56.0	7.9		12.2
28	9	45	54.8	4	3.4	7.4	+6.7	+12.4
29	9	41	44.4	4	10.4	7.0		12.3
30	9	36	27.3	4	17.1	6.7		12.2
Oct. 1	9	32	4.2	4	23.1	6.0		12.1
2	9	28	35.5	4	28.7	5.6	6.4	+12.1
3	9	24	1.7	4	33.8	5.1		12.2
4	9	19	23.3	4	38.4	4.6		12.2
5	9	14	40.8	4	42.5	4.1		12.3
6	9	9	54.6	4	46.2	3.7	6.7	+12.3
7	9	5	5.3	4	49.3	3.1		12.3
8	9	0	13.3	4	52.0	2.7		12.3
9	8	55	19.4	4	53.9	1.9		12.8
10	8	50	23.7	4	55.7	1.8	6.5	+12.4
11	8	45	26.9	4	56.8	1.1		12.5
12	8	40	29.0	4	57.4	0.6		12.5
13	8	35	31.9	4	57.6	−.02		12.6
14	8	30	34.8	4	57.1	+.05 09	6.5	+12.7
15	8	25	38.6	4	56.2	1.4		12.8
16	8	20	43.8	4	54.8	2.0		12.9
17	8	15	51.0	4	52.8	2.3		12.5
18	8	11	0.0	4	50.5	2.7	6.6	+13.0
19	8	6	12.7	4	47.8	3.8		13.0
20	8	1	28.7	4	44.0	3.7		12.9
21	7	56	48.4	4	40.3	4.9		12.9
22	7	52	13.0	4	35.4	5.4		12.8
	7	47	43.0	4	30.0	5.7	6.4	+12.8

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		Sept. 20	21	22	26	27	Oct. 14	18	21	22	23
N.C.M.T.		14 57 28	10 48 22	9 59 30	11 22 8	12 57 24	10 38 26	10 47 57	10 38 20	10 45 57	8 32 01
Red.		5 55 12	5 55 12	5 55 12	5 55 12	5 55 12	5 55 12	5 55 12	5 55 12	5 55 12	5 55 12
B.M.T.	8 52 40 20	20 52 40	16 43 34	15 54 42	17 17 20	18 52 36	16 33 38	16 43 09	16 33 32	16 45 09	14 27 13
Ab. T.	— 9 48	9 48	9 48	9 48	9 42	9 41	9 48	9 54	10 1	10 3	10 5
Cor. T.	8 42 52 20	42 52	16 33 46	15 44 54	17 7 38	18 42 65	16 23 50	16 33 15	16 23 31	16 35 06	14 17 8
"	8	−3 17 08	.19012	.15618	.21364	.27980	.18321	.18975	.18300	.19104	.09523
log "	.36810	−.12689	9.27903	9.19363	9.32968	9.44685	9.26295	9.27818	9.26245	9.28112	8.97877
	9.56003	9.13637					7807				
u (a)		−790.1	−726.1	−742.2	−794.7	−804.9	−780.7	−772.5	−672.9	−655.0	−633.7
u (a) "		−8.9	−8.3	−7.7	−5.6	−4.7	+5.8	+7.9	+9.2	+9.7	+10.1
u (δ)		−178.6	−188.4	−197.7	−232.0	−239.7	−296.9	−289.2	−277.5	−272.7	267.2
u (δ) "		−5.0	−4.8	−4.5	−3.9	+3.7	+0.2	+1.3	2.4	2.7	+2.9
log u (a)	4	2.84516n	2.86100n	2.87052	2.90020	2.90574	2.89248	2.88958	2.82860	2.81624	2.80284
log u (a) "		0.94939n	0.91908n	0.88649n	.74819n	0.76210n	0.76343	.89763	.96379	.98677	1.00432
log u (δ)		2.25188	2.27508n	2.29601n	2.36549	2.37967	2.47261n	2.46120	2.44389	2.43569n	2.42684n
log u (δ) "		0.69897n	0.68124n	0.653n	0.591n	0.568n	9.301	0.114	.380	.431	.463
T u a	−4 14.2	+1 36.6	−2 18.5	−1 55.9	−2 48.8	−3 45.2	−2 23.0	−2 27.2	−2 8.3	−2 5.1	−1 4.8
T² u a	−1.2	−.2	−.3	−.2	−.3	−.5	+.2	+.3	+.3	+.3	+.1
Sum	−4 16.4	+1 36.4	−2 18.8	−1 56.1	−2 50.1	−3 45.7	−2 22.8	−2 26.9	−2 8.0	−2 4.8	−1 4.7
a₀	32 04.9 27 47.5	31 46.4	16 20 07.2 15 17 48.4	15 7 52.8 15 5 56.7	14 16 33.0 14 13 42.9	14 3 12.8 13 59 27.1	10 9 59.7 10 7 36.7	9 19 41.1 9 17 14.2	8 44 39.9 8 42 36.9	33 35.3 31 30.5	22 50.2 8 21 45.5
T u δ	−1 4.8	+24.4	−35.8	−30.9	−49.6	−1 07.1	−54.4	−54.9	−50.9	−52.1	−25.4
T² u δ	−.6	−.1	−.2	−.1	−.2	−.3	+0	+.1	+.1	+.1	+0
Sum	−1 5.4	+24.3	−36.0	−31.0	−49.8	−1 7.4	−54.4	−54.8	−50.8	−52.0	−25.4
δ₀	14 39.4		10 11 3 59.9 10 10 59.9	10 8 22.7 10 7 51.7	9 54 1.5 9 53 11.7	9 50 56 48 58.2	8 30 43.0 29 48.6	8 11 8.9 10 14.1	7 56 56.9 7 56 6.1	52 21.6 51 29.6	47 51.9 47 26.3
log par a	.505	0.505	.552	.659n	.311	9.918	8.910n	8.129	9.156	9.787	0.453
log a	077	.077	.075	.074	.072	.071	.076	.078	.086	.088	.089
log par δ	695 428	.695	.699	.711	.691	.688	.703	.706	.708	.710	.719
log Δ par a	.428	~~0.582~~	.477n	.485n	.239n	9.847	9.834n	8.051	9.070	9.699	0.404n
log Δ par δ	.618	~~0.772~~	.624	.637	.619	.617	.627	.628	.622	.622	.630
Δ a		+2.7	−3.0	−3.1	−1.7	+0.7	−.7	+.0	+1	+5	−2.0
a₀		15 27 53.1	15 18 3.6	15 06 14.7	14 13 57.0	13 59 37.5	10 7 49.1	9 17 37.5	8 42 49.6	8 31 47.0	8 22 29.9
a O		15 27 56.8	15 18 0.6	15 6 11.6	13 55.3	59 38.2	10 7 48.4	17 37.5	8 42 49.7	47.5	47.4
a C		49.5	17 48.4	15 5 56.7	13 42.9	59 27.1	36.7	14.2	36.9	30.5	45.5
Δ a (C−O)		−6.3	~~−14.8~~ −12.2	−14.9	−12.4	−11.1	−11.7	−23.3	−12.8	−17.0	−21.9
Δ δ		+4.2	+4.2	+4.2	+4.2	+4.1	+4.2	+4.3	+4.2	+4.2	+4.3
δ		+10 13 30.8	+10 10 55.9	10 7 51.4	9 53 13.7	9 48 55.9	8 29 49.8	8 10 16.4	7 56 11.6	7 51 32.6	7 47 27.3
δ O		+10 13 35.0	10 11 3.1	10 7 55.6	9 53 17.9	9 49 0.0	8 29 54.0	8 10 20.7	7 56 15.8	7 51 36.8	7 47 31.6
δ C		+10 13 34.0	10 10 59.9	51.7	9 53 11.7	9 48 58.2	29 48.6	14.1	7 56 6.1	29.6	47 26.3
Δ δ (C−O)		−1.0	−3.2	−3.9	−6.2	−5.8	−5.4	−6.6	−9.7	−7.2	−5.3

	Δ a"		Δ δ"					Δ a		Δ δ		
Sept. 20	−6.3	+14.5	−1.0	+5.7	Oct. 14	+16.9	−11.7		−5.4		+6.5
21	−12.2	+14.7	−3.9	+5.7	18	+16.7	−23.3	−6.6	−6.6	+0.1	+6.6
22	−14.9	+14.9	−6.2	+5.7	21	+16.4	−12.8	+3.7	−9.7	−3.0	+6.5
26	−12.4	+15.6	−5.8	+6.0	22	+16.3	−17.0	−0.5	−7.2	−0.6	+6.4
27	−11.1	+15.8	−5.4	+6.1	23	+16.2	−21.9	−5.5	−5.3	+1.2	+6.4

Sept. 23 = −11.4" −4.5" Oct. 20 −17.3" −6.8"

+16.5 +6.8

−0.8 −0.2

			4a	4δ					
Sept. 20	+ 8.2"	+4.6	+0.7"	+2.9"	Oct. 14	+5.9"	+1.1"	+0.1	−0.9
21	+ 2.5	+1.6	−1.0	+0.8	18	−6.9	+0.9	−1.4	−2.0
22	+ 0.0	−0.5	−3.7	+0.3	21	+3.6	−3.2	−2.0	−0.3
26	+ 3.2	+0.2	−1.5	−1.4	22	−0.7	−0.8	−1.1	−3.0
27	+ 4.7	+0.7	+0.1	−1.0	23	−5.7	+4.1	−2.8	−1.2

+3.7" +1.4" −1.1" +0.3"   −0.8" −0.9" −1.4" −2.5"

Perturbations.

1870.0

$♃\ \Omega'$ 99° 4' 48" Ω 323 58 54 ♃ i' 1° 18' 39" i 2 36 34

♄ Ω' 112° 32' 00" Ω 323 58 54 ♄ i' 2° 29' 30" i 2 36 34

For ♃

	°	'	"
i	2	36	34
i'	1	18	39
$i'+i$	3	55	13
$i'-i$	−1	17	55
$\frac{1}{2}(i'+i)$	+1	57	36
$\frac{1}{2}(i'-i)$	−0	38	57

Ω'	99	4	48
Ω	323	58	54
$\Omega'-\Omega$	135	05	54
$\frac{1}{2}(\Omega'-\Omega)$	67	32	57

$\sin\frac{1}{2}(\Omega'-\Omega)$ 9.96577
$\sin\frac{1}{2}(i'+i)$ 8.58405
$\cos\frac{1}{2}I\ \sin\frac{1}{2}(N+N')$ 8.49982
$\sin\frac{1}{2}I\ \cos\frac{1}{2}(N+N')$ 7.63616 n
$\tan\frac{1}{2}(N+N')$ ~~8.91813~~ 0.86366 n
$\frac{1}{2}(N+N')$ − 82 12 21
97 47 39

$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.58194
$\sin\frac{1}{2}(i'-i)$ 8.05422
~~9.58168~~
7.63616 n

$\sin\frac{1}{2}I$ 8.50385
$\frac{1}{2}I$ 1 49 42
I 3 39 24

$\frac{1}{2}(N+N')$	97	47	39
$\frac{1}{2}(N-N')$	67	32	20
N	165	19	59
ϖ	13	51	34
$\omega=\varpi-N$	208	31	35
N'	30	15	19
Ω'	99	4	48
$N'+\Omega'$	129	20	07

$\sin\frac{1}{2}(\Omega'-\Omega)$ 9.96577
$\cos\frac{1}{2}(i'+i)$ 9.99975
$\cos\frac{1}{2}I\ \sin\frac{1}{2}(N-N')$ 9.96552
$\cos\frac{1}{2}I\ \cos\frac{1}{2}(N-N')$ 9.58191
$\tan\frac{1}{2}(N-N')$ .38361
$\frac{1}{2}(N-N')$ 67 32 20

$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.58194
$\cos\frac{1}{2}(i'-i)$ 9.99997
9.58191

$\cos\frac{1}{2}I$
$\frac{1}{2}I$

For ♄

i	2	36	34
i'	2	29	30
$i'+i$	5	06	04
$i'-i$	−0	07	04
$\frac{1}{2}(i'+i)$	+2	33	02
$\frac{1}{2}(i'-i)$	−0	03	32

Ω'	112	32	00
Ω	323	58	54
$\Omega'-\Omega$	148	33	06
$\frac{1}{2}(\Omega'-\Omega)$	74	16	33

$\sin\frac{1}{2}(\Omega'-\Omega)$ 9.98844
$\sin\frac{1}{2}(i'+i)$ 8.64837
$\sin\frac{1}{2}I\ \sin\frac{1}{2}(N+N')$ 8.63181
$\sin\frac{1}{2}I\ \cos\frac{1}{2}(N+N')$ 6.44489 n
$\tan\frac{1}{2}(N+N')$ 2.18692
$\frac{1}{2}(N+N')$ 89 37 39
90 22 21

$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.43298
$\sin\frac{1}{2}(i'-i)$ 7.01191
6.44489 n

$\sin\frac{1}{2}I$ 8.63182
$\frac{1}{2}I$ 2 27 18
I 4 54 37

$\sin\frac{1}{2}(\Omega'-\Omega)$ 9.98844
$\cos\frac{1}{2}(i'+i)$ 9.99957
$\cos\frac{1}{2}I\ \sin\frac{1}{2}(N-N')$ 9.98301
$\cos\frac{1}{2}I\ \cos\frac{1}{2}(N-N')$ 9.43298
$\tan\frac{1}{2}(N-N')$ 0.55003
$\frac{1}{2}(N-N')$ 74 15 41

$\cos\frac{1}{2}(\Omega'-\Omega)$ 9.43298
$\cos\frac{1}{2}(i'-i)$ 0.00000
9.43298

$\frac{1}{2}(N+N')$	90	22	20
$\frac{1}{2}(N-N')$	74	15	41
N	164	38	01
ϖ	13	51	34
ω	209	13	33
N'	16	06	39
Ω'	112	32	00
$N'+\Omega'$	128	38	39

	Sept. 20	21	22	26	27	Oct. 14	18	21	22	23
$\mu(a)$	−707.8	721.4	−741.7	−794.6	804.7	−710.7	−724.9	672.9	654.0	633.4
$\mu'(a)$	−8.1	+8.5	−7.8	−5.4	−4.7	+5.9	+8.1	+9.4	+9.4	+10.2
$\log\mu$	2.84991	2.86058	2.87023	2.90015	2.90563	2.85248	2.86028	2.82795	2.81558	2.80168
$T\mu$	−4 17.01	−2 17.91	−1 55.84	−2 49.76	−3 45.15	−2 23.03	−2 17.55	−2 3.14	−2 4.84	−1 03.2
$T'\mu'$	−1.2	−.3	−.2	−.3	−.5	+.2	+3.	+3.0	+.3	+.1
	−4 18.2	−2 18.2	−1 56.0	−2 50.1	−3 45.6	−2 22.8	−2 17.2	−2 2.8	−2 4.6	−1 3.1
	15 32 18.7	15 20 17.8	15 8 3.9	14 16 43.9	14 8 23.9	10 10 11.3	9 19 53.6	8 44 54.5	8 33 57.1	8 23 7.7
$\alpha(C)$	15 27 56.5	15 17 58.6	15 06 7.5	14 13 53.8	13 59 38.3	10 7 48.5	9 17 36.4	8 42 51.7	8 31 46.5	8 22 4.6
$\alpha(O)$	55.8	18 0.6	6 11.6	13 55.3	59 38.2	7 48.4	17 37.5	42 49.7	31 47.5	22 7.4
$\Delta\alpha(C-O)$	+0.7	−1.0	−3.7	−1.5	+0.1	+0.1	−1.1	−2.0	−1.0	−2.8
$T\mu(\delta)$	−1 5.4	−36.0	−31.0	−48.8	−1 7.4	−54.4	−54.8	−50.5	−52.0	−25.4
δ_0	10 14 42.3	10 11 39.9	10 8 26.9	9 54 6.3	9 50 10.4	8 30 47.5	8 11 13.5	7 57 1.3	7 52 25.8	7 47 15.8
$\delta(C)$	+10 13 37.9	10 11 3.8	10 7 55.9	9 58 16.5	9 49 3.0	8 29 53.1	8 10 18.7	7 56 10.5	7 51 33.8	7 47 30.4
$\delta(O)$	+10 13 35.0	10 11 3.1	10 7 53.6	9 53 17.9	9 49 4.0	8 28 54.0	8 10 20.7	7 56 15.8	7 51 36.8	7 47 31.6
$\Delta\delta(C-O)$	+2.9	+0.8	+0.3	−1.4	−1.0	−0.9	−2.0	−5.3	−3.0	−1.2

φ 7 16 06
log cos φ 9.99650
log cos² φ 9.99300
log a .38602
log p .37932
log $\sqrt{p}$ .18966
log e 9.10215
i 2 36 34
log sin i ~~8.65~~ 8.65832
½ i 1 18 17
φ 7 16 06
½ φ 3 38 03
log $\sqrt{a}$ .19316
log tang ½ φ 8.80287
log e'' 4.41657

log $\sqrt{a(1+e)}$ 21904
log $\sqrt{a(1-e)}$ 16379

log p tang ½ φ 9.18219
log 40 m'k 2_1 2.13176
log 120 k 0.31476
log (1) $\frac{40 m'k}{\sqrt{p}}$ 1.94210 h 1.41813
log (2) $\frac{1}{\sin i}$ = 0.34168
log (3) a cos φ .38282
log (4) $\frac{p}{e}$ 1.27717
log (5) $\frac{1}{e}$ 0.89785
log (6) Tang ½ i 8.35736

log 40 m'k h 1.60779

log (7) 120 $\frac{k e}{\sqrt{a}}$ ~~.12160~~ 9.22375
log (8) 120 $\frac{k \pi}{\sqrt{a}}$ .50092
log (9) p tang ½ φ 9.18219
log (10) 2 cos φ .29753
log (11) tang ½ φ 8.80287
log (12) p cot φ 1.27367
log (13) cot φ 0.89435

	1870 Sept. 15.0	Oct 8	Oct. 28	Nov. 17	Dec 7	1870 Dec 27	1871 Jan 16	Feb. 5	Feb 25	Mar 17	Apr 6
M	23 30 47		33 58 42		44 16 37		54 39 32		65 02 27		75 25 22
E	26 46 44		38 23 50		49 48 50		60 59 56		71 55 54		82 36 41
sin E	9.65374		9.79317		9.88307		9.94181		9.98802		9.99638
log e''	4.41657		4.41657		4.41657		4.41657		4.41657		4.41657
log e sin E	4.07031		4.20974		4.29964		4.35838		4.39459		4.41295
e sin E	11757		16208		19536		6 20 23		24808		25879
e sin E	3 15 57		4 30 08		5 32 16		6 55		6 53 28		7 11 19
E	26 46 44		38 23 50		49 48 53		60 59 55		71 55 55		82 36 41
½ E	13 23 22		19 11 55		24 54 26		30 29 57		35 57 58		41 18 20
sin ½ E	9.36468		9.51699		9.62444		9.70546		9.76886		9.81959
cos ½ E	9.98803		9.97515		9.95760		9.93534		9.90810		9.87575
log $\sqrt{a}$ sin ½ v	9.58372		9.73603		9.84348		9.92450		9.98790		0.03863
log $\sqrt{a}$ cos ½ v	.15182		.13894		.12139		.09913		.07194		.03954
tang ½ v	9.43190		9.59709		9.72209		9.82537		9.91596		9.99909
½ v	15 07 39		21 34 85		27 48 17		33 46 46		39 29 27		44 56 25
v	30 15 18		43 09 10		55 36 34		67 33 32		78 58 54		89 52 50
log r	.16714		.17049		.17467		.17943		.18448		.18960
log r²	.33428		.34098		.34934		.35886		.36896		.37920
ω + v = u	44 06 52		57 00 44		69 28 08		81 25 06		92 50 28		103 44 24
log cos u	~~9.85609~~		9.73597		9.54496		9.17382		8.69519n		9.37569n
log r²	.33428		.34098		.34934		.35886		.36896n		.37920
log sin u	9.84267		9.92365		9.97150		9.99571		9.99947		9.98739
log r sin u	.17695		.26463		.32084		.35397		.36843		.36659
log r cos u	.19037		.07695		9.89430		9.53268		9.06415n		9.75489
log sin² ½ v	9.70230		9.88502		9.91656		9.96580		9.99192n		0.00000
log cos² v	9.93641		9.86304		9.75192		9.58145		9.28131		9.19048
log cos E	9.95073		9.89416		9.80974		9.68559		9.49157		9.10924
cos u	+86380				+.56484		+.38146		.19112		
cos E	+.89276		+.72953		+.64527		+.48483		+.31015		+.12860
cos u + cos E	+1.75656		+.78373		+1.21011		0.86629		+.50127		+.00155
log (cos u + cos E)	0.24466		.51326 = 17991		0.08282		9.93766		9.70007		+.13015 = 9.11444
log $\frac{p}{r^2}$	.04504		.03834		.02998		.02046		.01036		.00012
$\frac{p}{r^2}$	1.1093		1.0923		1.0710		1.04825		1.02415		1.0003
log $(\frac{p}{2}+1)$	.32414		.32062		.31628		.31138		.30624		.30110
log r sin v	.03658		.17600		.26590		.32466		.36088		.37926
log $(\frac{p}{2}+1)$ r sin v	.36072		.49662		.58218		.63604		.66712		.68030
$(\frac{p}{2}+1)$ r sin v											

1871

Apr 26 May 16 June 5 June 25 July 15 Aug 4 Aug 24 Sept 13 Oct 13 Oct 23 Nov 12 Dec 2

M	85 48 17	96 11 12	106 34 07	116 57 02	127 19 57	137 42 52
E	93 02 36	103 14 08	113 13 52	123 01 41	132 39 49	142 05 38
sin E'	9.99935	9.98830	9.96328	9.92345	9.86649	9.78778
log e''	9.41657	9.41657	9.41657	9.41657	4.41657	4.41657
log e sin E'	9.41596	9.40487	9.37985	9.34002	4.28306	4.20435
e sin E'	26058	25402	23580	6 04 39	19190	16008
e sin E	7 14 18	7 03 22	6 39 40		5 19 50	4 26 48
E	93 02 35	103 14 34	113 13 47	123 01 41	132 39 47	142 09 40
½E	46 31 17	51 37 17	56 36 53	61 30 50	66 19 53	71 04 50
sin ½E	9.86072	9.89427	9.92168	9.94896	9.96184	9.97588
cos ½E	9.83764	9.79249	9.74058	9.67847	9.60363	9.51047
log tan ½ u	0.07976	.11384	.14072	.16300	.18088	.18452
log cos ½ u	.00143	9.95678	9.90437	9.84226	9.76742	9.67466
tang ½ v	.07833	.15658	.23635	.32074	.41346	.52026
½ v	50 08 22	55 06 33	59 52 25	64 27 40	68 58 44	73 12 20
v	100 16 44	110 13 06	119 44 50	128 55 20	137 47 28	146 24 40
log r	19462	19987	.20374	.20765	21103	21385
log r²	.38924	.39874	.40748	.41530	~~.44361~~ .42206	.42770
u	114 08 18	124 04 40	133 36 24	142 46 54	151 39 02	160 16 14
log cos u	9.61166n	9.74843n	9.83866n	9.90110n	9.94452n	9.97373n
log r²	38924	.39874	.40748	.41530	.42206	.42770
log sin u	9.96026	9.91818	9.85979	9.78165	9.67655	9.52838
log r² sin u	.34950	.31692	.26727	.19695	0.09861	9.95608
log r² cos u	0.00090n	.14717n	.24614	.31640n	.36658	.40143n
log sin v	9.99297	9.97238	9.93863n	9.89098	9.82726n	9.74291
log cos v	9.25149	9.53857n	9.69563n	9.79814	9.86964n	9.92066
log cos E	8.72488n	9.35998n	9.59596n	9.83646n	9.88103n	9.89748n
cos v	−.17849	−.34560	−.49617	−.62827	−.74070	−.83303
cos E	−.05309	−.22908	−.39443	−.54506	−.67769	−.78974
cos v + cos E	−.23153	−.57468	−.89060	−1.17333	−1.41839	−1.62277
log (cos v + cos E)	9.36461n	9.75943n	9.94968n	0.06944n	0.15780n	0.21024n
log (p+1)	.29610	.29143	.28718	.28341	~~.27752~~ .28019	.27752
log 2 sin u	.38221	.37112	.34611	.30628	.24932	.17061
log r² sin u (p/2+1)	.67831	.66255	.63329	.58969	.52951	.44813

1872

Dec 22 Jan 11 Jan 31 Feb 20 Mar 11 Mar 31 Apr 20 May 10 May 30 June 19 July 9 July 29

	148 05 47	158 28 42	~~168 51 37 179 14 32~~ 168 51 37	179 14 32	189 37 27	200 00 22
	151 33 00	160 51 19	170 06 21	8.06902	188 32 49	197 47 28
	9.67786	9.51581	9.23510	8.06902	9.17208n	9.48508
	4.41657	4.41657	9.41657	4.41657	4.41657	4.41657
	4.09453	3.93238	3.65167	2.48559	3.58861	3.90165
	12432	8558	4484	306	−1 4 38	−2 12 54
	3 27 12	2 22 38	1 14 44	5 6		
E	151 32 59	160 51 20	170 06 21	179 19 38	188 32 49	197 47 28
½E	75 46 20	80 25 40	85 03 10	89 39 49	94 16 24	98 53 44
sin ½E	9.98648	9.99391	9.99888	10.00000	9.99879	9.99474
cos ½E	9.39046	9.22087	8.93570	7.76872	8.87224n	9.18930n
log tan ½ u	.20552	.21295	.21742	.21904	.21783	.21378
log cos ½ u	9.55425	9.38466	9.09949	7.93251	9.03603	9.35309
tang ½ v	.65127	.82829	1.11793	2.28653	1.18180n	0.86069
½ v	77 25 01	81 33 17	85 58 29	89 42 14	−86 14 08	−82 09 11
					93 45 52	97 50 49
v	154 50 02	163 06 26	171 16 58	179 24 28	187 31 44	195 41 38
log √r	.21608	.21769	21868	21905	.21877	.21787
log r	.43216	.43538	43736	43810	43754	43574
u	168 41 36	176 58 00	185 08 32	193 16 02	201 23 18	209 33 12
log cos u	9.99149n	9.99939n	9.99825	9.98825n	9.96901n	9.93947n
log r	43216	.43538	43736	.43810	43754	43574
log sin u	9.29239	8.72359	8.95244n	9.36077	9.56192n	9.69305n
log r sin u	9.72455	9.15897	9.38980	9.79887n	9.99546	0.12879
log r cos u	.42365	.43477	.43568	.42635n	.40655n	.37521n
log sin v	9.62864	9.46327n	9.18058n	8.01435n	9.11736n	9.43216n
log cos v	9.95668	9.98084	9.99493	9.99991n	9.99624n	9.98350
log cos E	9.94410n	9.97529n	9.99349	9.99997n	9.99515n	9.97872n
cos v	−.87923	−.95685	.98845	−.99994	−.99138	96273
cos E	−.90507	−.94470	.98513	.99994	−.98890	.95220
cos v + cos E	−1.78430	−1.90155	−1.97358	−1.99988	−1.98028	1.91493
log (cos v + cos E)	0.25147n	0.27910n	0.29525n	0.30102n	.29673n	.28215n
p*×						
log (p/2+1)	.27541	27390	27298	27264	27290	27374
log 2 sin u	.06080	9.89865	9.61794	8.45245	9.55490n	9.86790n
log r sin u (p/2+1)	.33621	.17255	9.89092	8.72509	9.82780n	.14164n

1872 — 1873

1872 Aug 18 Sept. 7 Sept 27 Oct. 17 Nov. 6 Nov. 26 Dec 16 Dec 36 {Jan 5 Jan 5 Feb 14 ~~Feb. 14~~

	210 23 17	220 46 12	231 09 07	241 32 02	251 54 57
	207 05 15	216 27 43	225 56 34	235 33 21	245 19 43
	9.65835	9.77400	9.85651	9.91628	9.95843
	4.41657	4.41657	4.41657	4.41657	4.41657
	4.07492	4.19057	4.27308	4.33285	4.37500
	3 18 03	4 18 29	5 12 33	5 58 40	8 35 14
E	207 05 14	216 27 43	225 56 34	235 33 22	245 19 43
½ E	103 32 37	108 13 51	112 58 17	117 46 41	122 39 51
sin ½ E	9.98775	9.97763	9.96412	9.94682	9.92528
cos ½ E	9.36956n	9.49533n	9.59137	9.66843	9.73216
log tan ½ v	.20679	.19667	.18316	.16586	0.14427
cos ½ v	9.53335	9.65912	9.75516	9.83222	9.87595
log ½ v	0.67344	0.53755	0.42800	.33364	.24832
½ v	78 01 29	73 49 34	69 31 55	~~.3333~~ 65 27 00	60 33 16
v/2	101 58 31	106 10 26	110 28 05	114 33 00	119 26 44
v	203 59 02	212 20 52	220 56 10	229 46 00	238 53 28
log √r	.21635	.21421	.21148	.20817	.20434
log r	.43270	.42842	.42296	.41634	.40868
v + ω = w	217 48 34	226 12 24	234 47 42	243 37 32	252 45 00
log cos w	9.89766n	9.84014n	9.76080n	9.64761n	9.47208
log 2	43270	42842	42296	41634	40868n
log sin w	9.78749n	9.85844n	9.91227n	9.95225n	9.98001n
log 2 sin w	.22019n	.28686n	.33523n	.36859n	.38869n
log 2 cos w	0.33036n	.26856n	.18376n	.06355n	9.88076n
log sin v	9.60847n	9.72840n	9.81639n	9.88276n	9.93257n
log cos v	9.96090n	9.92676n	9.87820n	9.81016n	9.71321
log cos E	9.94954n	9.90539n	9.84222n	9.78251n	9.62057n
cos v	-.41391	-.84481	-.75544	-.64590	-.57667
cos E	-.89030	-.80430	-.69538	-.56561	-.41442
cos v + cos E	-1.80421	-1.64911	-1.45082	-1.21151	-.93409
log(cos v + cos E)	.25629n	.21725	.16161n	.08333	9.97039n
k	.88353	.89810n	.90440n	.91830n	.93464
log(k²+1)	.27497	.27717	.27976	.28292	.28660
log 2 sin v	.04117n	.15682n	.23595n	.29910n	.34125n
log(k²+1) 2 sin v	.31614n	.43399n	.51571n	.58202n	.62785n

1873

Mar 26 ~~Mar 26~~ ~~Apr 15~~ May 5 ~~May 5~~ May 25 June 14 ~~June 14~~ July 4 July 24 Aug 13 Sept 2 Sept 22

	262 17 52	272 40 47	283 03 42	253 26 37	303 49 32	314 12 27
	255 17 12	265 27 13	275 51 02	286 09 34	297 28 22	308 32 15
	9.98552	9.99863	9.99773	9.98175	9.94836	9.89332
	4.41657	4.41657	9.41657	41657	4.41657	4.41657
	4.40209	4.41520	4.41430	4.39832	4.36493	4.30989
	7 00 40	7 13 34	7 12 40	6 57 02	6 26 10	5 40 12
E	255 17 12	265 27 13	275 51 02	286 29 35	297 28 22	308 32 15
½ E	127 38 36	132 43 36	137 55 31	143 14 47	148 41 41	154 16 07
sin ½ E	9.89863	9.86605	9.82614	9.77697n	9.70567	9.63764
cos ½ E	9.78586	9.83155n	9.87056	9.90375n	9.93167n	9.95465n
log tan² ½ v	.11767	.08509	.04518n	9.99601	9.93471	9.85668
cos ½ v	9.54965	9.99534	.03435	.16754	.09546	.21844
tan ½ v	.16802	.08975	.01083	9.92847	9.83925	9.93824
½ v	55 49 01	50 52 43	-45 42 53	-40 18 14	34 37 50	28 41 34
v/2	124 10 59	129 07 17	134 17 07	189 41 49	145 22 10	151 18 26
v	248 21 58	258 14 34	268 34 14	279 23 38		
log √r	.20003	.19533	.19034	.18522	.18015	.17534
log r	.40006	.39066	.38068	.37044	.36030	.35068
w	262 13 30	272 06 06	282 25 46	293 15 10		
log cos w	9.13124n	8.56434n	9.33292	9.59636		
log 2	40006	39066	38068	37044		
log sin w	9.99599	9.99971	9.98970n	9.96321n		
log 2 sin w	.39605n	.39037n	.37038	.33365		
log 2 cos w	9.53130n	8.95500n	9.71360n	9.96680n		
log sin v	9.96828n	9.99079n	9.99966n	9.99414n		
log cos v	9.56664n	9.30914n	8.39700n	9.21265		
log cos E	9.40480n	8.89906n	9.00822n	9.45316		
cos v	-.36868	-.20377	-.02495	+.16317		
cos E	-.25399	-.07926	+.10194	+.28390		
cos v + cos E	-.62267	-.28303	+.07699	+.44707		
log(cos v + cos E)	9.79426n	9.45183n	8.88643	9.65038		
k	.95348	.97424	.99688	1.02868		
log(k²+1)	.29081	.29540	.30035	.30550		
log 2 sin v	.36434n	.38145n	.38034n	.36458n		
log(k²+1) 2 sin v	.65515n	.67685n	.68069n	.67008n		

1873 1874.

~~March 6. March 26~~

	Oct 12	Nov 1	Nov 21	Dec 11	Dec 31	Jan 20	Feb 9	Mar 1	Mar 21	Apr 10	Apr 30	May 20
		324 35 22		334 58 11	~~345 21 12~~	345 21 12						
		319 55 20		331 30 45								
		9.80877		9.67849								
		4.41657		4.41657								
		4.22534		4.09506								
		4 40 01		3 27 27								
E'		319 55 21		331 30 44								
½ E'		159 57 40		165 45 22								
sin ½ E'		9.53486		9.39102								
cos ½ E'		9.97288		9.98644								
lg tan ½ v		9.75390		9.61006								
lg cos² ½ v		.13667		.15023								
tan ½ v		9.61723		9.45983								
½ v		-22 30 01		-16 04 55								
v		157 29 59		163 55 05								
lg r		.17106		.16757								
lg r²		.34212		.33514								

1872 1873

	1872 Aug 18 Sept. 7	Sept 27 Oct. 17	Nov. 6 Nov. 26	Dec 16 Dec 36 {Jan 5	Jan 5 Feb 14 ~~Feb. 14~~
	210 23 17	220 46 12	231 09 07	241 32 02	251 54 57
	207 05 15	215 27 43	225 56 34	235 38 21	245 19 43
	9.65835	9.77400	9.85651	9.91628	9.95843
	4.41657	4.41657	4.41657	4.41657	4.41657
	4.07492	4.19057	4.27308	4.33285	4.37500
	3 18 03	4 18 29	5 12 33	5 58 40	6 35 14
E	207 05 14	216 27 43	225 56 34	235 33 22	245 19 43
½ E	103 32 37	108 18 51	112 58 17	117 46 41	122 39 51
sin ½ E	9.98775	9.97763	9.96412	9.94682	9.92523
cos ½ E	9.36956	9.49533n	9.59137	9.66843	9.73216
log sin ½ v	.20679	.19667	.18316	.16586	0.14427
log cos ½ v	9.53335	9.65912	9.75516	9.83222	9.89595
log tan ½ v	0.67344	0.53755	0.42800	.33364	.24832
½ v	78 01 29	73 49 34	69 31 55	~~[illegible]~~ 65 07 02	60 33 16
v	101 6? 31	106 10 26	110 28 05	114 53 00	119 26 44
2v	203 59 02	212 20 52	220 56 10	229 46 00	238 53 28
log √e	.21635	.21421	.21148	.20817	.20434
log e	.43270	.42842	.42296	.41634	.40868
2v − ω = w	217 48 34	226 12 24	234 47 42	243 37 32	252 45 00
log cos w	9.89766n	9.84014n	9.76080n	9.64761n	9.47208
log 2	43270	42842	42296	41634	40868n
log sin w	9.78749n	9.85844n	9.91227n	9.95225n	9.98001n
log 2 sin w	.22019n	.28686	.33523	.36859n	.38869
log 2 cos w	0.33036n	.26856n	.18376n	.06355n	9.88076n
log sin v	9.60847n	9.72840n	9.81639n	9.88276n	9.93257n
log cos v	9.96090n	9.92676	9.87820n	9.81016n	9.71321
log cos E	9.94954n	9.90539n	9.84222n	9.78251n	9.62057n
cos v	−.91391	−.84481	−.75544	−.64590	−.57667
cos E	−.89030	−.80430	−.69538	−.56561	−.41742
cos v + cos E	−1.80421	−1.64911	−1.45082	−1.21151	−.93409
log (cos v + cos E)	.25629n	.21725	.16161n	.08333	9.97039n
k	.88353	.89810n	.90440n	.91830n	.93464
log (k² + 1)	.27497	.27717	.27976	.28292	.28660
log 2 sin v	.04117n	.15682n	.23595n	.29910n	.84125n
log (k² + 1) 2 sin v	.31614n	.43399n	.51571n	.58202n	.62785n

1873

	Mar 26 ~~Mar 26~~	~~Apr 15~~ May 5 ~~May 5~~	May 25 June 14 ~~June 14~~	July 4 July 24	Aug 13 Sept 2	Sept 22
	262 17 52	272 40 47	283 03 42	293 26 37	303 49 32	314 12 27
	255 17 12	265 27 13	275 51 02	286 29 34	297 28 22	308 32 15
	9.98552	9.99863	9.99773	9.98175	9.94836	9.89332
	4.41657	4.41657	9.41657	41657	4.41657	4.41657
	4.40209	4.41520	4.41430	4.39832	4.36493	4.30989
	7 00 40	7 13 34	7 12 40	6 57 02	6 26 10	5 40 12
E	255 17 12	265 27 13	275 51 02	286 29 35	297 28 22	308 32 15
½ E	127 38 36	132 43 36	137 55 31	143 14 47	148 41 41	154 16 07
sin ½ E	9.89863	9.86605	9.82614	9.77697	9.71567	9.63764
cos ½ E	9.78586	9.83155n	9.87056	9.90375n	9.93167n	9.95465n
log sin ½ v	.11767	.08509	.04518n	9.99601	9.93471	9.85668
log cos ½ v	9.94565	9.99534	.03435	.16754	.09546	.21844
log tan ½ v	.16802	.08975	.01083	9.92847	9.83925	9.93824
½ v	55 49 01	50 52 48	−45 42 53	−40 18 19	34 37 50	28 41 34
v	124 10 02	129 07 19	134 17 07	189 41 49	145 22 11	151 18 26
2v	248 21 55	258 14 34	268 34 14	279 23 38		
log √e	.20006	.19535	.19034	.18522	18015	.17534
log e	.40006	.39066	.38068	.37044	.36030	.35068
W	262 13 30	272 06 06	282 25 46	293 15 10		
log cos w	9.13124n	8.56434n	9.33292	9.59636		
log 2	40006	39066	38068	37044		
log sin w	9.99599	9.99971	9.98970n	9.96321n		
log 2 sin w	.39605n	.39037n	.37038	.33365		
log 2 cos w	9.53130n	8.95500n	9.71360n	9.66680n		
log sin v	9.96828n	9.99079n	9.99966n	9.99414n		
log cos v	9.56664n	9.30914n	8.39700n	9.21265		
log cos E	9.40480n	8.89906n	9.00822n	9.45316		
cos v	−.36868	−.20377	−.02495	+.16317		
cos E	−.25399	−.07926	+.10194	+.28390		
cos v + cos E	−.62267	−.28303	+.07699	+.44707		
log (cos v + cos E)	9.79426n	9.45183n	8.88643	9.65038		
k	95848	97424	.99688	102868		
log (k² + 1)	29081	.29540	.30035	.30550		
log 2 sin v	136834n	.38145n	.38034n	.36458n		
log (k² + 1) 2 sin v	.65515	.67685	.68069	.67008n		

1873 1874.

~~March 6. March 26~~

	Oct 12	Nov 1	Nov 21	Dec 11	Dec 31	Jan 20	Feb 9	Mar 1	Mar 21	Apr 10	Apr 30	May 20
		324 35 22		334 58 11 ~~345 21 12~~ 345 21 12								
		319 55 20		331 30 45								
		9.80877		9.67849								
		4.41657		4.41657								
		4.22534		4.09506								
		4 40 01		3 27 27								
E'		319 55 21		331 30 44								
$\frac{1}{2}E'$		159 57 40		165 45 22								
sin $\frac{1}{2}E'$		9.53486		9.39102								
cos $\frac{1}{2}E'$		9.97288		9.98644								
lg tan $\frac{1}{2}v$		9.75390		9.61006								
lg cos² $\frac{1}{2}v$		.13667		.15023								
tan $\frac{1}{2}v$		9.61723		9.45983								
$\frac{1}{2}v$		-22 30 01		-16 04 55								
v		157 29 59		163 55 05								
log r		.17106		.16757								
log r²		.34212		.33514								

1884

June 9 June 29 July 19 Aug 8 Aug 28 Sept 17 Oct 7 Oct 27 Nov 16 Dec 6 Dec 26

$\Omega' + N' = 178\ 20\ 07$ ~~170~~

1870 1871

	~~Oct 8~~ ~~Sept 16~~	~~Nov 17~~ Oct 28	~~Dec 27~~ Dec 7	Jan 16	Feb 25	Apr 6	May 16	June 25	Aug 4	Sept 13	Oct 23
L'	73° 53 09	77 22 28	80 50 41	84 17 48	87 43 48	91 08 41	94 32 24	97 55 00	101 16 27	104 36 46	107 55 57
$u' = L' - (N' + \Omega')$	304 33 02	308 02 21	311 30 34	314 57 41	318 23 41	321 48 34	325 12 17	328 34 03	331 56 20	335 16 39	338 35 50
$\log \sin u'$	9.91570n	9.89630n	9.87432n	9.84978n	9.82216n	9.79118n	9.75637n	9.71708n	9.67248n	9.62141n	9.56220n
$\log \sin I$	8.80467										
$\tan u'$	.16284	.10659n	.05279n	.00059n	9.94842n	9.89579n	9.84192	9.78543n	9.72679n	9.66316n	9.59823
$\log \cos I$	9.99911										
$\log \tan \lambda'$	.16155	.10570	.05190	9.99970	9.94753	9.89490	9.84103	9.78504	9.72590	9.66227	9.59234
λ'	304 31 20	308 05 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
v'	30 15 18	43 09 10	55 36 34	67 33 32	78 58 54	89 52 50	100 16 44	110 13 06	119 44 50	128 55 20	137 47 28
ϖ'	208 31 35										
$v' + \varpi'$	238 46 53	251 40 45	264 08 09	276 05 07	287 30 29	298 24 25	308 48 19	318 44 41	328 16 25	337 26 55	346 19 03
$\lambda' - (v + \varpi')$	65 49 27	56 24 58	47 26 55	38 56 04	30 56 40	23 27 32	16 27 15	9 53 19	3 42 50	357 52 24	352 19 10
$\log \sin \beta'$	8.72040n	8.70097n	8.67906n	8.65445n	8.62683n	8.59585n	8.56104	8.52175	8.47715	8.42608	8.36687
$\log r'$	.70492	.70603	.70717	~~84 17 48~~ .70833	.70952	.71073	.71194	.71316	.71439	.71562	.71684
$\log \cos \beta'$	9.99940	9.99945	9.99950	9.99956	9.99961	9.99966	9.99971	9.99976	9.99980	9.99985	9.99988
$\log z' = \log r' \sin \beta'$	9.42532n	9.40700n	9.38623n	9.36278n	9.33635n	9.30658n	9.27298n	9.23491n	9.19154n	9.14170n	9.08371n
$\log \sin(\lambda' - (v+\varpi'))$ (y)	9.96013	9.92068	9.86727	9.79826	9.71114	9.59958	9.45217	9.23485	8.81140	8.58948n	9.12597n
$\log r' \cos \beta'$	.70432	.70548	.70667	.70789	.70913	.71039	.71165	.71292	.71419	.71547	.71672
$\log \cos(\lambda' - (v+\varpi'))$ (x')	9.61229	9.74285	9.83011	9.89090	9.93332	9.96253	9.98184	9.99350	9.99909	9.99870	9.99609
$\log \cos \gamma' = \cos \beta' \cos(\lambda' - \ldots)$	9.61169	9.74230	9.82961	9.89046	9.93293	9.96219	9.98155	9.99326	9.99889	9.99855	9.99597
$\log r'$	70492	70603	70717	70833	70952	71073	71194	71316	71439	71562	71684
$\log \sin \gamma'$	9.96026	9.92093	9.86769	9.79893	9.71220	9.60177	9.45538	9.24253	8.85326	8.65531	9.13186
$\log r' \cos \gamma'$	0.31661	0.44833	0.53678	.59879	.64245	.67292	.69349	.70642	.71328	.71517	.71281
$r' \cos \gamma'$	−2.0731	−2.8076	−3.4418	−3.9700	−4.3899	−4.7090	−4.9373	−5.0865	−5.1675	−5.1901	−5.1619
r	+2.1591	2.1927	2.2353	2.2849	2.3386	2.3944	2.4504	2.5046	2.5555	2.6020	2.6428
$r - r' \cos \gamma'$	+0.0860	−0.6149	−1.2065	−1.6851	−2.0513	−2.3146	−2.4869	−2.5819	2.6120	2.5881	−2.5191
$\log r' \sin \gamma' = \log \rho \sin l'$	.66518	.62696	.57486	.50726	.42172	.31250	.16732	9.95569	9.56765	9.37093	9.84870
$\log \rho \cos l'$	8.93450	9.78880	0.08153	0.22663	0.31203	0.36448	0.39566	0.41194	0.41697	0.41288	0.40125
$\log \tan l'$	1.73068	0.83816	.49333	.28063	.10969	9.94802	9.77166	9.54375	9.15068	8.95795	9.44745
$\log \rho$	.66526	.63149	.59617	.55995	.52424	.49066	.46073	.43700	.42127	.41476	.41765
$\log \frac{1}{\rho}$	9.33473	9.36851	9.40383	9.44005	9.47576	9.50944	9.53927	9.56300	9.57870	9.58524	9.58235
$\log \frac{1}{\rho^3}$	8.00419	8.10553	8.21149	8.32015	8.42728	8.52832	8.61781	8.68900	8.73619	8.75572	8.74705
$\log \frac{1}{r'}$	9.29508	9.29397	9.29283	9.29167	9.29048	9.28927	9.28806	9.28684	9.28561	9.28438	9.28316
$\log \frac{1}{r'^3}$	7.88524	7.88191	7.87849	7.87501	7.87144	7.86781	7.86418	7.86052	7.85683	7.85314	7.84948
$\frac{1}{\rho^3}$	0.010097	0.012751	0.016274	0.020900	0.026747	0.033754	0.041478	0.048866	0.054475	0.056980	0.055854
$\frac{1}{r'^3}$	.007678	.007619	.007560	.007499	.007438	.007376	.007314	.007253	.007192	.007131	.007071
$A = \frac{1}{\rho^3} - \frac{1}{r'^3}$	+.002419	.005132	.008714	.013401	.019309	.026378	.034164	.041613	.047283	.049849	.048783
$\log A$	7.38364	7.71029	7.94022	8.12714	8.28576	8.42124	8.53357	8.61923	8.67471	8.69766	8.68827
$\log z'$	9.42532n	9.40700n	9.38623n	9.36278n	9.33635n	9.30658n	9.27298n	9.23491n	9.19154n	9.14170n	9.08371n
$\log (1)$	1.94210n										
$\log W_0$	8.75106n	9.05939n	9.26855n	9.43202n	9.56421n	9.66992n	9.74865n	9.79624n	9.80835n	9.78146n	9.71008n
W_0	−.05637	−.11465	−.18559	−.27041	−.36662	−.46765	−.56060	−.62553	−.64321	−.60459	−.51440
$\log A$	7.38364	7.71029	7.94022	8.12714	8.28576	8.42124	8.53357	8.61928	8.67441	8.69766	8.68827
$\log y'$	.66445	.62616	.57394	.50615	.42027	.31087	.16382	9.94777	9.52559	9.28495n	9.84266n
$\log (1)$	1.94210										
$\log S_0$	9.99014	0.27855	0.45626	0.57539	0.64813	0.67371	0.63949	0.50910	0.14240	9.92471n	.47306n
S_0	+.97767	+1.8991	2.8593	3.7618	4.4477	4.7175	4.3601	3.2293	+1.3880	−.8408	−2.9721
$\log 2$	.33428	.34098	.34934	.35886	.36896	.37920	.38924	.39874	.40748	.41530	.42206
$\log \frac{1}{\rho^3}$	8.00419	8.10553	8.21149	8.32015	8.42728	8.52832	8.61781	8.68900	8.73619	8.75572	8.74705
$\log \frac{2}{\rho^3}$	8.33847	8.44651	8.56083	8.67901	8.79624	8.90752	9.00705	9.08774	9.14367	9.17102	9.16911
$\log A$	7.38364	7.71029	7.94022	8.12714	8.28576	8.42124	8.53357	8.61923	8.67471	8.69766	8.68827
$\log x'$	.31661	.44833	.53678	.59879	.64245	.67292	.69349	.70642	.71328	.71517	.71281
$\log Ax'$	7.70025	8.15862	8.47700	8.72593	8.92821	9.09416	9.22706	9.32065	9.38799	9.41283	9.40108
Ax'	+.005015	.014409	.029992	.053202	.08476 ~~.10671~~	.12421	.16868	.21167	.24434	.25872	+.25182
$-\frac{2}{\rho^3}$	−.021801	.027958	.036377	.047754	.06255	.08082	.10164	.12239	.13921	.14826	.14761
$Ax' - \frac{2}{\rho^3}$	−.016786	−.013569	−.006385	+.005448	.02221 +.04416	+.04339	+.06704	+.08928	+.10513	+.11046	+.10421
$\log(Ax' - \frac{2}{\rho^3})$	8.22495n	8.13255n	7.80516n	7.73624	8.34655	8.63739	8.82633	8.95075	9.02178	9.04321	9.01791
$\log (1)$											
$\log R$	0.16705n	0.07465n	9.74726n	9.67834	0.28865	0.57949	0.76843	0.89285	0.96383	0.98531	0.96001
R_0											

N'+Ω'	1871 Dec 2	1872 Jan 11	Feb 20	Mar 31	May 10	Jun 19	Jul 29	Sep 7	Oct 17	Nov 26
L'	111 14 01	114 30 59	117 46 52	121 01 41	124 15 29	127 28 17	130 40 06	133 50 58	137 00 56	140 10 02
u' = L' − (Ω'+N')	341 53 54	345 10 52	348 26 45	351 41 34	354 55 22	358 08 10	1 19 59	3 30 57	7 40 49	10 49 50
log sin u'	9.49235n	9.40784n	9.30167n	9.15986n	8.94693	8.57222n	8.36669	8.78843	9.12595	9.27399
sin I	8.80467									
log tan u'	9.51409n	9.42253n	9.31056n	9.16439n	8.94864n	8.51239n	8.36680	8.78824	9.12987	9.28180
cos I	9.99911									
tan λ'	9.57350	9.42164	9.30967	9.16350	8.94775	8.51160n	8.36591	8.78735	9.12898	9.28091
v	146 24 40	154 50 02	163 06 26	171 16 58	179 24 28	187 31 44	195 41 38	~~217 48 34~~ 203 57 02	~~226 12 24~~ 212 20 52	~~234 47 42~~ 220 56 10
v+ω'	354 56 15	3 21 37	11 38 01	19 48 33	27 56 03	36 03 19	44 13 13	52 28 37	60 52 28	69 27 45
λ'	341 55 59	345 12 36	348 28 07	351 42 34	354 55 59	358 08 24	1 19 49	3 30 25	7 39 53	10 48 07
λ' − (v+ω')	346 59 44	341 50 59	336 50 06	331 54 01	326 59 56	322 05 05	317 06 36	311 01 48	306 47 26	301 20 22
log sin β'	8.29702	8.21251n	8.10634n	7.96448n	7.75160n	7.31689n	7.17136	7.59210	7.93062	8.07866
log r'	.71805	.71926	.72044	.72161	.72275	.72386	.72494	.72599	.72701	.72799
log cos β'	9.99991	9.99994	9.99996	9.99998	9.99999	10.0000	10.0000	9.99999	9.99998	9.99997
log z' = log r' sin β'	9.01507	8.93177n	8.82678n	8.68609n	8.47435n	8.04075n	7.89630	8.31809	8.65763	8.80665
log sin (λ' − (v+ω'))	9.35223n	9.49347n	9.59481n	9.67303n	9.73612n	9.78852n	9.83289n	9.87087n	9.90354n	9.93147n
log r' cos β'	0.71796	.71920	.72040	.72159	.72274	.72386	.72494	.72598	.72700	.72796
log cos (λ' − (v+ω'))	9.98872	9.97783	9.96349	9.94553	9.92359	9.89703	9.86490	9.82576	9.77735	9.71619
log cos γ' = log cos β' cos (λ'−v−ω)	9.98863	9.97777	9.96345	9.94551	9.92358	9.89703	9.86490	9.82575	9.77733	9.71616
log r'	.71805	.71926	.72044	.72161	.72275	72386	72494	72599	72701	72799
log sin γ'	9.35381	9.49462	9.59504	9.67310	9.73612	9.78852	9.83288	9.87088	9.90355	9.93148
log r' cos γ'	0.70668	.69703	.68389	.66712	.64633	.62089	.58984	.55174	.50434	.44415
− r' cos γ'	−5.0896	−4.9778	−4.8294	−4.6464	−4.4293	−4.1773	−3.8891	−3.5624	−3.1941	−2.7807
R	+2.6773	+2.7050	+2.7251	+2.7376	+2.7427	2.7387	2.7274	2.7083	2.6818	2.6483
R − r' cos γ'	−2.4123	−2.2728	−2.1043	−1.9088	−1.6871	−1.4386	−1.1617	−0.8541	−.5123	−.1324
log r' sin γ' = log ρ sin l'	.07186	.21388	.31548	.39471	.45887	.51238	.55782	.59687	.63056	.65947
log ρ cos l'	0.38243	0.35656	0.32311	0.28031	0.22714	.15794n	.06509	9.93151	9.70952	9.12189
tan l'	9.68943	9.85732	9.99237	.11440	.23173	.35444	.49273	.66536	.92104	1.53768
log ρ	.42901	.44725	.46985	.49547	.52307	.55099	.57919	.60678	.63866	.65965
log 1/ρ	9.57099	9.55275	9.53015	9.50453	9.47693	9.44901	9.42081	9.39322	9.36634	9.34035
log 1/ρ³	8.71297	8.65825	8.59045	8.51359	8.43079	8.34703	8.26243	8.17966	8.09902	8.02105
log 1/r'	9.28195	9.28074	9.27956	9.27839	9.27725	9.27614	9.27506	9.27401	9.27299	9.27201
log 1/r'³	7.84585	7.84222	7.83868	7.83617	7.83175	7.82842	7.82518	7.82203	7.81897	7.81603
1/ρ³	.051639	.045525	.038945	.032628	.026964	.022235	.018299	.015124	.012561	.010497
1/r'³	.007012	.006954	.006897	.006858	.006788	.006736	.006686	.006638	.006591	.006547
A = 1/ρ³ − 1/r'³	.044627	.038591	.032048	.025770	.020176	.015499	.011613	.008486	.005970	.003950
log A	8.64960	8.58626	8.50580	8.41111	8.30484	8.19030	8.06494	7.92870	7.77597	7.59660
log z'	9.01507	8.93177n	8.82678n	8.68609n	8.47435n	8.04075n	7.89630	8.31809	8.65763	8.80665
log W₀	9.60677n	9.46013n	9.27468n	9.03930n	8.72129n	8.17315n	7.90334	8.18889	8.37570	8.34535
W₀	−.40437	−.28849	−.18823	−.10947	−.05264					
log A	8.64960	8.58626	8.50580	8.41111	8.30484	8.19030	8.06494	7.92870	7.77597	7.59660
log y'	.07019n	.21267n	.31521n	.39462n	.45886n	.51238n	.55783n	.59685n	.63054n	.65943n
log S₀	0.66189n	0.74103n	0.76311n	0.74783n	0.70580n	0.64478n	0.56497n	0.46765n	0.34861n	0.19813n
S₀	*.45909	×.55085	*.57958	*.55954	×.50793					
log 2	~~.43216~~ .42770	~~.43538~~ .43216	~~.43736~~ .43538	~~.43810~~ .43736	.43810	.43754	.43574	.43270	.42842	.42296
log 1/ρ³	8.71297	8.65825	8.59045	8.51359	8.43079	8.34703	8.26243	8.17966	8.09902	8.02105
log 2/ρ³	9.14067	9.09041	9.02583	8.95095	8.86889	8.78457	8.69817	8.61236	8.52744	8.44401
log A	8.64960	8.58626	8.50580	8.41111	8.30484	8.19030	8.06494	7.92870	7.77597	7.59660
log x'	70668	69703	68389	66712	.64633	.62089	58984	55174	50435	44415
log Ax'	9.35628	9.28329	9.18969	9.07823	8.95117	8.81119	8.65478	8.48044	8.28032	8.04075
Ax'	+.22713	+.19200	+.15477	+.11974	+.08937	+.064743	+.045163	+.030230	+.019069	+.010984
− 2/ρ³	−.13825	−.12314	−.10613	−.08932	−.07394	−.060899	−.049908	−.040960	−.033686	−.027798
Ax' − 2/ρ³	+.08888	+.06886	+.04864	+.03042	+.01543	+.003849	−.004745	−.010730	−.014617	−.016814
log (Ax' − 2/ρ³)	8.94880	8.83797	8.68699	8.48316	8.18837	7.58535	7.67624n	8.03060n	8.16486n	8.22567n
log R₀	0.89090	0.78007	0.62909	0.42526	0.13047	9.52745	9.61834n	9.97270n	0.10696n	0.16777n
R₀										

146 25 48 149 32 28 152 38 29 155 43 50

Jan 5 182 29

1194

Dec 26	~~Jan~~ 136 14	Mar 6 2	~~Apr 5~~ May	~~May 28~~ June 14	Jul 9	Aug 13	Sept 22	Nov 1	Dec 11	Jan 20	Mar 1	Apr 10
143 18 17	146 25 48	147 59 12	151 05 33	154 11 14	157 16 16	160 20 42	163 24 35	166 27 59	169 30 55	172 33 26	175 35 36	178 37 29
13 58 10	17 03 08	20 12 21	23 18 22	26 23 43	27 56 9	31 00 35	34 04 28	37 07 52	40 10 48	43 13 19	46 15 29	45 17 22
9.38274	9.46826	9.53831	9.59730	9.64793								
~~9.38274~~		56590										
9.39578	9.48788	9.57241	9.60426	9.69575								
9.39485	9.48691 9	9.57152 9.56501	9.63337	9.69486								
~~2433722~~	~~2524500~~	2482158	2581434	2658414								
2294600	2385328											
781735	872503	965333	1064609	1170549								
135631	170340	201004	231548	262056								
295 38 56	289 38 37	283 16 31	276 29 39	269 15 07								
8.18741	8.27293	8.34298	8.40197	8.45260								
72893	72982	73067	73147	73222	73257	~~73325~~	73386	73443	73493	73539	73578	.73611
9.99996	9.99992	9.99989	9.99986	9.99983								
8.91634	9.00275	9.07365	9.13344	9.18482								
9.95495n	9.97396n	9.98824n	9.99720n	9.99956								
.72888	.72974	.73056	.73133	.73205								
9.63633	9.52656	9.36103	9.05347	8.11580n								
9.63628	9.52648	9.36092	9.05333	8.11563n								
72893	72982	73067	73147	73222								
9.95496	9.97356	9.98824	9.99720	9.99956								
.36521	.25630	.09159	9.78480	8.84785n								
−23185	−18043	−12348	−60926	+07044								
2.6082	2.5626	2.5123	2.45850	2.40260								
+0.2897	+.7583	+1.2775	+~~3657~~ 1.84924	+2.4430								
.68389	.70378	.71891	.72867	.73218								
9.46195	9.87984	.10636	.26699	.39822								
1.22194	.82394	.61258	.46168	.38846								
.68467	.70861	.73148	.75314	~~.76935~~ .77356								
9.31533	9.29139	9.26853	9.24686	9.22644								
7.94599	7.87517	7.80559	7.74058	7.67932								
9.27107	9.27018	9.26933	9.26853	9.26778								
7.81321	7.81054	7.80799	7.80557	7.80334								
.00830	.007502	.006391	.005503	.004779								
.006505	.006465	.006427	.006391	.006358								
.002325	+.001037	−.000036	−.000888	−.001579								
7.36642	7.01578	5.55630	6.94841n	7.19838n								
8.91684	9.00275	9.07365	9.13344	9.18482								
8.22486	7.96063	6.57205n	8.02495n	8.32530n								
7.36642	7.01578	5.55630	6.94841n	7.19838								
68383n	70370n	41880n	72853n	.73201n								
9.99235n	9.66158n	8.21720	9.61904	7.87249								
41634	40868	40006	39066	38068								
7.94599	7.87517	7.80559	7.74058	7.67932								
8.36233	8.28385	8.20565	8.13124	8.06000								
7.36642	7.01578	5.55630	6.94841n	7.19838n								
36521	25630	09159	9.78480	8.84785n								
7.73163	7.27208	5.64789	6.73321n	6.04623n								
+.005391	+.001871	+.000044	−.000541	+.000118								
−.023027	+.019224	−.016057	−.03528	−.011482								
−.017638	−.017353	−.016101	−.014069	−.011371								
8.24638n	8.23987n	8.20685n	8.14826n	8.01580n								
0.18848n	0.18147n	0.14895n	0.09036n	9.99990n								

L'
u'
$\sin u'$
$\sin I$
$\tan u'$
$\cos I$
$\tan \lambda'$
v
$v+\omega'$
λ'
$\lambda'-(v+\omega')$
$\sin \beta'$
$\lg 2'$

May 20	Jan 29	Aug 8	Sep 117	oct 27	Dec 6
181 38 06	184 40 31	187 41 48	190 42 58	193 44 05	196 45 12
52 18 59	55 20 24	58 21 41	61 22 57	64 23 58	67 25 5
.73639	.73660	.73675	.73683	.73686	.73683

1871phae.proj..432O

	1870			1871						
	Sept. 18	Oct. 28	Dec 7	Jan 16	Feb. 25	Apr 6	May 16	Jun 25	Aug 4	Sept 23
	"	"	"	"	"	"	"	"	"	"
$di + r\cos\omega\, h_0$	−0.087	−.137	−.145	−.092	+0.42	+.266	+.562	+.878	+1.134	+1.253
$d\Omega$ (2) $2\sin\omega\, W_0$	−0.186	−.463	−.853	−1.342	−1.881	−2.389	−2.753	−2.850	−2.614	−2.090
(3) $\sin 2 R$	−1.787	−1.961	−1.113	+1.064	+4.607	+9.169	+13.939	+17.703	+19.288	+18.160
(3) $(\cos 2 + \cos^2 E)\, S_0$	+4.146	+6.939	+8.354	+7.868	+5.383	+1.482	−2.437	~~−2.980~~	~~+6.651~~	+16.178
$d\varphi$	+2.359	+4.968	+7.241	+8.932	+9.990	+10.651	+11.502	−4.481	−2.985	+2.982
								+13.222	+16.303	~~+18.978~~
										20.542
$-4\cos 2 R_0$	+24.023	+16.400	+5.975	−3.443	−7.033	−0.111	+19.820	+51.120	+86.424	+114.980
+(5) $(\frac{k}{2}+1)\, 2\sin 2 S_0$	+17.732	+47.100	+86.356	+128.613	+163.345	+178.593	+164.306	+117.355	+47.156	−25.838
(6) $2\sin\omega\, W_0$	+.003	−.005	−.009	−.014	−.019	−.026	−.029	−.030	−.027	−.022
$d\pi$	+41.752	+63.495	+92.322	+125.156	+156.293	+178.457	+184.097	+168.445	+133.553	+89.120
−(7) $\sin 2 R_0$	+0.1239	+.1360	+.0772	−0.0738	−.3194	−.5537	−.9664	−1.2274	−1.3373	−1.2591
−(8) $\frac{1}{2} S_0$	−1.4349	−2.7447	−4.0536	−5.2174	−6.0269	−6.2436	−5.6386	−4.0861	−1.7212	+1.0241
$d\mu$	−1.3110	−2.6087	−3.9764	−5.2912	−6.3463	−6.7973	−6.6050	−5.3135	−3.0585	−0.2350
−(9) $\cos 2 R_0$	+0.193	+.132	+0.048	+0.028	−0.057	−0.009	+.159	+.411	+.694	+.924
+(10) $2 R_0$	−6.293	−5.166	−2.478	+2.161	+9.019	+18.039	+28.523	+38.826	+46.649	+49.905
+(11) $(\frac{k}{2}+1)\, 2\sin 2 S_0$	+0.142	+.378	+.694	+1.033	+1.313	+1.435	+1.320	+0.943	+.379	−.208
+(6) $2\sin\omega\, W_0$	−.003	−.005	−.009	−.014	−.019	−.025	−.029	−.030	−.027	−.022
dL	−5.961	−4.661	−1.745	+3.152	+10.256	+19.440	+29.973	+40.150	+47.695	+50.599
+(12) $\cos 2 R_0$	−23.830	−16.269	−5.927	+3.415	+6.976	+0.111	+19.660	+50.710	+85.730	+114.057
−(10) $2 R_0$ wrong	+6.293	+5.166	+2.478	−2.161	−9.019	+18.039	+28.523	+38.826	+46.649	+49.905
(−13) $(\frac{k}{2}+1)\, 2\sin 2 S_0$	−17.590	−46.722	−85.663	−127.580	−162.033	−177.158	−162.987	−116.415	−46.780	+25.630
dM	−47.713	−68.157	−94.068	−122.004	−146.038	−159.008	−154.124	−128.299	−85.861	−38.522

	Jun 19	Jul 29	Sept 7	Oct 17	Nov. 26	Jan 5	Feb. 14	Mar 26	May 5	Jun 14
$di + r\cos\omega\, h_0$	~~−.044~~	~~+.112~~	~~+.381~~	~~+.684~~	~~+.964~~	~~+1.178~~	~~+1.300~~	~~+1.310~~	~~+1.205~~	~~+.994~~
	+.038	−.019	−.040	−.044	−.034	−.019	−.007	+.000	+.009	+.011
$d\Omega$ (2) $2\sin\omega\, W_0$	+.033	−.024	~~−.101~~	~~−.105~~	~~−.086~~	~~−.049~~	~~+.002~~	+.002	+.057	+.107
			−.076	−.101	−.105	−.086	−.049			
(3) $\sin 2 R_0$	−.106	+.271	+.920	+1.653	+2.328	+2.845	+3.140	+3.163	+2.911	+2.401
(3) $(\cos 2 + \cos^2 E)\, S_0$	+21.103	+16.980	+12.787	+8.886	+5.528	+2.874	+0.690	−.011	+.077	+.805
$d\varphi$	+20.997	+17.251	+13.707	+10.539	+7.856	+5.719	+3.830	+3.152	+2.988	+3.206
−(4) $\cos 2 R_0$	+6.822	−7.569	−16.247	−20.459	−21.046	−18.872	−14.854	−9.834	−4.750	−0.470
+(5) $(\frac{k}{2}+1)\, 2\sin 2 S_0$	+23.465	+40.223	+48.044	+47.913	+40.897	+29.663	+15.391	+0.594	−15.622	−28.251
(6) $2\sin\omega\, W_0$	+ 0	− 0	− 1	− 10	− 11	− 9	− 1	+ 0	+ 1	+ 13
$d\pi$	+29.787	+32.654	+31.796	+27.444	+19.840	+10.782	+0.536	−10.428	−20.371	−28.708
(−7) $\sin 2 R_0$	+5.1070	+4.2673	+3.4345	+2.6370	+1.8884	+1.1937	+.5673	−.0208	−.5362	−.9834
	+.0073	−.0188	−.0638	−.1146	−.1614	−.1972	−.2177	−.2193	−.2018	−.1665
(−8) $\frac{1}{2} S_0$	~~+.0511~~	~~+.0427~~	~~+.0343~~	~~+.0264~~	~~+.0119~~	~~+.0099~~	~~+.0057~~	~~−.0002~~	~~−.0054~~	~~−.0088~~
$d\mu$	~~+.0584~~	~~+.0239~~	~~−.0295~~	~~−.0882~~	~~−.1428~~	~~−.1858~~	~~−.2120~~	~~−.2195~~	~~−.2072~~	~~−.1763~~
	+5.1143	+4.2485	+3.3707	+2.5224	+1.7270	+.9965	+.3496	−.2401	−.7380	−1.1999
−(9) $\cos 2 R_0$	+.051	−.061	−.131	−.164	−.169	−.151	−.119	−.079	−.038	−.004
−(10) $2 R_0$	−1.830	+2.247	+5.046	+6.806	+7.732	+7.986	+7.721	+7.023	+6.005	+4.744
+(11) $(\frac{k}{2}+1)\, 2\sin 2 S_0$	+.188	+.323	+.386	+.385	+.329	+.238	+.124	−.005	−.126	−.227
(6) $2\sin\omega\, W_0$	−1.591	+2.509	− 1	− 10	− 11	− 9	− 1	+ 0	+ 1	+ 13
dL			+5.300	+7.016	+7.881	+8.064	+7.725	+6.939	+5.842	+4.500
+(12) $\cos 2 R_0$	−6.271	+7.508	+16.118	+20.295	+20.846	+18.720	+14.735	+9.706	+4.712	+0.466
−(10) $2 R_0$	−1.830	+2.247	+5.046	+6.806	+7.732	+7.986	+7.721	+7.023	+6.005	+4.744
+(13) $(\frac{k}{2}+1)\, 2\sin 2 S_0$	−23.277	−39.899	−47.659	−47.529	−40.569	−29.425	−15.268	+.590	+15.497	+28.024
dM	−31.378	−30.144	−26.495	−20.428	−11.961	−2.719	+7.188	+17.369	+26.214	+33.234

	Oct 23	Dec 2	Jan 11	Feb 20	Mar 31	May 10	Jun 19	Jul 29	Sept 7	Oct 17	Nov 26
	+1.204″	+1.019″	+.765″	+.572″	+.298	+.140″					
	−1.427	−0.803	−~~.034~~ .336	+~~.058~~ −.060	+.053	+.073					
	+14.794	+10.390	+6188	2987	+974	+034					
	+10.178	+17.987	+23.731	+26.609	26.663	+24.526					
	24.972	+28.377	+29.919	29.596	+27.637	24.560					
	+127886	+122678	+103248	+77109	+49818	+25.564					
	−79.510	−101.830	−94.426	−68.158	−34403	−22.132					
	−.015	−.008	−.003	−.001	+.001	+.001					
	+48.341	+20.840	+8.819	+8.950	+15.416	+[illegible] +23.433					
	−10257	−7204	−.4290	−2041	−0676	−0023					
	+3.5639	+5.4339	+5.1262 6.4535	+6.7399	+6.4773	+5.8698					
	+2.5382	+4.7135	+46972 6.0245	+6.5328	+6.4097	+5.8675					
	+1028	+0.986	+830	+620	+400	+.205					
	+47.819	+41.317	+32.342	+23.015	+14.460	+7.347					
	−.639	−.818	−761	−0.548	−276	−.017					
	−.015	−.008	−.003	−.001	+.001	+.001					
	+48.193	+41.477	+32.408	+23.086	+14.585	+7.536					
	+126.860	+121.685	+102430	+76.490	+49.418	+25.358					
	+47.819	+41.317	+32.342	+23.015	+14.460	+7.347					
x	+78872	+101.013	+93669	+67610	+34128	+22.105					
α =	0.169	+20.645	+23.581	+14.135	−0.830	~~+3.136~~ ±15.896					

ω' + N'
128 38 39

ω' = 209 13 33

	1870 Sept 14	Oct 28	Dec 7	1871 Jan 16	Feb 25	Apr 6	May 16	June 25	Aug 4	Sept 13	Oct 23
L'	268 02 17	269 14 25	270 26 33	271 38 41	272 50 49	274 02 57	275 15 05	276 27 14	277 39 24	278 51 35	280 03 48
u' = S(L' + Ω')	139 23 38	140 35 46	141 47 54	143 00 02	144 12 10	145 24 18	146 36 26	147 48 35	149 00 45	150 12 56	151 25 09
log sin u'	9.81348 n	9.80263 n	9.79129 n	9.77946 n	9.76710 n	9.75417 n	9.74066 n	9.72651 n	9.71168 n	9.69613 n	9.67979 n
sin I	8.93245										
tang u'	9.93313 n	9.91462 n	9.89596 n	9.87710 n	9.85803 n	9.83868 n	9.81901 n	9.92752 n	9.77856 n	9.75766 n	9.73622 n
cos I	9.99848										
tang λ'	9.93153 n	9.91302 n	9.89436 n	9.87550 n	9.85643 n	9.83708 n	9.81741 n	9.82592 n	9.77696 n	9.75606 n	9.73462 n
v	30 15 18	43 09 10	55 36 34	67 33 32	78 55 54	89 52 50	100 16 49	110 13 04	119 44 50	128 55 20	137 47 28
v+ω'	239 28 51	252 22 43	264 50 07	276 47 05	288 12 27	299 06 23	309 30 17	319 26 39	328 58 23	338 08 53	347 01 01
λ'	137 29 51	140 41 58	141 54 02	143 06 06	144 18 08	145 30 11	146 42 13	147 54 13	149 06 19	150 18 22	151 30 28
λ' − (v+ω')	260 01 00	248 19 15	237 03 55	226 19 01	216 05 41	206 23 48	197 11 56	188 27 34	180 07 56	172 09 29	164 29 27
log sin β'	8.74573 n	8.73508 n	8.72374 n	8.71191 n	8.69955 n	8.68662 n	8.67311 n	8.65896 n	8.64413	8.62858	8.61224
log r'	1.00218	1.00221	1.00223	1.00224	1.00223	1.00222	1.00219	1.00216	1.00212	1.00206	1.00199
log cos β'	9.99932	9.99936	9.99939	9.99942	9.99945	9.99949	9.99952	9.99955	9.99958	9.99961	9.99964
log z' = log r' sin β'	9.74841 n	9.73729 n	9.72597 n	9.71415 n	9.70178 n	9.68884 n	9.67530 n	9.66112 n	9.64625 n	9.63064 n	9.61423 n
log sin (λ' − (v+ω'))	9.99337 n	9.96814 n	9.92391 n	9.85924 n	9.77121 n	9.64745 n	9.47084 n	9.16764 n	7.36318 n	9.13494	9.42715
log r' cos β'	1.00150	1.00157	1.00162	1.00166	1.00166	1.00171	1.00171	1.00171	1.00170	1.00167	1.00163
log cot (λ' − (v+ω'))	9.23895 n	9.56751 n	9.73535 n	9.83927 n	9.90743 n	9.95218 n	9.98013 n	9.99525 n	0.00000 n	9.99592 n	9.98389 n
log cos j' = cos β' cos (c)	9.23827 n	9.56687 n	9.73474 n	9.83869 n	9.90688 n	9.95167 n	9.97965 n	9.99480	9.99958	9.99553	9.98353
log r'	1.00218	1.00221	1.00223	1.00224	1.00223	1.00222	1.00219	1.00216	1.00212	1.00206	1.00199
log tan j'	9.99339	9.96824	9.92416	9.85974	9.77129	9.65003	9.47578	9.18681	8.40000	9.15454	9.43175
log r' cos j'	0.24045	0.56908	0.73697	0.84093	0.90911 n	0.95389	0.98184	0.99696	1.00170	0.99759	0.98552
r' cos j'	+17396 n	+37075 n	+54543 n	+69333	+81117	+89928	+95905	+99323	+10.0390	99447	96722
R	+2.0191	2.1927	2.2353	2.2849	2.3386	2.3944	2.4504	2.5046	2.5551	2.6026	2.6428
R − r' cos j'	+3.8987	+5.9002	+7.6926	+9.2182	10.4503	11.3872	12.0405	12.4349	12.5945	12.5467	12.3150
log Q sin l'	0.99557	0.97045	9.92638	0.86200	0.77347	0.65225	0.47797	0.18857	9.64202	0.15660	0.43374
log Q cos l'	.59092	.77087	.88607	.96400	1.01913	1.05641	1.08066	1.09465	1.10018	1.09852	1.09043
log tang l'	.40465	.19958	0.04032	9.89800	9.75434	9.59585	9.39731	9.09432	8.54194	9.05808	9.34331
log Q	1.02689	1.04334	1.05768	1.06802 06985	1.07985	~~1.07924~~ 1.08780	1.09379	1.09798	1.10044	1.10134	~~1.44404~~ 1.10073
log 1/Q	8.97311	8.95666	8.94231	8.93015	8.92015	8.91220	8.90621	8.90202	8.89956	8.89866	8.89927
log 1/Q³	6.91933	6.86998	6.82693	6.79045	6.76045	6.73660	6.71863	6.70606	6.69868	6.69598	6.69781
log 1/r'	8.99782	8.99779	8.99777	8.99776	8.99777	8.99778	8.99781	8.99784	8.99788	8.99794	8.99801
log 1/r'³	6.99346	6.99337	6.99331	6.99328	6.99331	6.99334	6.99343	6.99352	6.99364	6.99382	6.99403
1/Q³	+.0008304	.0074128	.0067138	.0061724	.0057764	.0054526	.0052316	.0050823	.0049967	.0048657	.0049867
− 1/r'³		98485	98472	− 98465	98472	98479	98500	98520	98547	98588	98635
A	−.0098506	~~84~~	~~31085~~	− 36741	40868	43953	46184	47697	48580	48931	48768
	−.0015459	− 24357	− 31339								
log A	6.18916 n	6.38662	6.49609	6.56515	6.61138	6.64299	6.66449	6.67849	6.68646	6.68958	6.68813
log z'	9.74811 n	9.73729 n	9.72597 n	9.71415 n	9.70178 n	9.68884 n	9.67580 n	9.66112 n	9.64625 n	9.63064 n	9.61423 n
log Az'	5.93729	6.12391	6.22545	6.27930	6.31316	6.33183	6.33979	6.33961	6.33271	6.32022	6.30236
log W₀	7.35642 n	7.54204 n	7.64059 n	7.69743 n	7.73129 n	7.74996 n	7.75792 n	7.75774 n	7.75084 n	7.73835 n	7.72042 n
log A	6.18918	6.38662	6.49608	6.56515	6.61138	6.64299	6.66449	6.67849	6.68646	6.68958	6.68813
log y'	99487 n	96971 n	.92553 n	.86090 n	77187 n	64966 n	47255 n	16935 n	8.36488 n	13661 n	42878 n
log S₀	8.60218	8.77446	8.83975	8.84418	8.80138	8.71078	8.55377	8.26597	6.46947	8.24432 n	8.53504 n
S₀		−									
log r	33428	34088	34934	35886	36856	37920	38924	39874	40748	41530	42206
log 1/Q³	6.91933	6.86998	6.82693	6.79045	6.76045	6.73660	6.71863	6.70606	6.69868	6.69598	6.69781
log r/Q³	7.25361	7.21096	7.17627	7.14931	7.12941	7.11580	7.10787	7.10480	7.10616	7.11128	7.11987
log A	6.18918 n	6.38662	6.49609	6.56515	6.61138	6.64299	6.66449	6.67849	6.68646	6.68958	6.68813
log x'	24045	56908 n	73697 n	84093 n	90909 n	95389 n	98184 n	99696 n	1.00170 n	99759 n	.98552 n
log Ax'	6.42963 n	6.95570 n	7.23306 n	7.40608 n	7.52047 n	7.59688 n	7.64638 n	7.67545 n	7.68816 n	7.68710 n	7.67365 n
Ax'	+.0002689	+.0009030	.0017108	.0025473	.0033149	.0039526	.0044293	.0047365	.0048771	.0048660	.0047169
r/Q₀	−.0017931	−.0016254	−.0015006	−.0014103	−.0013471	−.0013056	−.0012820	−.0012729	−.0012769	−.0012921	−.0013179
Ax' r/Q₀	−.0015242	−.0007224	~~+.0002275~~ +.0002097	+.0011370	+.0019678	+.0026470	+.0031473	+.0034636	+.0036002	+.0035735	+.0033990
log S₀ Q₀											
log R Q₀	7.18304 n	6.85878 n	6.32160	7.05576	7.29398	7.42275	7.49794	7.53933	7.55633	7.55314	7.53135
log R₀	8.60117 n	8.27691 n	7.73973	8.47389	8.71211	~~7.56470~~ 8.84088	8.91607	8.95766	8.97446	8.97127	8.94948

1872

Dec 2	Jan 11	Feb. 20	Mar 31	May 10	Jun 19	Jul 29	Sept 7	Oct 17	Nov 26	Jan 5	Feb. 14	Mar 26	Ma
281 16 02	282 28 18	283 40 38	284 52 58	286 05 21	287 17 41	288 30 16	289 42 47	290 55 23	292 08 02	293 20 44	294 33 31	295 46 22	15 296 59 18
152 37 23	153 49 39	155 01 59	156 14 19	157 26 42	158 39 08	159 51 37	161 04 08	162 16 44	163 29 23	164 42 05	165 54 52 4 ~~52 59~~	167 07 43	168 20 35
9.66261	9.64451	9.62541	9.60523	9.58384	9.56113	9.53694	9.51112	9.48342	9.45360	9.42135	9.38627	9.34785	9.30542
9.71420	9.69147	9.66802	9.64370	9.61840	9.59204	9.56435	9.53527	9.50453	9.47189	9.43702	9.39952 ~~9.40674~~	9.35890	9.31444
9.71260	9.68967	9.66642	9.64210	9.61680	9.59044	9.56275	9.53367	9.50293	9.47029	9.43592	9.39792	9.35730	9.31284
146 24 40	154 50 02	163 06 26	171 16 58	179 24 28	158 43 20	160 00 48	161 8 00	162 20 24	163 32 50	164 45 18	165 57 52	167 10 27	168 23 12
355 38 13	403 36	12 19 59	20 30 31	28 38 01	187 31 44	195 41 38	203 57 02	212 20 52	220 56 10	229 46 00	238 53 28	248 21 57	258 14 34
152 42 31	153 54 48	155 06 48	156 18 58	157 31 11	36 45 17	44 55 11	53 10 35	61 34 25	70 09 43	78 59 33	88 07 01	97 35 31	107 28 07
157 04 18	149 51 06	142 46 49	135 48 27	128 53 10	121 58 08	115 00 32	107 57 27	100 45 19	93 23 07	85 45 45	77 50 51	69 34 56	60 55 0
8.59506	8.57696	8.55786	8.53768	8.51629	8.49358	8.46939	8.44357	8.41587	8.38605	8.35380	8.31872	8.28030	8.23737
1.00191	1.00182	1.00172	1.00160	1.00149	1.00136	1.00121	1.00105	1.00089	1.00072	1.00054	1.00034	1.00018	1.00002
9.99967	9.99969	9.99972	9.99974	9.99977	9.99979	9.99981	9.99982	9.99985	9.99987	9.99801	9.99991	9.99992	9.99993
9.59697	9.57878	9.55958	9.53928	9.51778	9.49494	9.47060	9.44462	9.41676	9.38677	9.35434	9.31906	9.28043	9.23739
9.55060	9.70091	9.78166	9.84328	9.89120	9.92857	9.95724	9.97831	9.99228	9.99924	9.99881	9.99010	9.97182	9.94147
1.00158	1.00151	1.00144	1.00134	1.00126	1.00115	1.00102	1.00088	1.00074	1.00059	1.00043	1.00025	1.00005	9.99995
9.96426	9.93688	9.90109	9.85552	9.79780	9.72382	9.62610	9.48899	9.27140	8.77122	8.86159	9.32320	9.54266	9.61669
9.96393	9.93657	9.90081	9.85526	9.79757	9.72361	9.62591	9.48882	9.27125	8.77105	8.86848	9.32311	9.54258	9.61662
1.00191	1.00182	1.00172	1.00160	1.00149	1.00136	1.00121	1.00105	1.00089	1.00072	1.00054	1.00034	1.00013	1.000
9.59239	9.70183	9.78215	9.84355	9.89135	9.92865	9.95729	9.97831	9.99229	9.99924	9.99881	9.99016	9.97182	9.94149
0.96584	0.93839	0.90253	0.85686	0.79906	0.72497	0.62712	0.48987	0.27214	9.77187	9.86902	0.32345	0.54271	.68662
+.92436	+.86775	+.79898	+.71923	+.62960	+.53085	+.42376	+.30894	+.18713	+0.05913	-0.07397	-.21060	-.34891	-.48599
2.6773	2.7050	2.7251	2.7376	2.7422	+2.7387	2.7274	2.7083	2.6818	2.6483	+2.6082	+2.5626	+2.5123	+2.4585
11.9209	11.3825	10.7149	9.9299	9.0382	+8.0472	+6.9650	+5.7977	+4.5531	+3.2396	+1.8685	+0.4566	-.9768	-2.4014
0.59430	0.70365	0.78387	0.84515	0.89284	0.93001	0.95850	0.97936	.99318	0.99996	0.99935	0.99050	.97195	0.94149
1.07631	1.05623	1.02999	0.99694	0.95080	0.90564	.84292	.76326	.65831	.51049	.27149	9.65954	9.98981	0.38046
9.51799	9.64742	9.75388	9.84821	9.93171	0.02437	.11558	.21610	.33487	.48947	.72786	1.33096	.98214	.56103
1.09871	1.09531	1.09059	1.08457	1.07727	1.06868	1.05883	1.04766	1.03528	1.02163	1.00682	.99097	.99429	.95729
8.90129	8.90469	8.90941	8.91543	8.92273	8.93132	8.94117	8.95234	8.96472	8.97837	8.99818	9.00903	9.02571	9.04271
6.70387	6.71407	6.72823	6.74629	6.76819	6.79396	6.82351	6.85702	6.89416	6.93571	6.97954	7.02709	7.07718	7.12813
8.99809	8.99818	8.99828	8.99840	8.99851	8.99864	8.99879	8.99895	8.99911	8.99928	8.99946	8.99966	8.99987	8.99997
6.99427	6.99454	6.99484	6.99520	6.99553	6.99592	6.99637	6.99685	6.99733	6.99784	6.99838	6.99898	6.99961	6.99991
.00050568	.00051769	.00053485	.00055716	.00058640	.00062225	.00066606	.00071949	.00078372	.00086120	.00095400	.00106433	.00119435	.00134320
98690	98751	98820	98902	98977	99066	99169	99278	99386	99505	.99629	.00099767	99910	99980
48122	46982	45335	.43146	-.40337	-.00036841	32563	27329	21014	.13385	-.00004229	+.00006666	.00019524	+.00034340
6.68234	6.67193	6.65643	6.63484	6.60570	6.56633	6.51272	6.43662	6.32251	6.12662	5.62624	5.82386	6.29059	6.53580
9.59697	9.57878	9.55958	9.53928	9.51778	9.49494	9.47060	9.44462	9.41676	9.38777	9.35424	9.31906	9.28043	9.23739
6.27931	6.25071	6.21601	6.17422	6.12348	7.47936								
7.69744	7.66884	7.63414	7.59235	7.54161	7.47936	7.40145	7.29937	7.15740	6.93252	6.39871	6.56105	6.98915	7.19132
6.68234	6.67193	6.65643	6.63484	6.60570	6.56633	6.51272	6.43662	6.32251	6.12662	5.62624	5.82886	6.25059	6.58580
59218	70242	78310	84462	89246	92992	95826	97919	99302	99983	99924	99041	97187	94142
8.69265	8.79248	8.85766	8.89769	8.90629	8.91418	8.88911	8.83394	8.73366	8.54458	8.04361	8.23240	8.68059	8.89535
42770	43216	43538	43736	43810	43754	43574	43270	42842	42296	41634	40868	40006	39066
6.70387	6.71407	6.72823	6.74629	6.76819	6.79396	6.82351	6.85702	6.89416	6.93511	6.97954	7.02709	7.07718	7.12813
7.13157	7.14623	7.16361	7.18365	7.20629	7.23150	7.25925	7.28972	7.32258	7.35807	7.39588	7.43577	7.47719	7.51879
6.68234	6.67193	6.65643	6.63454	6.60570	6.56633	6.51272	6.43662	6.32251	6.12662	5.62624	5.82386	6.29059	6.58580
96584	93839	.90253	.85686	.79906	72497	62712	48987	27214	9.77181	9.86902	32347	.54271	.68664
7.64818	7.61032	7.55896	7.49180	7.40476	7.29130	7.13984	6.92651	6.55465	5.89843	5.49526	6.14733	6.83330	7.22244
.0044412	-.0040768	.0036221	.0031032	.0025396	+.0017041	+.0018166	-.0019486	+.0021018	-.0022807	-.0024882	-.0027275	.0030005	.0033022
-.0013587	-.0014003	-.0014575	-.0015264	-.0016080	+.0019557	+.0013799	.0008443	+.0003932	+.0000992	+.0000312	.0001404	.0006812	+.0016650
+.0030945	+.0026765	+.0021646	+.0015768	+.0009316	+.0002516	-.0004367	-.0011043	-.0017086	-.0022015	-.0025194	-.0025872	-.0023193	-.0016332
7.49059	7.42757	7.33538	7.19778	6.96923	6.40071	6.64018	7.04309	7.23264	7.34272	7.40130	7.41281	7.36536	7.21304
8.90872	8.84570	8.78351	8.61591	8.38736	7.81884	8.05831	8.46122	8.65097	8.76085	8.81943	8.83094	8.98348	8.63117

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	1870 Sept 18	Oct 28	Dec 7	1871 Jan 16	Feb 25	Apr 16	May 16	June 25	Aug 4	Sept 13
$i \cos u\, k_0$	-.003″	-.004	-.003	-.002	+.001	+.003	+.006	+.008	+.010	+.011
$\frac{d\Omega}{dt}$ (2) $i \sin u\, w_0$	-.007	-.014	-.020	-.025	-.028	-.029	-.028	-.026	-.023	-.019
(3) $\sin v\, R_0$	-.049	-.031	+.011	+.066	+.122	+.167	+.196	+.206	+.198	+.176
(3′) $(\cos v + \cos E)\, \delta_0$	+.170	+.217	+.202	+.146	+.077	+.016	-.020	-.026	+.001	+.050
$\frac{d\varphi}{dt}$	+.121	+.186	+.213	+.212	+.199	+.183	+.176	+.180	+.197	+.226
(4) $\cos v\, k_0$	+.653	+.261	+.059	-.215	-.186	-.002	+.278	+.593	+.886	+1.113
(5) $(e+1) \sin v\, \delta_0$	+.726	+1.475	+2.088	+2.388	+2.320	+1.945	+1.353	.670	+.010	-.539
(6) $3 \sin u\, w_0$	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
$\frac{d\pi}{dt}$	+1.379	+1.736	+2.029	+2.173	+2.139	+1.943	+1.631	+1.263	+.896	+.574
(7) $\sin v\, R_0$	+.0034	+.0022	-.0008	-.0046	-.0085	-.0116	-.0136	-.0142	-.0137	-.0122
(8) $\frac{1}{2}\delta_0$	-.0587	-.0860	-.0980	-.0969	-.0858	-.0680	-.0464	-.0233	-.0001	+.0214
$\frac{d\mu}{dt}$	-.0553	-.0838	-.0988	-.1015	-.0943	-.0796	-.0600	-.0375	-.0138	+.0092
(9) $\cos v\, R_0$	+.005	+.002	-.001	-.002	.000	+.002	+.005	+.007	+.009	+.010
(10) $e\, R_0$	+.171	+.082	-.024	-.135	-.239	-.329	-.401	-.451	-.478	-.483
(11) $(e+1)\, e \sin v\, \delta_0$	+.006	+.012	+.017	+.019	+.018	+.016	+.011	+.005	-.004	-.004
(6) $e \sin u\, w_0$	.000									
$\frac{d\epsilon}{dt}$	+.182	+.096	-.007	-.118	-.221	-.311	-.385	-.439	-.469	-.477
(12) $\cos v\, R_0$	-.647	-.259	+.088	+.213	+.185	+.002	-.276	-.589	-.879	-1.104
(10) $e\, R_0$	+.171	+.082	-.024	-.135	-.239	-.329	-.401	-.451	-.478	-.483
(13) $(e+1)\, e \sin v\, \delta_0$	-.720	-1.464	-2.072	-2.369	-2.306	~~-2.366~~ 1.929	~~-1.929~~ 1.342	-1.342 -.665	~~-.665~~ -.010	~~+.010~~ +.530
	-1.196	-1.641	-2.038	-2.291	-2.360	-2.256	-2.019	-1.705	-1.367	-1.052

	Jun 19	July 29	Sept 7	Oct 17	Nov 26	Jan 5	Feb 14	Mar 26	May 5	June 14	July 24
di	+.008	+.006	+.004	+.003	+.001	+.000	-.000	-.000	+.000	+.001	+.002
$d\Omega$	+.007	+.007	+.007	+.006	+.004	+.001	-.002	-.005	-.008	-.104	-.115
$d\varphi$	-.002	+.007	+.028	+.058	+.091	+.122	+.140	+.136	+.108	+.037	-.080
	+.382	+.358	+.297	+.216	+.123	+.032	-.038	-.072	-.054	+.014	+.122
	+.390	+.365	+.325	+.274	+.214	+.154	+.102	+.064	+.047	+.051	+.062
$d\pi$	+.124	-.208	-.500	-.716	-.824	-.807	-.663	-.424	-.165	-.011	-.072
	+.436	+.848	+1.117	+1.163	+.908	+.334	-.573	-1.728	-2.952	-3.841	-4.359
$d\Pi$	+.560	+.640	+.617	+.447	+.084	-.473	-1.236	-2.152	-3.117	-3.852	-4.431
$d\mu$	+.0001	-.0003	-.0020	-.0040	-.0063	-.0084	-.0097	-.0094	-.0070	-.0026	+.0043
	+.0950	+.0900	+.0798	+.0640	+.0419	+.0134	-.0211	-.0604	-.1013	-.1355	-.1611
$d\mu$	+.0951	+.0895	+.0778	+.0600	+.0356	+.0050	-.0308	-.0698	-.1083	-.1381	-.1568
$d\mathcal{L}$	+.001	-.002	-.004	-.005	-.007	-.007	-.005	-.003	-.001	-.000	-.005
	-.036	+.062	+.155	+.238	+.303	+.341	+.345	+.303	+.209	+.074	-.118
	+.003	+.007	+.009	+.009	+.008	+.003	-.005	-.014	-.024	-.032	-.036
$d\mathcal{L} =$	-.035	+.067	+.160	+.242	+.304	+.337	+.335	+.286	+.184	+.042	-.155
dM	-.123	+.206	+.496	+.710	+.818	+.800	+.657	+.420	+.164	+.011	+.071
	-.036	+.062	+.155	+.238	+.303	+.341	+.345	+.303	+.209	+.074	-.118
	-.433	-.842	-1.108	-1.153	-.901	-.331	+.568	+1.714	+2.928	+3.810	+4.323
dM	-.592	-.574	-.457	-.205	+.220	+.810	+1.570	+2.437	+3.301	+3.895	+4.276

1872

Oct 23	Dec 2	Jan 11	Feb 10	Mar 31	May 10
+.012	+.013	+.012	+.012	+.011	+.009
~~−.014~~ −.018	− −.010	−.005	−.001	+.002	+.004
+.144	+.108	+.072	+.040	+.015	+.006
+.117	+.193	+.267	+.331	+.377	+.398
+.261	+.301	+.339	+.371	+.392	+.404
+1.248	+1.278	+1.201	+1.027	+.773	+.462
−.917	−1.093	−1.063	−.847	−.486	−.035
.000	.000	.000	.000	.000	.000
+.331	+.185	+.138	+.180	+.287	+.427
−.0100	−.0075	−.0049	−.0028	−.0010	−.0000
+.0411	+.0583	+.0726	+.0838	+.0915	+.0953
.0311	+.0508	+.0677	+.0810	+.0905	+.0953
+.010	+.009	+.008	+.007	+.006	+.004
−.467	−.438	−.376	+.307	−.224	−.183
−.007	−.009	−.009	−.007	−.004	−.000
−.464	−.430	−.379	−.307	−.222	−.129
−1.238	−1.268	−1.191	−1.019	−.767	−.458
−.467	−.430	−.376	−.307	−.224	−.183
+.910	+1.084	+1.054	+.841	+.482	+.034
−.795	−.614	−.513	−.485	−.509	−.557

	Sept 2	Oct 12	Nov 21	Dec 31	Feb 9	Mar 21	Apr 30	Jun 9	Jul 14	Aug 28	Oct 7	Nov 16
74												
2	+.003	+.004	+.005	.003	.001	.000	.000	.000	.000	.000	.000	.000
5	−.110	−.090	−.060	−.029	−.006	+.004	+.003	−.003	−.008	−.007	−.001	+.014
10	−.168	−.249	−.270	−.017	−.119	−.027	+.015	+.001	−.050	−.100	−.124	−.117
2	+.228	+.268	+.188	−.014	−.269	−.466	−.528	−.448	−.286	−.117	−.005	+.061
2	+.060	+.019	−.082	−.231	−.388	−.493	−.513	−.447	−.336	−.217	−.129	−.056
2	−.472	−1.198	−2.035	−2.602	−2.575	−1.913	−.912	−.013	+.574	+.720	+.568	+.310
9	−4.087	−2.978	−1.371	+.065	+.694	+.364	+.501	−1.241	−1.393	−.884	−.069	+1.145
				−2.537	−1.881	−1.549	−1.413	−1.254	−.819	−1.64	+.499	+1.455
1	4.559	−4.176	−3.406									
43	+.0118	+.0176	+.0190	+.0153	+.0084	+.0019	−.0011	−.0000	+.0035	+.0070	+.0087	+.0083
11	−.1647	−.1374	−.0773	+.0049	+.0871	+.1450	+.1643	+.1461	+.1025	+.0487	+.0031	−.0457
8	−.1529	−.1198	−.0583	+.0202	+.0955	+.1469	+.1632	+.1461	+.1060	+.0557	+.0118	−.0374
	−.004	−.010	−.017	−.022	−.021	−.016	−.007	−.000	+.001	+.005	+.005	+.003
	−.337	−.541	−.681	−.712	−.621	−.435	−.208	+.003	+.160	+.247	+.266	+.234
	−.034	−.025	−.011	+.001	+.003	~~+.003~~	−.103	~~−.115~~	~~−.007~~	−.007	−.001	+.009
							−.004	−.012	−.008	+.245	+.270	+.246
5	−.375	−.576	−.709	−.733	−.639	−.448	−.219	−.009	+.152			
1	+.468	+1.189	+2.019	+2.581	+2.554	+1.897	+.904	+.013	−.570	−.719	−.563	−.308
	−.337	−.541	−.681	−.712	−.621	−.435	−.208	+.003	+.160	+.247	+.266	+.234
3	+4.053	+2.953	+1.360	−.065	+.689	+.361	+.497	+1.230	+1.382	+.847	+.068	−1.436
b	+4.184	+3.601	+2.698	+1.804	+1.244	+1.101	+1.193	1.246	0.972	+0.410	−.229	−.526 −1.210

	$\frac{\omega^2}{dt}d\mu di^2$	′f	″f	$\frac{di}{dt}$″	′f	$\frac{d\Omega}{dt}$″	′f	$\frac{d\varphi}{dt}$ f	′f	$\frac{d\pi}{dt}$	′f
1870 Sept 11	-1.3110		-.1087	-.087		-.186		+2.359		+41.752	
		+.0540			+.002		+.012		-.109		-.906
a Oct 28	-2.6087		-.0547	-.137		-.463		+4.968		63.495	
		-2.5547			-.135		-.451		+4.859		+62.589
Dec 7	-3.9764		-2.6094	-.145		-.853		+7.241		92.322	
		-6.5311			-.280		-1.304		+12.100		+154.911
1871 Jan 16	-5.2912		-9.1405	-.092		-1.342		+8.932		125.156	
		-11.8223			-.372		-2.646		+21.032		+280.067
Feb 25	-6.3463		-20.9628	+.042		-1.881		+9.990		156.293	
		-18.1686			-.330		-4.527		+31.022		+436.360
Apr 6	6.7973		-39.1314	+.266		-2.389		+10.651		178.457	
		-24.9659			-.064		-6.916		+41.673		+614.817
May 16	-6.6050		-64.0973	+.562		-2.753		+11.502		184.097	
		-31.5709			+.498		-9.669		+53.175		+798.914
June 25	-5.4135		-95.6682	+.878		-2.850		+13.222		168.445	
		-36.9844			+1.376		-12.519		+66.397		+967.359
Aug 4	-3.0585		-132.6526	+1.134		-2.614		+16.302		133.553	
		-40.0429			+2.510		-15.133		+82.700		+1100.912
Sept 13	-0.2350		-172.6955	+1.253		-2.090		+20.542		89.120	
		-40.2779			+3.763		-17.223		+103.242		+1190.032
Oct 23	+2.5382		-212.9734	+1.204		-1.427		+24.972		48.361	
		-37.7397			+4.967		-18.650		+128.214		+1238.393
Dec 2	+4.7135		-250.7131	+1.019		-.803		+28.377		20.840	
		-33.0262			+5.986		-19.453		+156.591		+1259.233
1872 Jan 11	+6.0245		-283.7393	+0.765		-.336		+29.919		8.819	
		-27.0017			+6.751		-19.789		+186.510		+1268.052
Feb 20	+6.5328		-310.7410	+.512		-.060		+29.596		8.950	
		-20.4689			+7.263		-19.849		+216.106		+1277.002
Mar 31	+6.4097		-331.2099	+.298		+.053		+27.637		15.416	
		-14.0592			+7.561		-19.796		+243.743		+1292.418
May 10	+5.8679		-345.2691	+.140		+.073		+24.560		+23.433	
		-8.1913			+7.701		-19.723		+268.303		+1315.851
June 24	+5.1143		-353.~~2134~~ 4608	+.038		+.033		+20.997		+29.787	
		-3.0774			+7.739		-19.690		+289.300		+1345.638
July 29	+4.2485		-356.~~2894~~ 5382	-.019		-.024		+17.251		+32.654	
		+1.1711			+7.720		-19.714		+306.551		+1378.292
Sept 7	+3.3707		-355.~~1183~~ 3671	-.040		-.076		+13.707		+31.796	
		+4.5418			+7.680		-19.790		+320.258		+1410.088
Oct 17	+2.5224		-350.~~5765~~ 8253	-.044		-.101		+10.539		27.444	
		+7.0642			+7.636		-19.891		+330.797		+1437.532
Nov 26	+1.7270		-343.~~5123~~ 7611	-.034		-.105		+7.856		+19.840	
		+8.7912			+7.602		-19.996		+338.653		+1457.372
Jan 5	+0.9965		-334.~~7211~~ 9699	-.019		-.086		+5.719		+10.782	
		+9.7877			+7.583		-20.082		+344.372		+1468.154
Feb 14	+0.3496		-~~324.9334~~ 325.0822	-.007		-.049		+3.830		+0.536	
		+10.1373			+7.576		-20.131		+348.202		+1468.690
Mar 26	-0.2401		-314.~~7961~~ 9449	+.000		+.002		+3.152		-10.428	
		+9.8972			+7.576		-20.129		351.354		+1458.262
May 5	-0.7380		-~~304.8589~~ 305.0477	+.009		+.057		+2.988		-20.371	
		+9.1592			+7.585		-20.072		354.342		+1437.891
June 14	-1.1499		-295.~~7397~~ 8885	+.011		+.107		+3.206		-28.706	
		+8.0093			+7.596		-19.965		357.548		+1409.185
			-287.~~7304~~ 8792								

$\frac{dL}{dT}$	$'f$	$\frac{dLL}{dT}$	$'f$	
-5.961		-47.713		
	-.054		+.852	
-4.661		-68.157		
	-4.715		-67.305	
-1.745		-94.068		
	-6.460		-161.373	
+3.152		-122.004		
	-3.308		-283.377	
10.256		-146.038		
	+6.948		-429.415	
19.440		-159.009		
	+26.388		-588.424	
29.973		-154.124		
	+56.361		-742.548	
40.150		-128.299		
	+96.511		-870.847	
47.695		-85.861		
	+144.206		-956.708	
50.599		-38.522		
	+194.805		-995.230	
48.193		-0.169		
	+242.998		-995.399	
41.477		+20.645		
	+284.475		-974.754	
32.408		+23.581		
	+316.883		-951.173	
23.086		+14.135		
	+339.969		-937.038	
14.585		-0.830		
	+354.554		-937.868	
+7.536		-15.896		
	+362.090		-953.764	
-1.591		-31.378		
	+360.499		-985.142	
+2.509		-30.144		
	+363.008		-1015.286	
+5.300		-26.495		
	+368.308		-1041.781	
+7.016		-20.428		
	+375.324		-1062.209	
+7.881		-11.961		
	+383.205		-1074.170	
+8.064		-2.719		
	+391.269		-1076.889	
+7.725		+7.188		
	+398.994		-1084.077	1069.701
+6.939		+17.369		
	+405.933		-1101.446	1052.332
+5.842		+26.214		
	+411.775		-1127.660	1026.118
+4.500		+33.234		
	+416.275		-1160.894	992.884

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		$\omega^2\frac{du\,dI^2}{dt}$	′f	″f	$\frac{di}{dt}$	′f	$\frac{d\Omega}{dt}$	′f	$\frac{d\varphi}{dt}$	′f	$\frac{d\pi}{dt}$	′f	
1870	Sept. 18	-.0553''		-.0035	-.003		-.007		+.121		+1.379		
			+.0012			.000		.000		-.003		-.015	+0
	Oct. 28	-.0838		-.0023	-.004		-14		+.186		+1.736		
			-.0826			-.004		-.014		+.183		+1.721	+1
	Dec 7	-.0988		-.0849	-.003		-20		+.213		+2.029		
			-.1814			-.007		-.034		+.396		+3.750	+0
1871	Jan 16	-.1015		-.2663	-.002		-25		+.212		+2.173		
			-.2829			-.009		-.059		+.608		+5.923	-.0
	Feb. 25	-.0943		-.5492	+.000		-28		+.199		+2.139		
			-.3772			-.009		-.087		+.807		+8.062	-.2
	April 6	-.0796		-.9264	+.003		-29		+.183		+1.943		
			-.4568			-.006		-.116		+.990		+10.005	-.5
	May 16	-.0600		-1.3832	+.006		-28		+.176		+1.631		
			-.5168			-.000		-.144		+1.166		+11.636	-.9
	June 25	-.0375		-1.9000	+.008		-26		+.180		+1.263		
			-.5543			+.008		-.170		+1.346		+12.899	-1.3
	Aug 4	-.0138		-2.4543	+.010		-23		+.197		+.896		
			-.5681			+.018		-.193		+1.543		+13.795	-1.8
	Sept. 13	+.0092		-3.0224	+.011		-19		+.226		+.574		
			-.5589			+.029		-.212		+1.769		+14.369	-2.3
	Oct 23	+.0311		-3.5813	+.012		-15		+.261		+.331		
			-.5278			+.041		-.227		+2.030		+14.700	-2.9
	Dec 2	+.0508		-4.1091	+.013		-10		+.301		+.185		
			-.4770			+.054		-.237		+2.331		+14.885	-3.2
1872	Jan 1	+.0677		-4.5861	+.012		-5		+.339		+.138		
			-.4093			+.066		-.242		+2.670		+15.023	-3.6
	√ Feb. 20	+.0810		-4.9954	+.012		-.001		+.371		+.180		
			-.3283			+.078		-.243		+3.041		+15.203	-3.9
	March 31	+.0905		-5.3237	+.011		+.002		+.393		+.287		
			-.2378			+.089		-.241		+3.434		+15.490	-4.1
	May 10	+.0953		-5.5615	+.009		+.004		+.404		+.427		
			-.1425			+.098		-.237		+3.838		+15.917	-4.25
	June 19	+.0951		-5.7040	+8		+7		+.390		+.560		
			-.0474			+.106		-.230		+4.228		+16.477	-4.29
	July 29	+.0895		-5.7514	+6		+7		+.365		+.640		
			+.0421			+.112		-.223		+4.593		+17.117	-4.22
	Sept. 7	+.0778		-5.7093	+4		+7		+.325		+.617		
			+.1199			+.116		-.216		+4.918		+17.734	-4.06
	Oct 17	+.0600		-5.5894	+3		+6		+.274		+.447		
			+.1799			+.119		-.210		+5.192		+18.181	-3.82
1872	Nov 26	+.0356		-5.4095	+1		+4		+.214		+.084		
			+.2155			+.119		-.206		+5.406		+18.265	-3.52
1873	Jan 5	+.0050		-5.1940	+0		+1		+.154		-.473		
			+.2205			+.119		-.205		+5.560		+17.792	-3.183
	Feb. 14	-.0308		-4.9735	+0		-2		+.102		-1.236		
			+.1897			+.119		-.207		+5.662		+16.556	-2.848
	March 26	-.0698		-4.7838	+0		-5		+.064		-2.152		
			+.1199			+.119		-.212		+5.726		+14.404	-2.56
	May 5	-.1083		-4.6639	+0		-8		+.047		-3.117		
			+.0116			+.119		-.220		+5.773		+11.287	-2.37
	June 14			-4.6523									

Integration fr. May 25 1873

	$\iint\frac{du\,dI^2}{dt}$		dμ ~~di~~		di		dΩ		dφ			d
	♃	♄	♃	♄	♃	♄	♃	♄	♃	♄		♃
	-300'468	-46.581	+9.1592	+.0116	+7.585	+0.119	-20.072	-0.220	+354.342	+5.773		+14
	+ .039	+ .005	- .0172	- .0016	.000	.000	+ .002	.000	+ .009	- .001		–
	-300'429	-46.576	+9.1420	+0.100	+7.585	+.119	-20.070	-.220	+354.333	+5.772		+143
	46.576		+ .0100		+ .119		.220		5.772			+ 11.
	-347.005		+9.1520		+7.704		-20.290		+360.105			+1448
			+.20380						+6 00.105			+24
Precession					+1.254		+2 46.125		~~+2 30.705~~			+2 3
			+ 20380		+ 8''96		+ 2' 25''83		+ 6' 00''10			+26 2
			933.43898		2 36 48.28		323 59 59.81		7 13 41.52		337	40 3
			933.64278		2 36 57.24		324 02 25.64		7 19 41.62		336	13 1

	$\frac{d\mathcal{L}}{dt}$	f	$\frac{d\psi}{dt}$	f
	+.182		-1.196	
+.004		+.004		+.019
	+.096		-1.641	
+.100		+.100		-1.622
	-.007		-2.038	
+.093		+.093		-3.660
	-.118		-2.291	
-.025		-.271		-5.951
	-.221		-2.360	
-.246		-.432		-8.311
	-.311		-2.256	
-.557		-.843		-10.567
	-.385		-2.019	
-.942		-1.128		-12.586
	-.439		-1.705	
-1.381		-1.567		-14.291
	-.469		-1.367	
-1.850		-2.036		-15.658
	-.477		-1.052	
-2.327		-2.513		-16.710
	-.464		-.795	
-2.791		-2.977		-17.505
	-.430		-.614	
-3.221		-3.407		-18.119
	-.379		-.513	
-3.600		-3.786		-18.632
	-.307		-.485	
-3.907		-4.093		-19.117
	-.222		-.509	
-4.129		-4.315		-18.626
	-.129		-.557	
-4.258		-4.444		-20.183
	-.035		-.592	
-4.293				-20.775
	+.067		-.574	
-4.226				-21.349
	+.160		-.457	
-4.066				-21.806
	+.242		-.205	
-3.824				-22.011
	+.304		+.220	
-3.520				-21.791
	+.337		+.810	
-3.183				-20.981
	+.335		+1.570	
-2.848				-19.411
	+.286		+2.437	
-2.562				-16.974
	+.184		+3.301	
-2.378				-13.673

$d\pi$		$d\Omega$		$d\omega$	
h_1	h_2	h_1	h_2	h_1	h_2
+1437.891	+11.287	+411.773	-2.378	+1026.118	-13.673
-.347	-.040	-.056	-.004	+.293	+.036
+1437.544	+11.247	+411.715	-2.382	+1025.825	-13.637
+11.247		-2.382		-13.637	
+1448.791″		+409.337		~~+1012.188~~	
+24 8.791				+1039.462	
+2 30.705				-347.005	
+26 39.50				1386.467 = -23′ 06.47″	
40 37.95				-23 6.47	
13 17.45				277 50 35.30	
				277 27 28.83	

+24′ 13.67″

13 46 38.14

14 10 51.81

Integrationes

♃

Feb. 20.5 1873

	$\iint dU\,dt^2$ ♃	♄	du ♃	♄	di ♃	♄	$d\Omega$ ♃	♄	$d\varphi$ ♃	♄	$d\pi$ ♃	♄
Sat p	−310.741	−4555	−23.735	−.3688	+7.007	+.072	−19.819	−0.242	+201.308	+2.855	+1272.527	+15.113
$+\frac{1}{1200}$	+.546	+.007	−.0161	−.0009	+.019	.000	−.016	.000	+.095	−.003	−.275	−.006
	−310.195	−4988	−23.7874	−.3697	+7.026	+.072	−19.835	−.242	+201.403	+2.852	+1272.252	+15.107
	−4.988		−.3697		+.072		−.242		+2.852		+15 107	
	−315.183		−24.1271									
			−.60308		+7.10		−20.08		+204.25		+1287.86	
	−5' 15.183"		−60308		+7.10"		−20.08"		+3' 24.25"		+21' 27.86"	
Precession					+.84		+1' 50.75"				+1' 40.97	ΔΩ ' "
			−60303		+7.94		+1 30.67		+3 24.25		+23 7.83	ΔΩ = 21 37.16
fo			934.37700		2 36 34.40		323 58 54.10		*7 16 6.10		337 50 28.20	13 51 34.10
			933.77397		2 36 42.34		324 00 24.77		7 19 30.35		338 13 36.23	14 13 11.26

Ω 324 00 24.77
Ω − ν 144 00 24.77
½(Ω − ν) 72 00 12.38

i' 2 36 42.34
ε 23 27 21.36
i' + ε 26 04 03.70
i' − ε ~~+23~~ −20 50 39.02
½(i' + ε) 13 02 1.85
½(i' − ε) −10 25 19.51

sin ½(Ω − ν) 9.9782147
sin ½(i' + ε) 9.3531978
sin ½ i'' sin ½(Ω' + a) 9.3314125
sin ½ i'' cos ½(Ω' + a) 8.7473365n
tan ½(Ω' + a) 0.5840760n
½(Ω' + a) −75 23 42.76
104 36 17.24

cos ½(Ω − ν) 9.4899021
sin ½(i' + ε) 9.2574344n
8.7473365n

sin ½ i'' 9.3456772
½ i'' 12 48 22.50
i'' 25 36 45.00

sin ½(Ω − ν) 9.9782147
cos ½(i' + ε) 9.9886646
cos ½ i'' sin ½(Ω' − a) 9.9668793
cos ½ i'' cos ½(Ω' − a) 9.4826773
tan ½(Ω' − a) 0.4842020
½(Ω' − a) 71 50 36.50
½(Ω' + a) 104 36 17.24
Ω' 176 26 53.74
a 32 45 40.74
ω 14 13 11.26
ω' 341 27 30.52

cos ½(Ω − ν) 9.4899021
cos ½(i'' − ε) 9.9927752
9.4826773

cos ½ i'' 9.9890606

sin Ω' 8.7920402
cos i' 9.9550805
cos Ω' 9.9991651n
sin i' 9.6357676

−cos Ω' 9.9991651
cos i' sin Ω' 8.7471207
tan A 1.2520444
A 86 47 47 39
9.9998443

−sin Ω' 8.7920402
−cos i' cos Ω' 9.9542456
tan B 8.8377946n
B − 3 56 15.40
9.9552720

B 356 03 44.60

lg a 9.9998443
lg b 9.9552720
lg c 9.6357676

A + ω' 68 15 17.91
B + ω' 337 31 15.12
C ω' 341 27 30.52

2(A + ω') 136 30 35.82
2(B + ω') 315 02 30.24
2 ω' 322 55 1.04

sin 2(A + ω') 9.8377327
sin 2(B + ω') 9.8491684n
sin 2 ω' 9.7802971n

sin² (A + ω') 1.9554654
sin² (B + ω') 9.1793360
sin² ω' 9.5605942

log e = log sin φ 9.1055070
(e) .1274990
1 + e
1 − ε .8725010
log(1 + ε) .0521162
log(1 − ε) 9.9407659

log √(1 + ε) .0260581
log √a 9.1932550
log √(1 − ε) 1.9703829

log √(1 + e) √a 0.2193131
log √(1 − ε) √a 0.1636379

½ φ 3 39 45.17
45 − ½ φ 41 20 14.83
tan (45 − ½ φ) 9.9448249

log b 5.3144251
log e 9.1055070
log e'' 4.4159321

log b 3.5500066
log μ 2.9702415
3/2 log a .5797651
½ log a 1.932550
log a .3865100

Oppolzers formulae.

$d\Omega = l + \cot i \, \pi \sin(\Omega - \Pi)$

$d\pi = l - \tan\frac{1}{2} i \, \pi \sin(\Omega - \Pi)$

$di = - \pi \cos \Omega - \Pi$

1870

$\Pi = 173\ 12\ 15$

$l = 50.240$

$\pi = .4793$

log cot i	1.34116
log π	9.68079
sin (Π-Ω)	9.68860
	0.71055

i	2°	36	34
½ i	1	18	17
Ω =	323	58	54
π =	173	12	15
Ω-π	150	46	39

- log tan ½ i	8.35747n
log π	9.68079
sin(Ω-π)	9.68860
	7.72686n

- log π	9.68079n
cos(Ω-π)	9.94088n
	9.62167

$d\Omega = 50.240$
$+ 5.135$
$= 55.375$

$d\pi = +50.240$
$- .005$
$= 50.235$

$di = +.418''$

dL

h₁	h₂
+328.426	-3.753
+ .743	-.006
+329.169	-3.759
-310.195	-4.988
+18.974	-8.747
- 8.747	
+10.227	
+10.23	

dM

h₁	h₂
-944.105	-18.874
+ 1.257	.000
-942.848	-18.874
-310.185	-4.988
-1253.033	-23.862
23.862	
-1277.14	
-21′ 17.14″	

-21′ 17.14″
156 16 20.70

155 55 3.56

M Feb. 11.5 BMT 1872

	156	16	20.70
4M		-21	17.14
M	155	55	3.56
Red. to Feb. 20.5	2	20	9.39
Feb. 20.5 M	158	15	12.95
-	3	53	26.61
M Feb. 5.5 Athens	154	21	46.34

$d\pi = m' + n' \tan\frac{1}{2} i' \sin(\Omega + N)$

$d\Omega = m' - n' \cot i' \sin(\Omega + N)$

$di' = n' \cos(\Omega + N)$

$m' = 50.288$

$n' = .488$

$N = 7\ 15\ 30$

1870 Sept. 20 = 4326 Julian day

1872 Feb. 20 = 4844

(518) 518

1873 May 25 5304 978

log n′	9.68841
tan ½ i	8.35747
sin(Ω+N)	9.67528n
	7.73116n

Ω =	323	58	54
N =	7	15	30
(Ω+N) =	331	14	24

- log n =	9.68841n
cot i′	1.34116
sin(Ω+N)	9.67528n
	0.70485n

log n′ =	9.68841
cos(Ω+N)	9.94488
	9.63329

$d\pi = +50.288$
~~+ 0.005~~
~~50.306~~
$+ 50.233$

$d\Omega = 50.288$
$+ 5.068$
~~50.288~~
$+ 5.306$

$di = .430$

1872

	Feb. 5.5	Feb. 6.0	Feb. 28.5	Mar 1.5	2.5	6.5	7.5	8.5
M	154 21 46.34	154 29 33.23	160 19 43.14	160 50 50.69	161 21 58.24	161 53 5.79	162 24 13.34	162 55 20.89
E	157 11 39.90	157 18 46.50	162 31 21.39	162 59 6.24	163 26 50.60	163 54 34.50	164 22 18.00	164 50 1.20
sin E	9.5883888	9.5862475	9.4775983	9.4663054	9.4546866	9.4427206	9.4302918	9.4176744
e''	4.4199321	4.4199321	4.4199321	4.4199321	4.4199321	4.4199321	4.4199321	4.4199321
e sin E	4.0083209	4.0061796	3.8975304	3.8862375	3.8746187	3.8626522	3.8501728	3.8376065
e sin E	2 49 53.44	2 49 3.31	2 11 38.25	2 8 15.51	2 04 52.35	2 01 28.78	1 58 4.78	1 54 40.29
E	157 11 39.78	157 18 46.54	162 31 21.39	162 59 6.20	163 26 50.59	163 54 34.05	164 22 18.07	164 50 1.18
½ E	78 35 49.89	78 39 23.27	81 15 40.69	81 29 33.10	81 43 25.30	81 57 17.27	82 11 9.03	82 25 0.59
sin ½ E	9.9913420	9.9914323	9.9949240	9.9957948	9.9955433	9.9957047	9.9959484	9.9961851
cos ½ E	9.2960185	9.2937850	9.1816389	9.1700809	9.1582026	9.1459860	9.1334124	9.1204595
√ sin ½ v	9.2106557	.2107459	.2142421	.2145079	.2147664	.2150176	.2152615	.2154982
√ cos ½ v	9.4596564	9.4574229	9.3452768	9.3337188	9.3218405	9.3096242	9.2970503	9.2840974
tan ½ v	.7509987	.7533225	.8689653	.8807891	.8929259	.9053934	.9182112	.9314008
½ v	79 56 21.49	79 59 30.84	82 17 57.41	82 30 13.41	82 42 29.02	82 54 44.29	83 06 59.09	83 19 13.57
v	159 52 42.98	159 59 01.68	164 35 54.82	165 00 26.82	165 24 58.04	165 49 28.58	166 13 58.18	166 38 27.14
log √r	.2173850	.2174047	.2181766	.2182356	.2182931	.2183491	.2184034	.2184561
log r	.4347700	.4348094	.4363532	.4364712	.4365862	.4366982	.4368068	.4369122
v+A+ω'	228 08 0.89	228 14 19.59	232 51 12.73	233 15 44.73	233 40 15.95	234 04 46.38	234 29 16.09	234 53 45.05
v+B+ω'	137 23 58.10	137 30 16.80	142 07 09.94	142 31 41.54	142 56 13.16	143 20 43.60	143 45 13.30	144 09 42.26
v+ω'	141 20 13.50	141 26 32.20	146 3 25.34	146 27 57.34	146 52 28.56	147 16 59.00	147 41 28.70	148 05 57.66
sin(v+A+ω')	9.8719830	9.8726963	9.9015096	9.9038404	9.9061354	9.9083951	9106200	.9128107
log r a	.4346143	4346537	.4361975	4363155	4364305	4365425	4366511	4367565
			3377071	3401559	.3425659	.3449376	.3472712	3495672
sin(v+B+ω')	9.8305135	9.8296449	9.7881808	9.7841672	9.7800962	9.7759663	9.7717768	9.7675263
r b	.3900420	3900814	3916252	3917432	3918582	3919702	3920788	3921842
			.1798060	.1759104	.1719544	.1679365	.1638556	.1597105
sin(v+ω')	9.7956975	9.7946991	9.7469200	9.7422796	9.7375688	9.7327870	9.7279310	9.7230023
r c	.0705376	.0705770	.0721208	.0722388	.0723538	.0724658	.0725744	.0726798
x	−2.0258032	−2.0263173	−2.1762415	−2.1885470	−2.2007257	−2.2127766	−2.2246084	−2.2364812
X	+.7158148	+.7218507	+.9297186	+.9416538	+.9524494	+.9620910	+.9705655	+.9778612
x'	−1.3099884	−1.3074666	−1.2465229	−1.2468932	−1.2482763	−1.2506859	−1.2541329	−1.2586200
y	+1.6617110	1.6585409	~~1.5447674~~ 1.5128851	1.4993705	1.4851780	+1.4720973	+1.4583291	1.4444767
Y	−.6223894	.6167129	−.3151070	−.2852217	−.2548848	−.2244323	−.1936023	−.1625353
y'	+1.0393216	1.0418280	~~1.2296604~~ 1.1977781	1.2141538	1.2307932	1.2476650	1.2647268	1.2819414
z	+0.7349116	+.7332905	+.6592359	+.6524066	.6455393	.6386352	+.6316920	+.6247152
Z	−.2700557	−.2675906	−.1367217	−.1237558	−.1106375	−.0973822	−.0840061	−.0705264
z'	+.4648559	+.4656999	+.5225142	+.5286508	+.5349018	+.5412530	+.5476859	+.5541888
Δ cos δ cos α	.1172176	.1154307	.0957024	.0958292	.0968107	.0971482	.0983436	.0998946
Δ cos δ sin α	.0167081	.0177961	.0788763	.0842736	.0901886	.0960987	.1019967	.1078681
tan α	9.8994649	9.9023654	~~9.9940828~~ 9.9826739	9.9884444	9.9938761	9.9989499	.0036581	.0079735
α	−38 25 30.23	−38 36 47.47	43 51 26.52	44 14 16.2	44 35 45.57	44 55 50.64	45 14 27.50	45 31 33.36
α	141 34 23.77	141 23 12.53	136 08 33.48	135 45 43.39	135 24 19.43	135 04 9.36	134 45 32.50	134 28 26.64
Δ sin δ	9.6674410	9.6681061	9.7180981	9.7231688	9.7282440	9.7334003	9.7385315	9.7436578
Δ cos δ	9.2233713	.2225703	.2377263	.2406430	.2437849	.2471392	.2506929	.2544330
tan δ	9.4440388	9.4455358	9.4803718	9.4825258	9.4844891	9.4862611	9.4878386	9.4892248
δ	15 32 08.18	15 35 12.35	16 49 35.1	16 53 47.42	16 58 07.22	17 02 05.6	17 05 32.72	17 08 37.93
log Δ	.2385357	.23884	.25671	.25980	.26311	.26662	.27031	.27417
Δ(·) T	14 16	14 17	14 51	14 57	15 04	15 11	15 19	15 27
l	204 24		219 05	220 21	221 36	222 50	224 03	225 16
α	141 34		136 09	135 46	135 24	135 04	134 45	134 28
l − α	345 58		355 14	356 07	357 00	357 54	358 48	359 44
log g	6629		5952	5907	5863	5821	5780	5739
sin (β+α)	9.3852ₙ		8.9196ₙ		8.7188ₙ		8.3210ₙ	
tan δ	9.4440		9.4804		9.4845		9.4878	
log (α − α′)	9.4521		8.9952		8.7896		8.3868	
α − α′	−31	30	−10	−08	−06	−04	−02	00
f	−9.68	9.63	−7.07	−6.87	−6.67	−6.48	−6.29	−6.11
	−9.99	−9.93	−7.17	−6.95	−6.73	6.52	−6.31	−6.11
log g	6629		5952		5863		5780	
cos (β+α)	9.9869		9.9985		9.9994		9.9999	
log (δ′ − δ)	.6498		.5937		.5857		.5779	
δ′ − δ	+4.46	4.44	+3.92	+3.89	+3.85	+3.82	+3.78	+3.75

a   δ

Feb 15	141 34 23.77		15 32 8.18	
60	23 12.53	11 11.24	15 35 12.35	3 41.7

	° ′ ″					
Feb. 28.5	136 08 33.48					
	135 56 58.41	−22 50.05			−11 35.07	10 05 20.05
Mar 1.5	135 45 43.39		+121.13		11 15.02	53 20.33
2	135 34 48.70	−21 28.96		+1.76	10 54.69	54 20.42
3.5	135 24 14.43		+123.89		10 34.20	20.89
4	135 14 1.05	−20 5.07		+4.32	10 13.38	21.69
5.5	135 04 9.36		+128.21		9 51.69	22.06
6	134 54 39.73	−18 36.86		+2.79	9 29.63	22.40
7.5	134 45 32.50		+31.00		9 7.23	22.67
8	134 36 47.94	17 5.86			8 44.56	23.26
9.5	134 28 26.64		34.0		8 21.30	

Feb. 28.5	+16 49 35.7				16 49 35.1				
	+16 51 28.46	+2 24.55			51 28.46	+2 24.95		−5.99	
Mar 1.5	16 53 47.42	2 18.96	−5.99		53 47.42	2 18.96		5.99	
2	16 56 00.39	2 12.97	5.99	2	56 00.39	2 12.99		6.14	
3.5	16 58 7.22	2 6.83	6.14	3	58 7.22	2 6.83		6.18	
4	17 00 7.87	2 0.65	6.18	4	00 7.87	2 0.65		6.16	
5.5	17 02 2.36	1 54.49	6.16	5	2 2.36	1 54.49		6.11	
6	17 03 50.74	1 48.38	6.11	6	3 50.74	1 48.36		6.30	
7.5	17 05 32.82	1 42.08	6.30	7	5 32.82	1 42.08		6.30	
8	17 07 8.60	1 35.78	6.30	8	7 8.60	1 35.78		6.45	
9.5	17 08 37.93	1 29.33	6.45	9	8 37.93	1 29.33			

	Leip.				Lund				Berlin	
Date	Feb. 28	Mar 4	Mar 6	Mar 8	Mar 2	5	7	9	Feb. 5	11
M. T.	10 23 02	8 46 07	11 20 47	9 49 06	10 31 41	12 18 50	10 03 27	9 35 16	13 09 47	9 21 56
Red to B.M.T.	+0 4 1	0 4 1	0 4 1	0 4 1 +	49	49	49	49	00	00
B.M.T.	10 27 03	8 50 08	11 24 48	9 53 7	10 82 30	12 19 39	10 3 16	9 36 05	13 09 47	9 21 56
Ab. T	−3 14 51	15 07	15 15	15 24	15 07	15 11	15 19	15 24	14 16	14 17
Corr T	10 12 12	8 35 01	11 09 33	9 37 43	10 17 29	12 04 28	9 47 57	9 20 41	12 55 31	9 07 39
"	−07484	−14235	−03503	−09881	−07117	+00310	−09170	.11063	.03855	
log T	8.87425	9.15336	8.54444	8.99480	8.85230	7.49136	8.96237	9.04387	8.58602	
log T²	7.748	8.307	7.269	7.989	7.704	4.982	7.924	8.087	7.172	
μ(a)	−705.1	−602.58	−558.56	−512.93	−644.48	−580.60	−535.89	512.93	671.24	
μ′(a)	+10.02	+10.84	+11.30	+11.63	+10.21	+11.33	+11.23	+11.63	1392.48	
μ δ	+147.95	+117.57	+105.23	+92.55	+129.92	+111.53	+99.10	92.55	+443.4	
μ′ δ	−3.00	−3.08	−3.08	−3.22	−3.09	−3.15	−3.32	−3.22		
log μ(a)	2.84825	~~2.84801~~ 2.77998	2.74707	~~2.42932~~ 2.71006	2.80921	2.76392	2.72908	2.71006	3.12491	
log μ′(a)	1.00087	1.01870	1.05500	1.06556	1.059	1.045	1.053	1.065		
log μ δ	2.17011	~~2.17580~~	2.07030	1.96638	2.11368	2.04439	1.99607	1.96637	2.64680	
log μ′ δ		2.07030	2.02214							
Tμa	+52.78	+1 28.80	+1957	+50.67	+45.9	1.80 +	49.15 +	56.75 −	51.75 −	
T²μ′a	+.05	+.21	+.06	+.10	+5	0	.09	14		
sum	52.83	+1 26.05	+19.60	+50.88	45.9	1.80	49.24	56.89		
a₀	136 08 33.48	135 14 1.05	134 54 39.73	134 36 47.94	~~16 56 0.89~~	~~17 02 2.36~~	~~17 05 32.82~~	~~17 07 8.60~~	141 34 23.77	
a	136 09 26.31	135 15 27.10	134 54 22.53 59.3	134 37 38.92	~~16 56 46.31~~ 135 34 48.78 135 35 39.40	~~17 02 42.4~~ 135 04 9.36 135 04 7.56	~~17 06 22.06~~ 134 45 32.50 134 46 21.74	~~17 8 54.9~~ 134 26 47.94 134 37 44.83	141 33 32.02	
Tμδ	−11.08	−16.74	−3.67	−9.15	−9.24 3.66	0.34	9.08	−10.24	+17.09	
T²μ′δ	16 49 3.51	17 00 7.87	17 03 50.74	17 07 8.60	16 56 0.89	17 02 2.36	17 05 32.82	17 07 8.6	15 32 8.18	
sum	16 48 52.43	16 59 46.53	17 03 46.2 47.0	17 06 59.45	16 55 57.15	17 02 2.7	17 05 23.74	17 6 58.3	15 32 25.27	
δ₀	+4.46	+8.82 5.1	+3.8	+3.76	+3.87	+3.8	+3.8	+3.8		
δ	16 48 56.9	16 59 54.9	17 03 50.8	17 07 3.2	16 55 58.0	17 2 6.5	17 5 27.5	17 7 2.1	~~164 33.4~~	
log par (a)	8.446n	9.140n	9.134	7.301n	8.322	9.292	8.114	8.362n	8.877	
log Δ	256	264	268	274n	.260	.267	240	272	.240	
log par δ	~~7.800~~ 7.8100	708	.723	.699	.145	.763	.743	.743	0.727	
log par aΔ	7.890	8.876	8.866	7.030	8.062	7.026	7.844	8.090	8.637	
log par δΔ	.444	.444	.455	.428	.485	.496	.473	.471	0.487	
Δa	−.02	−1.1	+1.1	.0	+.2	+1.6	+.2	+0.6	.05	
a	135 59 17.0	135 05 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	141 23 19.95	139 54 12.9
a ☉	135 59 17.0	135 05 24.2	134 44 58.1	134 27 48.7	135 25 29.3	134 54 10.6	134 36 32.7	134 27 51.5	141 23 24.0	
a ℓ	136 09 26.3	135 15 27.4	134 54 39.3	134 37 38.9	135 35 30.4	135 04 7.6	134 46 21.4	134 37 44.8	141 33 32.0	
Δa(C−O)	+10 9.3	+10 3.1	+10 41.2	9 50.0	+10 1.02	+9 57.0	+9 49.0	+9 53.3	+10 12.0	
Δδ	+2.8	+2.8	+2.9	+2.7	5.4 3.2	3.1	3.0	3.0	+3.1	
δ	16 52 24.0	17 03 59	17 06 52.9	17 10 13	16 59 11.2	17 05 20.7	17 08 40.0	17 09 56.4	15 36 4.3	15 58 22.8
δ ☉	16 52 26.8	17 3 8.7	17 06 55.8	17 10 40	16 59 14.0	17 05 23.8	17 8 43.0	17 09 57.4	15 36 7.4	
δ ℓ	16 48 52.4	16 59 46.5	~~17 03 46.7~~	~~17 06 59.4~~	16 55 51.1	~~17 2 2.7~~	~~17 5 23.7~~	~~17 6 58.4~~	~~15 32 25.3~~	
Δδ(C−O)	−3 34.4	−3 22.2	−3 19.1	8 34.6	−3 25.1	~~−3 21.1~~	~~−3 19.3~~	−3 1.0	−3 42.1	

	Leipz				Lund			
	Feb. 28	Mar 4	6	8	Mar 2	5	7	8
a (𝒪)	135 59 16.8	135 05 23.2	134 44 59.1	134 27 48.7	135 25 29.4	134 54 12.1	134 36 32.5	134 27 52.1
Red for 1872.0	−7.7	−6.6	−6.4	−6.2	−6.8	−6.5	−6.3	−6.2
	136 09 26.3	135 15 27.1	134 54 59.3	134 37 38.7	135 35 34.6	135 04 7.6	134 46 21.7	134 37 44.8
a 𝒞 =	~~135 59 9.6~~	~~135 05 16.6~~	~~134 44 52.7~~	~~134 27 42.5~~	~~135 25 22.6~~	~~134 54 5.6~~	~~134 36 26.2~~	~~134 27 45.9~~
a 𝒪	136 09 19.1	135 15 20.5	134 54 52.9	134 37 32.5	135 35 27.8	135 04 1.1	134 46 15.4	134 37 38.6
4 a(C−O)	+10 2.3	+9 57.3	+9 53.8	+9 43.8	+9 58.4	+9 49.0	+9 42.9	+9 46.5
δ 𝒞	16 48 56.9	16 59 54.9	17 03 50.7	17 07 32	16 55 55.0	17 02 06.5	17 05 27.5	17 07 21
δ 𝒪	16 52 26.8	17 03 8.7	17 06 55.4	17 10 40	16 59 14.2	17 05 23.8	8 40.4	17 9 59.4
4 δ(C−O)	−3 29.9	−3 13.8	−3 5.0	−3 08	−3 19.2	−3 17.3	3 15.5	2 57.3
Correction assumed			+15	+15				+15 same corr. for each.
δ(C−O)	−3 29.9	−3 13.8	−3 20.0	−3 15.8	−3 19.2	−3 17.3	−3 15.5	−3 12.3

Feb. 28	+10′ 2.″3	−3′ 29.″9
Mar 4	9 57.3	13.8
6	9 53.8	20.0
8	9 43.8	15.8
2	9 58.4	19.2
5	9 49.0	17.3
7	9 42.9	15.5
8	9 46.5	12.3
Mar 5	+9 51.8 = 591.″8	−3 18.0 = −198.″0

(C−O)	1870 Sept. 24	1870 Oct. 18.5	1872 Mar 15	1870 Sept. 24.5	Oct. 14.5	1872 Mar 15	1873 Mar 25.5		1876 Feb. 13
Δa	+ 3.7	−0.8	+ 591.8	−1.1	−1.4		~~+836.0″~~ +876″		~~−~~ +307.8
Δδ	+1.4	−0.4	−198.0	+0.3	−2.5		~~−148.0~~ −12.6		+3.5
a − Ω₀									
sin i	9.63578	9.63573	9.63576	9.63573	9.63573		9.63573		9.63582
cos(a−Ω₀)	9.97750	9.98578	9.87207n	9.97750	9.98578		9.71622		9.98013n
sec O	12	29	3	12	29		00022n		10
cos N	9.61335	9.62580	9.50786n	9.61335	9.62580		9.35217n		9.61595n
sin N	9.95992	9.95731	9.97623	9.95952	9.95731		9.98872	9.98872	9.95939
cos δ	9.99332	9.99555	9.98051	9.99332	9.99555		9.96024	9.96024	9.99599
lg Δa	0.56820	9.90309	2.77218	.04139	14613n		2.94221	2.94250	2.48827n
lg I	0.52144	9.85595n	2.72892	9.59463n	0.09899n		2.89117	2.89146	2.48865n
lg cos N	9.61335	9.62580	9.50786n	9.61335	9.62580		9.35217n	9.35217n	9.61595n
lg Δδ	0.14613	9.60206	2.29666n	9.47712	0.39794n		2.17026n	2.24551n	0.54407
lg II	9.75948	9.22786	1.80452	9.09047	0.02374n		1.52243n	1.59768	0.16002n
I	+ 3.322	−.717	+ 535.70	−.99	−1.26		+ 778.3	+ 778.9	~~+~~ 11.1
II	+ .574	+ .169	+ 63.76	+ .12	−1.06		+ 33.3	+ 39.6	−11.4
dn sin θ	+ 3.896	−.548	+ 599.46	−.87	−2.32		+ 811.6	+ 818.5	~~+ 303.6~~ + 308.6 ~~+ 270.3~~
−lg sin N	9.61335	9.62580	9.50786	9.61335n	9.62580n		9.35217	9.35217	9.61595
cos δ	9.99832	9.99555	9.98051	9.99302	9.99555		9.96024	9.96024	9.99599
lg Δa	0.56820	9.90309n	2.77218	.04139n	14613n		2.94221	2.94250	2.48827n
lg I	0.17987n	9.52444	2.26055	9.64806	9.76748		~~2.24872~~ 2.24462	2.25491	2.10021n
lg sin N	9.95992	9.95731	9.97623	9.95952	9.95731		9.98872	9.98872	9.95939
lg Δδ	14613	9.60206	2.29666n	9.47712	0.39794n		2.17026	2.24551n	.54407
lg II	0.10605	9.55937	2.27289n	9.43704	0.35525n		2.15898n	2.23423n	0.50346
I	−1.497	+ .334	+ 182.45	+ .44	+ .58		+ 145.6	+ 179.8	+ 125.9
II	+ 1.277	+ .362	+ 182.20	+ .27	−2.27		−144.2	−171.5	+ 3.2
dθ	−0.220	+ .696	−5.25	+ 0.71	−1.69		+ 31.4	+ 8.3	+ 129.1 −122.7

Differential Coefficients

φ = 7° 23'

	1870		1872				1873	1874
Date	Sept. 24	Oct. 18	Mar 5.5				May 25	Nov 4
T	0	24	528				974	1498
log T	∞	1.38021	2.72263				2.98856	3.17551
log 2μ sin 1"	7.83220	7.83220	7.83190$_n$				7.83190$_n$	7.83230$_n$
log μT	∞	9.21241$_n$	0.55453$_n$				0.82046$_n$	1.00783$_n$
log r	.33523	.33921	.43670				.38600	.35846
r	2.1639	2.1838	2.7334				2.4323	2.2828
p	2.3951	2.3951	2.3955				2.3955	2.3933
r+p	4.5590	4.5789	5.1289				4.8278	4.6761
log(r+p)	0.65887	.66076	.71002				.68375	.66988
E	28 40 44	35 39 17	163 54 35				270 15 40	61 11 42
log sin E	9.68115	9.76559	9.44272				9.99999$_n$	9.94264
Compl log a cos φ	9.61718	9.61718	9.61703				9.61703	9.61739
log H	9.95720	.04353	9.76979				.30077$_n$	~~.68259~~ .22991
log rr	.67046	.67842	.87340				.77200	.71692
log aa cos φ	.76914	.76914	.76946				.76946	.76884
log $\frac{rr}{aa \cos\varphi}$	9.90132	9.90928	.10394				.00254	9.94808
$\frac{rr}{aa \cos\varphi}$	+.79675	+.81149	+1.27040				1.0059	.88732
$\frac{rr}{aa \cos\varphi} - 1$	−.20325	−.18851	+.27040				+.0059	−.11268
log$\left(\frac{rr}{aa \cos\varphi} - 1\right)$	9.30803$_n$	9.27533$_n$	9.43201				7.77085	9.05185$_n$
log F n	.30803$_n$	.27533$_n$	.43201				8.77085	.05185$_n$
log tan φ	9.10566	9.10566	9.10906				9.11165	9.11254
log cos E	9.94316	9.90985	9.98264$_n$				7.65870	9.68289
cos E	+.87733	+.81255	−.96082				+.00456	.48183
e	.12652	.12652	.12750				+.12824	.12855
e + cos E	1.00385	+.93907	−.83332				+.13280	.61038
− log(e + cos E)	.00167$_n$	9.97270	9.92081				9.12320	9.78560$_n$
log cos φ	9.99650	9.99650	9.99644				9.99644$_n$	9.99638
log tan ψ	0.00517$_n$	9.97620$_n$	9.92437				9.12676$_n$	9.78922$_n$
log tan ψ	9.78681$_n$	9.87125$_n$	9.55178$_n$				.11164	.05518$_n$
log cot ψ	8.78681	8.87125	8.55178				9.11164$_n$	9.05518
ψ	~~87 30 23~~ 86 29 51	~~4 15 40~~ 85 44 58	~~8 02 30~~ 87 57 34				−82 37 55 97 22 05	80 31 20
log sin ψ	9.99919	9.99880	9.99972				9.99640	9.99722
log r	.33523	.33921	.43670				.38600	.35846
log aa cos φ	.76914	.76914	.76946				.76946	.76884
log r sin ψ	.33442	.33801	.43642				.38240	.35568
log C'	.43472	.43113	.33304				.38706	.41316
a	14 42 53	9 19 56	135 04 53				235 0 6	46 41 00
Ω₀	356 26 56	356 26 56	356 26 44				356 27	356 27
v	10 01 34	8 11 14	170 20 1				−24 08	+21 43
a − Ω₀	18 15 57	12 53 00	138 37 09				238 39	48 14
log cos v	9.99332	9.99555	9.98051	9.99332	9.99555	9.98051	9.96028	9.96803
log sin(a − Ω₀)	9.49614	9.33133	9.82427	9.49614	9.34824	9.82024	9.93146$_n$	9.87266
log m cos θ	9.48946	9.32688	9.80478	9.48946	9.34379	9.80075	9.89174$_n$	9.84069
log sin v = log m sin θ	9.24079	9.15354	9.46681	9.24079	9.15354	9.46681	9.61151$_n$	9.56822
log tan θ	9.75133	9.82666	9.66203	~~9.97755~~ 9.75133	9.80975	9.66606	9.71983	9.72753
θ	29 25 34	33 57 29	24 39 58	29 25 34	32 50 1	24 52 06	207 40 53	28 06 06
i₀	25 36 37	25 36 37	25 36 44	25 36 37	25 36 37	25 36 44	25 36 47	25 36 53
log m	9.54945	9.40758	9.84639				9.94453	9.89516
log cos(a − Ω₀)	9.97754	9.98978	9.87207$_n$	9.97755	9.98893	9.87525	9.97622	9.82354
θ − i₀	3 48 57	8 14 52	−0 56 46	3 48 57	7 13 24	−0 44 38	182 04 08	2 29 13
log sin(θ − i₀)	8.82315	9.15641	8.21780$_n$	8.82315	9.09946	8.11338$_n$	8.55752$_n$	8.63741
log m	9.54945	9.40758	9.84634	9.54945	9.41938	9.84301	9.94453	9.89516
log cos(θ − i₀)	9.99904	9.99549	9.99994	9.99904	9.99654	9.99556	9.99972	9.99959
log sin θ	8.37260	8.56429	8.06414$_n$	8.37260	8.51884	7.95635$_n$	8.50205$_n$	8.53257
log sin h cos θ	9.54849	9.40307	9.84628	9.54849	9.41592	9.84297	9.94425$_n$	9.89475
log cos h cos θ	9.97082	9.98838	9.85258$_n$	9.97087	9.98448	9.85576	9.67650$_n$	9.79157
log tan h	9.57767	9.41874	9.99380$_n$	9.57762	9.43144	9.98721$_n$	0.26775$_n$	0.10318
log cos θ	9.99984	9.99971	9.99997	9.99989	9.99976	9.99998$_n$	9.99978	9.99975
θ								
h	20 42 52	14 39 49	135 24 55	20 42 44	15 06 44	135 50 36	241 38 20	51 44 35
i = v + Ω'	13 26 59	21 11 56	147 16 59	13 26 59	21 11 56	147 16 59	244 24 29	49 15 43
i − h	352 44 07	6 32 07	11 52 04	−7 15 45 352 44 15	6 5 12	11 26 23	2 46 09	357 31 08
ψ	86 29 51	85 44 53	87 57 34	86 29 51	85 44 53	87 57 34	97 22 05	80 31 20
i + ψ − h	79 13 58	92 17 00	99 49 38	79 14 06	91 50 05	99 23 57	100 08 14	~~93 37 49~~ 81 02 28

	1870 Sept. 24.5	Oct. 11.5	1872 Mar 5.5	2nd Computation 1870 Sept. 24.5	Oct. 11.5	1872 Mar 5.5	1873 May 25.5	1874 Nov 4
$u'+\psi-n$	79 13 55	92 17 00	99 49 38	79 14 06	91 50 05	99 22 35	100 8 14	81 02 48
$u-n$	352 44 07	6 32 07	11 52 04	352 44 15	6 5 12	11 26 23	2 46 9	357 31 68
$\log c'$	.43472	.43113	.33304	.42472	.43113	.33304	.38706	.41316
$\log a$	.07292	.08091	.26662	.07252	.08051	.26662	.15386	.11295
$\log r$	.33523	.33921	.43670	.33523	.33521	.43670	.38600	.35846
$\log c'$	.36180	.35022	.06642	.36180	.35022	.06642	.23320	.30021
$\log \sin(u'+\psi-n)$	9.99229	9.99965	9.99356	9.99229	9.99978	9.99416	9.99311	9.99467
$\log M$	.35409	.34987	.05998	.35409	.35000	0.06055	.22631	.29488
$\log \sin\theta$	8.37260	8.56429	8.06414_n	8.37260	8.51884	7.95639_n	8.50205_n	8.53257
$-\log \frac{c'}{a}$	.36180	.35022	.06642	.36180	.35022	.06642	$.23320_n$	$.30021_n$
$\log \cos(u'+\psi-n)$	9.27143	8.60033_n	9.23216_n	9.27132	8.50537_n	9.21302_n	9.24553	8.19236
$\log M_0$	8.00583_n	7.51484_n	7.36272_n	8.00572_n	7.37443	7.23583_n	7.98078_n	~~7.67609~~ 8.02514_n
$\log \frac{2}{a}$	.26231	.25830	.17008	.26231	.25830	.17008	.23214	.24551
$\log \sin(u-n)$	9.10193_n	9.05620	9.31814	9.10180_n	9.02544	9.29740	8.68406	8.63639_n
$\log N$	9.36424_n	9.31450	9.48322	9.36411_n	9.28374	9.46748	8.91620	8.88190_n
$-\log \frac{2}{a}$	.26231	.25830	.17008	$.26231_n$	.25830	$.17008_n$	.23214	$.24551_n$
$\log \sin\theta$	8.37260	8.56429_n	8.06414_n	8.37260	8.51884_n	7.95639_n	8.50205_n	8.53257
$\log \cos(u-n)$	9.99650	9.99717	9.99062	9.99650	9.99754	9.99129	9.99949	9.99957
$\log N_0$	8.63141_n	8.81976_n	8.22484	8.63141_n	8.77468_n	8.11776	8.73368_n	8.77767_n
$M = \frac{dn\cos\theta}{dt_1}$	+2.2599	+2.2381	+1.1481	+2.2599	+2.2387	+1.1496	+1.6839	+1.9719
$\frac{M}{N}\tan x$	0.0000	−0.3650	−4.1169	.0000	−0.3651	−4.1218	−11.1370	−20.0778
	−.2313	+.2063	+.3093	−.2313	+.1922	+.2934	+.0824	−.0762
$\frac{dn\cos\theta}{d\log a}$	−0.2313	−0.1587	−3.8126	−.2313	−.1729	−3.8284	−11.0546	−20.1540
$\frac{M}{N}\tan y$	+2.0478	+2.4740	+.6758	+2.0478	+2.4748	+.6766	−3.3660	+3.3481
	+.2341	−.1953	+.2549	+.2340	−.1820	+.2465	−.0110	+.0469
$\frac{dn\cos\theta}{d\varphi}$	+2.2819	+2.2787	+0.9307	+2.2818	+2.2928	+.9231	−3.3770	+3.3950
$\frac{M}{N}\tan z_1$	+4.5933	+4.2189	−3.1046	−4.5933	−4.2202	+3.1086	+0.0995	+2.2220
	+.1416	+.1534	−.1081	+.1416	−.1429	−.1045	+.1066	+.0865
$10\frac{dn\cos\theta}{d\chi}$	+4.7349	+4.0655	−3.2127	−4.4517	−4.3631	+3.0041	+0.2061	~~+2.3085~~ −2.1355
$M^0 = \frac{d\theta}{dt_1}$	−.0101	+.0033	−.0023	−.0101	+.0024	−.0017	−.0096	−.0106
$\frac{M^0}{N^0}\tan x$	.0000	−.0005	+.0082	.0000	−.0004	+.0062	+.0633	+.1079
	−.0428	−.0660	+.0168	−.0428	−.0595	+.0131	+.0541	−.0599
$\frac{d\theta}{d\log a}$	−.0428	−.0665	+.0250	−.0428	−.0599	+.0193	+.1174	+.0480
$\frac{M^0}{N^0}\tan y$	−.0092	+.0036	−.0013	−.0092	+.0026	−.0010	+.0191	~~+.1799~~ −.0180
	+.0433	+.0625	+.0141	+.0433	+.0564	+.0110	−.0072	+.0369
$\frac{d\theta}{d\varphi}$	+.0341	+.0661	+.0128	+.0341	+.0590	+.0100	~~−.0534~~ +.0119	+.0189
$\frac{M^0}{N^0}\tan z_1$	−.0206	+.0062	+.0062	+.0206	−.0045	−.0046	−.0005	+.0119
	+.0262	+.0491	−.0060	+.0262	+.0443	−.0047	+.0700	+.0681
$10\frac{d\theta}{d\chi}$	+.0056	+.0558	+.0002	+.0468	+.0398	−.0093	+.0695	~~+.0562~~ +.0800
$\log \frac{2}{a}$	.26231	.25830	.17008				.23214	.24551
$\log \sin\omega$	9.36659	9.55824	9.73278				9.95516_n	9.87950
$\log \cos\theta$	9.99987	9.99976	9.99998				9.99978	9.99975
$\log \frac{d\theta}{di''}$	9.62878	9.81625	9.90283				0.18708	0.13476_n
$\frac{d\theta}{di'}$	+.4254	+.6550	+.7995				−1.5385	+1.3328
$-\log \frac{2}{a}$	$.26231_n$	$.25830_n$	.17008				$.23214_n$	$.24551_n$
$\log \cos\omega$	9.98792	9.96957	9.92498_n				9.63543_n	9.63580
$\log \sin i$	9.63573	9.63573	9.63576_n				9.63576	9.81465
$\log \cos\theta$	9.99988	9.99976	9.99998				9.99978	9.99975
$\log \frac{d\theta}{d\Omega'}$	9.88584_n	9.86331_n	9.73079				9.80311	9.69571_n
$\frac{d\theta}{d\Omega_1}$	−.7689	−.7300	+.5380				+.3185	−.4962

n,, a b c d s

0 = +35.8 $d\iota$ $d\chi a$ $d\varphi$ $d\chi$

−09 −35.5 +38 +2.26 −0.23 +2.28 +4.43 +9.04

−2.35995 −2.5 +2.24 −0.16 +2.28 +4.07 +8.43

+599.5 +599.5 +1.15 −3.81 +0.93 −3.21 −4.44

0 = −07 +07 −52 n a b s

di′ dΩ′

0 = +07 +43 −47 −34

+1.1 +65 −73 −08

−5.2 +80 +54 +1.34

nn na na nb nb nc nc nd nd ns ns

15.21 8.81 −0.90 8.89 1845 35.26

.02 −1.24 .08 1.14 2.03 4.22

359400.25 689.44 2284.09 557.53 192440 29615.3

+697.11 −2284.96 +565.28 −1907.98 −2961.58 −2930.49

aa ab ab ac ac ad ad as as

5.11 .52 5.15 1069 20.43

5.02 .36 5.10 9.11 18.88

1.32 4.38 1.07 3.68 5.68

11.45 −5.26 +11.32 +16.12 +33.63

bb bc bc bd bd bs bs

05 .52 1.09 208

.03 .36 65 1.35

14.52 3.54 12.23 18.82

+14.60 −4.92 +10.49 +15.41

cc cd cd cs cs

5.20 10.79 20.60

5.20 9.28 19.19

0.86 2 2.99 4.59

11.26 +17.08 +35.24

dd ds ds

22.37 42.76

16.56 34.31

10.30 18.86

49.23 +92.93

a b c d s n

+68226 (aa) +11.45 −5.26 +11.32 +16.12 +33.63 +697.01

2.83395 lg (aa) 1.05881 0.72099n 1.05385 1.20737 1.52673 2.84324

−2283.52 (bb) +14.60 −4.42 +10.49 +15.41 −2284.91

−313.42 lg (ab) −2.42 −5.20 −7.41 −15.45 −320.20

−1970.10 bb (aa) +12.18 +0.78 +7.90 +30.86 −1964.71

3.29449n lg bb, 1.08565 9.89209 1.25285 1.48840 3.29330n

+550.26 (cc) +11.26 +17.08 +35.24 +561.28

+67452 (ac)(ac)/(aa) +11.19 +15.64 +33.25 +669.10

−12426 cc +.07 +1.14 +1.99 −123.82

−12616 bc bc, / bb +.05 +1.15 +1.98 −123.92

+1.90 cc2 +02 −01 +01 +1.00

0.27875 lg cc2 8.30103 8.00000 8.00000 0.30103

+49.23 +92.52 −1907.98

nn na na nb nb nc ns +22.69 +47.35 +981.30

44 0 .09 +15 +07

.49 45 −.51 −05

27.04 −4.16 −2.81 −7.00 −153802 dd

27.57 −3.80 −3.17 6.97 +960.53 (ad)(ad)/(aa)

aa ab ab as as −2898.53 +26.54 +45.57 −2889.28

.18 .33 74 −2895.30 dd, +26.31 +45.36 −2884.40

.42 47 .05 −3.25 bd, bd, / bb, +0.23 +.21 −1.88

64 .43 1.07 −.95 dd cd cd2 + 01 −01 −1.00

1.24 −.37 +.88 −2.30 dd2 +0.22 +0.22 −0.88

bb bs bs 0.36173n lg dd3 9.34242 9.94448n

.59 26

.53 6

29 12

1.41 1.04

lg dn 0.34173 dχ cd 9.94448 −08 −10 a n as an

−lg dd3 9.34242n Wcn2 9.34242n +2004.50 ad/dd

lg dχ 1.00730 Sum 0.60206 +1.954150 bn, bs, bn, / bb,

+10.454 lg sum 9.29003 0.25527

dχ 4046 −lg cc2 8.30103 8.30103n

dχ 104.54 lg dφ 0.98900 1.95424n

dφ −9.75 +90.00

n s n n

−2930.49 359415.4

+204720 42430

−497769 316985

−497800 316925

+ 0.31 60

+ 10

.21

0 = −380 + 124 di′ − 37 dΩ′

0 = −317 − 37 ″ + 1.41 ″

0 = −306 + di′ − 30 dΩ′

0 = −517 − di″ + 3.81

0 = +5.51 − 4.11 dΩ′

dΩ′ = +1.34″

0 = −380 + 1.24 di′ − 4.9 dΩ′

di′ = +3.48″

dχ bd, +7243 +1871 dχ ad +6523 +1684

dχ bc, −1160 −902 dφ ac −11037 −10188

bn, −19647 −1970 dχa ab −82029 −8003

Sum −18994 −18532 aa +69701 +682.3

lg sum 3.27862 3.26792 Sum −16892 −9684

−lg bb, 1.08565n 1.08565n lg sum 2.22639 2.98605

lg dχa 2.19297 2.18227 lg aa 1.05881n 1.05881n

dχa 15595 15215 lg dφ 1.19758 1.92724

+2 33.55 +2 32.15 dφ −14.71 +84.57

dn3 ds dn3 / dd3 nn4

0 = +3.9 +3.31 −3.59 −2.23 +1.90 = −2.3

−0.54 +3.21 −2.50 −2.23 +1.13 = +2.6

+599.5 +1.69 −5.94 −9.0 −1.27 = +0.3

0 = −0.9

−2.3

+599.5 +97.3 −57.7 +83.7 −35.5

0 = −02 + 15 − 1.0 = +0.3

0 = +0.7 + 2.3 − 1.0 +2.0

0 = −5.2 + 2.8 + 0.7 −1.5

$\lg\cos i'$ 9.95508
$\cos i'$ .9017
$1-\cos i'$ .0983
$\lg(1-\cos i')$ 8.99255
$\lg d\Omega'$ 0.12710
$\lg d\Omega'(1-\cos i')$ 9.11965
$d\chi$ +8.18
40.46
$d\pi'$ +40.59
$d\Omega'$ +1 34
$d\omega'$ +89.25

$\lg\cos i'$ 9.95508
$d\Omega'$ 12710
$-\lg\cos i' d\Omega'$ 0.08218
$d\chi$ −1.21
40.46
$d\omega'$ +89.25

dL_1 +14.71
$(1-\cos i')d\Omega'$ +.13
$d\varphi'$ +14.84
$d\pi$ +40.59
$d\mathcal{M}$ −25.75

$\lg C$ 9.76609n
$\lg d\lg a$ 2.19297n
$\lg d\mu$ 1.95906n
$d\mu$ −.91004
μ_0 934.37700   933.46696
$\lg\mu$ 9.3528704   2.9700948
$\lg\mu$ 2.9709451   2.9700948
$\lg C$ 3.5500066   3.5500066
$\lg a$ .5790615   .5799124
$\lg a$ 1930205   1933041
$\lg a$ .3860410   3866058

$\lg M\sin i''$ = 4.32335
$\lg d\lg a$ 2.19297
$\lg M d\lg a$ 6.51632
$d\lg a$ .0003283
a_0 −38 .3863230
a .3866513

$$d\mu = -\frac{3}{2} d\lg a\, \mu \sin 1'' = M \sin 1'' d\lg a$$

$-\log\frac{3}{2}$ −.17609n
$\lg d\lg a$ 2.19297
$\lg d\mu$ 2.97009
$\sin 1''$ 4.68557

.02472

$d\mu$ −1.0586
μ_0 934.3770
μ 933.3184
$\lg\mu$ 2.9700297
$\lg C$ 3.5500066
.5799769
1933256
$\lg a$ .3866512

Oct 18
31 25 45.37
−25.75
31 25 19.62
−25.41
31 24 54.21

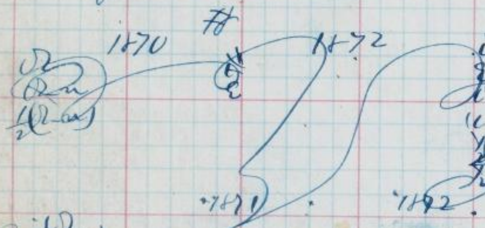
$\lg 932.7154$ = 2.9697491
3.5500066
5802575
19341.92
2

1870
Sept. 24

	M	μ	Ω'	i'	ω'	φ
4	25° 12′ 03″.2	934.3770	176 26 55.81	25 36 36.76	341 04 21.03	7 16 6.1
	−25.75	−1.0586	+ 1.34	+ 3.48	+39.25	− 9.75
	25 11 34.57	933.3184	176 26 57.15	25 36 40.24	341 05 00.28	7 15 56.35

1872 Mai 5.5

	M	μ	Ω'	i'	ω'	φ
	161 53 5.79	933.77397	176 26 53.74	25 36 45.00	341 27 30.52	7 19 30.35
	−25.75	−1.05860	+1.34	+3.48	+39.25	− 9.75
	161 52 40.04	932.71537	176 26 55.08	25 36 48.48	341 28 9.77	7 19 20.60
$d\mu$	− 9 18.90					
	161 43 21.14					



	1870	1872
$\sin\Omega'$	8.7919245	8.7919948
$\cos i'$	9.9550853	9.9550769
$\cos\Omega'$	9.9991655	9.9991652
$\sin i'$	9.6357468	9.6357830
$\frac{1}{2}(\Omega'-\varepsilon)$		

	1870	1872
$-\cos\Omega'$	9.9991655	9.9991652
$\cos i' \sin\Omega'$	8.7470098	8.7470717
$\tan A$	1.2521557	1.2520935
A	86 47 50.83	86 44 48.69
$\lg a$	9.9998446	9.9998443

	1870	1872
$-\sin\Omega'$	8.7919245n	8.7919948n
$-\cos i' \cos\Omega'$	9.9542508	9.9542421
$\tan B$	8.8376737n	8.8377527n
B	−3 56 11.47	−3 56 14.09
B	356 03 48.53	356 03 45.91
$A+\omega'$	67 52 50.61	68 15 58.46
$B+\omega'$	337 08 48.81	337 31 55.43
ω'	341 05 0.28	341 28 9.77
$\lg a$	9.9998444	9.9998443
$\lg b$	9.9552766	9.9552683
$\lg c$	9.6357468	9.6357830

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

	1870	1872
$\lg\sin\varphi = \lg e$	9.1019874	9.1053473
e	.1264700	.1274522
$1+\varepsilon$	1.1264700	1.1274522
$1-\varepsilon$	.8735300	.8725478
$\lg(1+\varepsilon)$	.0517197	.0520982
$\lg(1-\varepsilon)$	9.9412778	9.9407892
$\lg\sqrt{1+\varepsilon}$	.0258598	.0260491
$\lg\sqrt{a}$	9.9706389	9.9703946
$\lg\sqrt{1-\varepsilon}$		
$\lg a(1+\varepsilon)$	.2191854	.2194683
$\lg a(1-\varepsilon)$	.1635645	.1638188
$\frac{1}{2}\varphi$	7 15 56.35	7 19 20.60
	3 37 58.18	3 39 40.30
$45-\frac{1}{2}\varphi$	~~41 37 58.17~~	41 20 19.70
$\tan 45-\frac{1}{2}\varphi$	41 22 1.82	
	9.9447791	9.9443456
$\lg e$	9.1019874	9.1053473
$\lg C$	5.3144251	5.3144251
$\lg e''$	4.4164125	4.4197724

1870 1872

Corrected computation of place for 1870

Dec 24 Oct 18.5 Mar 5 Mar 5.5

M 25 11 34.57 31 24 54.21 | 161 43 21.14
E 28 40 9.54 | 163 45 01.12 163 45 51.25
9.6810183 | 9.4468875 9.4465224
4.4164125 | 4.4164125 4.4197724
4.0574308 | 3.8663000 3.8662948
3 18 25.00 | 2 13 7.62 2 3013
28 40 9.57 | 163 45 07.61 163 45 51.27
½ E 14 20 4.78 | 81 52 50.38 81 52 55.63
sin ½ E 9.3937247 | 9.9956147 9.9956262
cos ½ E 9.9862638 | 9.1502386 9.1498660
9.6129101 | .2150945
.1502283 | 9.3136798
9.4626818 | 0.9014147
.1610 5583 | 82 50 51.83
1677 8.50 | 2184870
½ v .3355700 | 4369840
v 32 21 51.66 | 165 41 43.66

100 14 42.7 | 233 57 42.12
9 30 40.47 | 143 13 39.39
13 26 51.54 | 147 09 53.43

9.9930198 | 9.9077166
.3541 44 | .4368183
9.2181181 | 9.7776412
.2808466 | .3922423
9.3665328 | 9.7341787
9.5713168 | .0727570

+.2130 2176 | −2.2108766
−1.0019679 | +.9620910
+.3228282 | −1.2487878
−.0269419 | +1.4770844
+.2176955 | −.2244323
−.0116864 | +1.2526561
+.6411145
−.0973822
+.5437323

x a cos S cos a 9.0524244 | .0964887
y a cos S sin a 9.4711175 | .0978320
z a 0.4186531 | .0013433
a | .4505 1800

9.7353853
.2476764
9.4877089
17 05 15.40

sept 205	15	33	−14.7		+18.2
21	15	20	−17.8	−11 56.9	+17.0
22	15	8	3.9	−12 13.9	15.7
23	14	55	34.3	12 29.6	14.4
24	14	42	50.3	12 44.0	13.2
25	14	29	53.1	12 57.2	12.0
26	14	16	43.9	13 09.2	10.8
27	14	03	26.6	13 20.0	9.4
28	13	49	54.5	14 29.4	8.1
29	13	36	17.0	39.5	6.9
30	13	22	32.6	44.4	6.1 5.5
1	13	8	42.7	13 49.9	4.2
2	12	54	48.6	13 54.1	2.9
3	12	40	51.6	13 57.0	+1.7
4	12	26	52.9	13 58.7	+.07
5	12	12	50.5	13 59.4	+1.4
6	11	58	55.5	13 58.0	+2.1
7	11	44	55.6	13 59.9	3.4
8	11	31	7.1	13 52.5	4.6
9	11	16	19.2	13 47.8	5.8
10	11	3	37.1	13 42.1	7.1
11	10	50	2.1	13 35.0	8.2
12	10	36	35.3	13 25.8	9.4
13	10	22	17.9	13 17.4	10.8
14	10	10	11.3	13 6.6	11.9
15	9	57	16.0	12 54.7	12.8
16	9	44	34.7	12 41.9	13.8
17	9	22	6.6	12 28.1	15.1
18	9	19	53.6	12 13.0	16.2
19	9	7	56.8	11 56.8	16.8
20	8	56	16.8	11 40.0	17.7
21	8	44	54.5	11 22.3	18.9
22	8	33	51.1	11 3.4	20.0
23	8	23	7.7	10 43.4	

nu	na	na	nb	nb	nc	nc	nd	nd	ns	ns
81		−203	+20			203		−926		814
529		5.15	37			524		9.36		19.30
35940.25	68.949	−228.409			55.703			1924.90		−2961.53
35940.35	+68.226	−228.352			+550.26			−1938.02		−2589.00

Equations of Condition

0 = −0.9 + 2.2599 dL, −23
−2.3 + 2.2381
+599.5 + 1.1481

b c d e dφ f s

0 = −0.9 + .0000 dΩ' + .0000 di' + 2.2599 dL, −.2313 d log a + 2.2819 + 4.7349 d χ/10 + 9.0454
−2.3 " " +2.2381 −.1587 +2.2787 +4.0655 +8.4236
+599.5 " " +1.1481 −3.8126 + .9307 −3.2127 −4.9465

+ 0.7 −.7689 " +.4254 " − .0101 +.0428 + .0341 +.0056 −.3567
−1.7 −.7300 " +.6550 " + .0033 +.0665 + .0661 +.0553 −.0168
−5.2 +.5380 " +.7995 " − .0023 +.0250 + .0128 +.0002 +1.3932

lg n ~~9.95424~~ ~~9.36173~~ ~~9.77779~~ ~~9.84510~~ ~~0.23045~~ ~~.71600~~
a
b
c
d
e
f
s

lg						
n	9.9542425	0.3617278 n	2.7777892	9.84510	0.23045	.71600 n
a	—	—	—	9.88587	9.86332 n	9.73078
b	—	—	—	9.62880 n	9.81624 n	9.90282
c	0.3540892	0.3498795	0.0599797	8.00432	7.51851	7.36173
d	9.3641756	9.2005769 n	0.5812212	8.63144 n	8.82282	8.39799 n
e	0.3582966	0.3576862 n	9.9688097 n	8.53275 n	8.82020 n	8.10721
f	0.6753108	0.6091140	0.5068702	7.74819	8.74272	6.30103
s	.9564278	.9254977	.6942880 n	9.56230 n	8.22531 n	0.13978

nn na na nb nb nc nc nd nd ne ne nf nf ns ns
0.8 — — — — 2034 .208 2054 4261 8141
8.3 5147 .365 5241 9.351 19.374
358840 0.2 688286 2285654 557955 1926.014 2965.427
0.5 .538 .298 .007 .030 0.024 .004 .250
2.9 1.241 1113 .005 113 .112 .094 .029
27.0 2.798 4157 .012 .130 .067 .001 7.191
3594367 −2095 −4972 +681.105 −2285.128 +550.505 −1939.717 −3000.309

aa +ab −ab ac ac +ad −ad ae ae af af as as
5912 8271 .0078 .0024 .0329 .0262 .0043 .2743
.5329 ~~4782~~ 4782 .0024 .0485 .0483 .0404 .0123
2894 .4301 .0013 .0134 .0069 .0001 .7388
1.4135 +.5812 −.3752 +.0041 +.0948 00 −.0676 −.0446 1.0250

bb bc bc bd bd be be bf bf bs bs
.1810 .0043 .0182 .0145 .0024 .1517
.4290 .0022 .0436 .0433 .0362 .010
.6392 .0018 .0200 ~~.0702~~ .0102 .0002 1.0979
1.2492 −.0039 −.0418 +.0680 +.0388 +.9352

cc cd cd ce ce cf cf cs cs
51071 .5227 51568 10.7005 20.4415
50091 3552 50999 90990 188525
1.3181 4.3773 1.0685 36885 .56790
.0001 .0004 .0003 .0000 .0036
.0000 .0002 .0002 .0002 .0032
.0000 .0000 .0000 .0000 .0000
11.4346 −.52550 +11.3251 +19.7994
3.6885
+16.1109 +33.1158

ff fs fs
22.4165 42.8251
16.8283 34.2462
10.3214 15.8916
.0000 .030 .0020
31 .0009
00 .0003
49.2721 92.9642

dd de de df df ds ds ee ef ef es es
.5278
.0535 ~~5.2781~~ 1.0952 20922 52071 10.8046 20.6407
.0251 .3616 .6452 1.3368 51925 9.2644 19.1948
14.5358 35484 12.2487 18859 .8662 2.9002 2.9900 46.037
.0018 .0015 .0002 .0153 .0012 .0036 .0122
.0044 .0044 .0037 .0017 .0243 .0000 .0011
.0005 .0003 .0000 .0343 .0002 .0177
14.6211 ~~4.1927~~ 4.4434 +10.5044 +15.5079 11.2915 17.0825 8.7448 +35.2361

	a	b	c	d	e	f	s	n
(aa)	+1.4135	−3752	+0041	+0948	−0676	−0446	+1.0250	−2.095
g(aa)	0.1502958	9.5742628	7.61278	8.97681	8.82995n	8.64933	0.01072	0.32118n
(bb)		+1.2452	−0039	−0418	+0680	+0388	+9351	−4.972
ab/aa		+.09960	−0011	−.0252	+.0179	+.0118	−.2721	+.556
bb₁		+1.14960	−0028	−0166	+0501	+.0270	+1.2072	−5.528
gbb₁		0.06055	7.44716n	8.22271n	8.69984	8.43136	0.08178	0.74257n
cc			+11.43460	−5.2550	+11.3251	+16.1109	+33.6158	+681.105
ac ac/aa			+0001	+0003	−0002	−0001	+0030	−.006
cc₁			+11.43459	−5.2553	+11.3253	+16.1110	+33.6129	+681.111
bc₁ bc₁/bb₁			0000	.0000	−0001	−0001	−.0029	+.013
cc₂			+11.43458	−5.2553	+11.3254	+16.1116	+33.6158	+681.098
gcc₂			1.0582209	0.7205975n	1.0540535	1.2071252	1.5265434	2.8332096
dd				+14.6211	−4.4434	+10.5044	+15.4801	−2285.128
ad ad/aa				+0036	−0045	−0030	+.0697	−.140
dd₁				+14.61674	−4.4389	+10.5074	+15.4114	−2284.988
bd₁ bd₁/bb₁				+.0024	.0007	+.0004	−.0175	+.080
dd₂				+14.6145	−4.4382	+10.5078	+15.4289	−2285.068
cd₂ cd₂/cc₂				+2.41532	−5.2051	−7.4046	−15.4497	−313.030
dd₃				+12.1991	+0.7669	+19.5124	+30.8786	−1972.038
gdd₃				1.0863806	9.8847347	1.2531538	1.4896562	3.2949155n
ee					+11.27150	+17.0825	+35.2361	+550.505
ea ea/aa					+.00323	+.0021	−.0490	+.100
ee₁					+11.26827	+17.0804	+35.2851	+550.405
be₁ be₁/bb₁					+.00218	+.0012	+.0526	−.244
ee₂					+11.26609	+17.0792	+35.2325	+550.646
ce₂ ce₂/cc₂					+11.21726	+15.9572	+33.2948	+674.594
ee₃					+.04883	+1.1219	+1.9377	−123.948
de₃ de₃/dd₃					+.04821	+1.1260	+1.9412	−123.572
ee₄					+.00062	−.0041	−.0035	+0.024
gee₄					6.~~54810~~ 79239	~~7.59106~~ 7.61276n	~~7.50515~~ 7.54407n	~~9.31387~~ 8.38071
ff						+49.2721	+92.9642	−1935.747
af af/aa						+.0014	−.0328	+.066
ff₁						+49.2707	+92.9965	−1939.783
bf₁ bf₁/bb₁						+.0006	+.0284	−.130
ff₂						+49.2701	+92.9682	−1938.653
cf₂ cf₂/cc₂						+22.7002	+47.3640	+959.653
ff₃						+26.5699	+45.6042	−2898.306
df₃ df₃/dd₃						+26.3013	+45.3398	−2895.600
ff₄						+.2686	+0.2644	−3.706
ef₄ ef₄/ee₄						+.0258	+0.0226	−.159
ff₅						+.2567	+0.2578	−5.085
gff₅								

+2686 + 2644 − 3.706
+ 271 + 231 − 159
+.2415 + 2413 − 3547
9.38292 9.n 0.54986n

lgfn₅ .54986n
−lgff₅ 9.38292
lg dx 1.16694n
dx/10 + 14.687

dx ef₄ − 0.060
en₄ + 024
Sum − 0036
log sum 8.55630n
−lg ee₄ 6.79239n
log dφ 1.76391n
dφ + ~~88.47~~ +58.06

dx df₃ +26308
dφ de₃ + 4458
dn₃ −1972.04
Sum −1664.43
log sum 3.22124n
−lg dd₃ 1.08633n
lg dλa 2.13493
dλa ~~+134.71~~ +136.44

dx cf₂ +23663
dφ ce₂ +65760
dλa cd₂ −70701
cn₂ +681.10
Sum +117.9186832
log dω 2.93808
−lg cc 1.05822
lg dL 1.88046n
dL ~~−103.02~~ −75.94

an as an
sn nn
bn₁ bs₁ bn₁
sn₂ nn₂
cn₂ cs₂ cn₂
sn₃ nn₃
dn₃ ds₃ dn₃
sn₄ nn₄
en₄ es₄ en₄
sn₅ nn₅
fn₅ fs₅
nn₆

ns	nn
−3000.32	+359436.7
1.52	3.1
−2998.80	+359433.6
− 5.80	+ 26.6
−2993.00	+359407.0
+200232	+440569.4
−4995.32	+318837.6
−4991.62	+318716.8
− 3.70	+120.8
− .14	.9
− 3.56	+119.9
	52.1
	67.8

dx bf₁ +0.40
dφ be₁ +2.91
dλa bd₁ −2.28
dL bc₁ +0.21
bn₁ −5.53
Sum −4.29
log sum −4.29
−lg bb 0.63246
lg di′ 0.06055n
di′ 0.57191
+ 3″.73

dx af − 0.65
dφ ae − 3.92
dλa ad +12.93
dL ac − .31
di ab −2.09
an − 1.40
Sum + 4.56
log sum 0.65896
−lg aa .15030
lg dΩ′ 0.50866n
dΩ′ − 3.47 −3.23

0 = −0.90 + 69.54 + 132.52 31.55 − 171.61 = −2″.1
0 = −2.30 + 59.71 + 132.31 − 21.65 − 169.96 = −1.9
0 = +155.10 + 47.19 + 54.04 − 52.018 − 87.18 = −1.0

0 = +0.70 + 08 + 1.98 − 5.84 + 0.46 + 1.59 + 2.48 = + 1.7
0 = −1.70 + 7.81 + 3.84 − 9.07 − .25 − 2.44 + 2.35 = − 5.4
0 = −5.20 + 00 + .74 + 3.41 − .17 + 2.98 − 1.74 = + 0.0

lg(1−cos i) 8.95255
lg dΩ′ 50866n
lg(1−cos i)dΩ′ 9.50096n
(1−cos i)dΩ′ − 0.32
dx +2 26.87
dπ′ +2 26.55
dΩ′ − 3.23
dω′ +2 ~~22.51~~ ~~30.45~~ 29.78

lg cos i 9.95508
lg dΩ′ 50866n
−lg dΩ′ cos i .45624
−dΩ′ cos i +2.86
dx 2 26.87
dω +2 ~~30.44~~ 29.78

dL − 75.94
(1−cos i)dΩ′ − .32
dL′ −1 16.26
dπ′ +2 26.48
dM ~~−1 10.15~~ −3 42.74

− lg 3/2 .17609n
lg dλa 2.13493
log a 2.57009
sin 1″ 4.68557
lg dμ 9.96668n
dμ −.92615
μ 934.37700
933.45085
log μ 2.9700915
log 6 3.5500066
.5799151+
1933050
.3866100

lg M sin 1″ 4.32335
lg dλa 2.13493
6.45828
lg dλa .0002843
.3863230
.3866103

1870

	M Sep. 24.5	u	Ω'	i'	ω'	φ
f₀	25 12 0.32	934.3770	176 26 55.81	25 36 36.76	341 04 21.03	7 16 6.10
	− 3 42.74	− 92615	− 3.23	+ 3.73	+ 2 29.78	+ ~~58~~ + 58.06
f	25 8 17.58	933.45085	176 26 52.58	25 36 40.49	341 6 ~~51.44~~ 50.81	7 17 4.16

M Oct 18.5 = 31 25 45.37
− 8 42.74
31 22 02.63
adm − 22.23
31 21 40.40

1872 Mar 5.5							
f₀	161 53 5.79	933.77397	176 26 53.74	25 36 45.00	341 27 30.52	7 19 30.35	log a 2.9658108
	− 3 42.74	− 92615	− 3.23	+ 3.73	+ 2 29.78	+ 58.06	log e 8.5500066
f	161 49 23.05	932.84782	176 26 50.51	25 36 48.73	341 30 ~~0.26~~ 0.30	7 20 28.41	.5801556
adm	− 8 9.01						.1938986
	161 41 14.04						

1872		1870	1872
8.7921498	sin Ω'	8.7920788	
9.9550767	cos i''	9.9550850	
9.9991646	cos Ω'	9.9991648	
9.6357839	sin i''	9.6357479	

	1870	1872
− cos Ω'	9.9991648	9.9991646
cos i sin Ω'	8.7472048	8.7472265
tan A	1.2510003	1.2519381
A	86 47 44.24	86 47 44.56
log a	9.9998443	9.9998443

	1870	1872	
− sin Ω'	8.7921088	8.7921498	
− cos i tan Ω'	9.9542498	9.9542413	
tan B	8.8378257	8.8379085	
B	− 3 56 16.54	− 3 56 19.10	356 03 43.46 356 03 40.90
log b	9.9552763	9.9552683	

	1870	1872
A + ω'	67 54 37.02	68 17 44.86
B + ω'	337 10 34.27	337 33 41.20
ω'	341 06 50.81	341 30 0.30
log a	9.9998443	9.9998443
log b	9.9552763	9.9552683
log c	9.6357479	9.6357839

log e = sin φ

	1870	1872
e	9.1031058	9.1064570
1 + e	.1267961	.1277783
1 − e	.8932039	.8722217
log (1 + e)	.0518450	.0522257
log (1 − e)	9.9411156	9.9406268
log $\sqrt{1+e}$	.0259227	.0261118
log $\sqrt{\dfrac{1-e}{1+e}}$	9.9703578	9.9703134
log a (1 + e)	.2192277	.2195104
log a (1 − e)	.1638628	.1637120

	1870	1872
φ	7 17 4.16	7 20 28.41
½ φ	3 38 32.08	3 40 14.20
45 − ½ φ	41 21 27.92	41 19 45.80
log tan (45 − ½ φ)	9.9446343	9.9442076
log e	9.1031058	9.1064570
log 6	5.3144251	5.3144251
log e''	4.4175309	4.4208821

	1870 Sep. 24.5	Oct. 18.5	1872 Mar 5.5	Sep. 24.5
M	25 10 20.17	31 24 12.99	161 43 46.63	
E	28 39 55.93	35 38 11.09	163 46 30.71	25 8 17.58
½ E	14 19 57.96	17 49 5.54	81 53 15.35	28 37 4.17
sin² ½ E	9.3936688	9.4857183	9.9956322	14 18 32.08
cos² ½ E	9.9862674	9.9786516	9.1495748	9.3929604
$\sqrt{r}$ sin ½ v	9.6128962	9.7049460	.2151426	9.9863136
$\sqrt{r}$ cos ½ v	.1501302	.1425144	9.3132868	9.6121881
tan ½ v	9.4627660	9.5624316	0.9018558	.1501764
½ v	16 11 06.55	20 3 28.72	82 51 17.70	9.4620117
v	32 22 13.10	40 06 57.44	165 42 35.40	16 9 30.71
log r	.3353868	.3390776	.4370566	32 19 1.42
				.3353622

100 16 50.15
8 32 47.25
13 29 4.57

9.9929711
33,52311
9.2197054
2906633
9.3676988
9.9711347
+ .2129 1300
− 1.0019707
+ .3238707
− .0268533
+ .2183893
− .0116479

a b c d e f s

new Interpolation = −0.9 + .0000 dΩ′ + .0000 di + 2.2599 dL, ~~−~~.2318 $\frac{dl}{dt}$ + 2.2818 dφ − 4.4517 d$\frac{\chi}{10}$ −.1413

−2.3 +2.2387 −.1729 +2.2928 −9.3631 −.0045

+.5995 +1.1496 −3.8284 + .9231 +3.0041 ~~+2.0727~~ 1.2474

+0.7 −.7689 +.4254 −.0101 −.0428 +.0341 + .0468 −.3155

−1.7 −.7300 +.6550 +.0024 −.0599 +.0590 + .0398 −.0337

−5.2 +.5380 +.7995 −.0017 +.0193 +.0100 −.0093 +1.3558

log n 9.9542425 .3617278ₙ 2.7777852 9.84510 23045 .71600ₙ

log a — — — 9.88587ₙ 9.86302ₙ 9.73078ₙ

log b — — — 9.62880 9.81629 9.90282

log c 0.3540892 0.3499959 0.0605468 8.00432 7.38021 7.23045ₙ

log d 9.3641756ₙ 9.2377950ₙ 0.5830173 8.63144ₙ 8.77743 8.28556ₙ

log e 0.3582776ₙ 0.3603662 9.9652488 8.53275ₙ 8.77085 8.00000

log f 0.6485259ₙ 0.6397952 0.4777144 8.67024 8.59988 7.96844ₙ

log s 9.1501422ₙ 7.6532125ₙ 0.~~2165364~~ 0.4653538 9.49900ₙ 8.52763ₙ 0.13220ₙ

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

20384 +.2982 −2.0536 +4.0065 4.1272 ~~1272~~

5.1490 .3977 5.2734 10.0352 .0105

689.1853 2295.1259 5533987 1800.9578

.5382 .2978 .0071 .0800 +.0239 .0328 2209

12410 11135 .0041 .1018 1008 −.0627 573

27986 41574 .0088 1004 .0520 .0484 7.0503

3554367 + −2.0948 −4.9731 +682.0000 −2294.5486 +545.9433 +1815.0130 +741.3398

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

.5912 .3271 .0078 ~~.0078~~ .0329 .0262 .0560 .2426

.5329 .4782 .0017 .0437 .0431 .0291 .440 ~~.0246~~

.2894 .4301 .0009 .0104 .0054 .0050 .7294

+1.4135 −.3752 +.0052 ~~−.0104~~ +.0870 −.0629 −.0701 +.~~7474~~ .9965

bb bc bc bd bd be be ff bf bs bs

.1810 .0043 .0182 .0145 +.0199 + ~~.1342~~ .1342

.4290 .0016 .0392 .0386 .0261 ~~.0221~~ .0221

.6392 .0014 .0154 .0080 .0079 1.0840

1.2492 −.0041 −.0420 +.0611 +.0386 ~~1.2403~~ 1.9276

cc cd cd ce ce cf cf cs cs

.51071 .5227 .51566 10.0607 .3193

.50118 .3871 .51329 .97677 .0101

1.3215 ~~.51328~~ 4.4011 1.0612 3.4535 1.4352

.0001 .0004 .0003 .0005 .0032

.0000 .0002 .0002 ~~.0000~~ .0001 .0000 .0001

.0000 .0000 .0000 .0023

11.4405 −5.3107 +11.3506 −16.3753 +1.4068

dd de de df df ds ds

.0535 .5278 +.0297 .0325

.0299 .3964 .7544 .0019

1.46566 3.5340 11.5000 47794

.0018 .0015 .0020 .0135

.0036 .0035 .0024 .0020

.0004 .0002 ~~.0002~~ .0002 .0262

14.7458 −4.4680 −9.7214 −4.7104 B

ee ef ef es es ff fs fs

.520661 10.1578 .3224 19.8476 .6290

.525693 10.0037 .0103 19.0366 .0196

0.85211 .47731 1.1524 .90246 3.7503

.00126 .0016 .0108 .0022 .0148

.00348 .0023 .0136 .0020 .0016 .0013

.00010 .0001 ~~.0136~~ .0001 .0126

11.32039 −19.3846 +~~7933~~ .8207 +47.8827 4.3699

	a	b	c	d	e	f	s	n	
(aa)	+1.4135	−.3752	+.0052	+.0870	−.0639	−.0701	+.9965	−2.0948	
ℓ an	.15029	9.54426n	7.71600	8.93952	8.80550n	8.84542	9.99848	0.32114n	
(bb)		+1.2452	−.0041	−.0420	+.0611	+.0386n	+.9276	−4.9731	
ab.aa		+.0996	−.0014	−.0231	+.0170	+.0186	−.2645	+.5561	
ab bb1		+1.1496	−.0027	−.0189	+.0441	+.0200	+1.1921	−5.5292	
ℓbb1		.06055	7.43136n	8.27646n	8.64444	8.30103	0.07631	.74266n	
ce			+11.4405	−5.3107	+11.3506	−16.3753	+1.1063	+682.0000	
ae.ae			+.0000	+.0003	−.0002	−.0003	+.0036	−.0077	
aa ee1			+11.4405	−5.3110	+11.3508	−16.3750	+1.1029	+682.0077	
be1.be1			+.0000	+.0000	−.0001	+.0001	−.0028	+.0130	
bb ee2			+11.4405	−5.3110	+11.3509	−16.3749	+1.1055	~~+682.0207~~	+681.9947
ℓee2			1.0584450	0.7251763n	1.0550303	1.2141787n	0.0435687	2.8337971	2.8337809
dd				+14.7458	−4.4630	−9.7214	−4.7443	−2294.5486	
ad ad				+.0054	−.0029	−.0043	+.0083	−.1289	
aa dd1				+14.7404	−4.4591	−9.7171	−4.7655	−2294.4197	
bb bd1				+.0003	−.0007	−.0003	−.0196	+.0909	2294.5106
bb dd2				+14.7401	−4.4584	−9.7168	−4.7460	−2294.3288	−316.6110
cd2.ed2				+2.4655	−5.2694	+4.6017	−.5132	316.6130	
cc dd3				+12.2746	+0.8110	−17.3185	−4.2328	−1977.7158	1977.8996
ℓdd3				1.0890074	9.9090209	1.2385103n	0.6266380n	3.2961629n	3.2962042n
ee					+11.3203	−17.3846	+.8206	+545.9483	
ea.ea					+.0028	+.0032	−.0451	+.0997	
aa ee1					+11.3176	−17.3878	+.8658	+545.8486	
be1 be1					+.0019	+.0008	+.0458	.2121	
bb ee2					+11.3158	−17.3886	+.8200	+545.6365	+546.0607
ce2 ce2					11.2620	−16.2468	+1.0968	+676.6...	+676.6533
cc ee3					+.05386	−1.1418	−0.2766	−131.0528	−130.5926
d3 de3					+.05356	−1.1442	−0.27976	−130.6705	−130.6826
dd ee4					+.0002	+.0024	+0.0026	−0.3823	+.0900
ℓee4					6.~~54407~~ 38021	7.38021	7.44497	9.5808n	8.95424
ff						+47.8827	+4.3699	+1815.0130	
af af						.0035	−.0493	+.1039	
aa ff1						+47.8792	+4.4192	+1814.8091	
bf1 bf1						+.0003	+.0207	+.0962	+1815.0053
bb ff2						+47.8789	+4.3985	+1814.8129	−976.1455
cf2 cf2						+23.4376	−1.5820	−976.1830	
cc ff3						+24.4413	+5.9808	+2790.9959	+2791.1508
df3 df3						+24.4359	+5.9723	+2790.4619	2790.6609
dd ff4						+.0062	+.0085	+0.5940	+0.4899
ef4 ef4						+.0240	+.0260	2.5526	+.9000
ee ff5						−.0178	−.0175	+3.1523 4.3170	−0.4101
ℓff5						~~8.01703n~~ 8.25042n	~~8.03342n~~	~~0.50668~~ ~~0.49868~~ 0.63518	9.61289n

	ns	n
an asa	+741.3398	359437
aa	−1.4768	+ 3
snlnr	+742.8166	359434
bn bs.bn1	+5.7385	+ 26
bb1 sn2 nn2	+737.0781	359408
cn cs2 cn2	+65.9040	40658
cc2 sn3 nn3	+671.1844	+318750
dn3 ds3 dn3	+682.0160	+318666
dd3 sn4 nn4	−10.8366	+ 94
en4 es4 en4	−3.0481	
ee4 sn5 nn5		

+742.8166	
−5.7335	
+748.5501	359408
+65.8013	40655
+682.6488	318753
682.0780	318714
+.5708	39
+.9750	34
−.4042	5

lg fs − 9.61288
−lg bb₁ − 8.25042n
lg dχ/10 1.36247n
dχ/10 − 23.040
dχ −230.40
−3 50.40

dψ efy −0.0556
10 emy +.0900
Sum +.0347
lg sum 8.54033
−lg eey 6.38021n
lg dψa 2.16012n
dψa −144.58
−2 24.58

dψ df3 +399.01
10 dψ des −117.26
d u3 −1977.90
sum −1696.15
lg sum 3.22947n
−lg dd3 1.08901n
lg dψa 2.14046
dψa +138.19
+2 18.19

dψ cf2 +377.27
10 dψ ce2 −1641.15
dψa cd2 +733.91
a u2 +681.99
Sum −1315.80
lg sum 3.11919n
−lg ee2 1.05844n
lg dℒ₁ 2.06075
dℒ₁ +115.01
+1 55.01

dχ bb1 −0.461
10 dφ be1 −6.376
dψa bd1 −26.12
dℒ be1 −3.10
b u1 −55.29
Sum −152.88
lg sum 1.18435n
−lg bb1 .06055n
lg di' 1.12380
di' + 13.30

dχ ab +1.61
10 dφ ae +4.24
dψa ad +12.02
dℒ ae +0.60
di' ab −4.99
a u −2.09
Sum +16.39
lg sum 1.214580
−lg aa .15029n
lg dΩ' 1.06429n
dΩ' −11.60

0 = −0.90 + 259.92 − 36.96 − 329.91 + 102.57 = −0.27
−2.30 + 257.49 − 23.89 − 331.51 + 100.53 = +0.32
+59.50 ~~+23.87~~ +132.22 − 529.03 − 133.47 − 65.21 = −0.1
0 = +0.70 + 8.91 + 5.66 − 1.16 − 5.91 − 4.83 − 1.08 = +2.19
0 = −1.70 + 8.46 + 0.27 − 8.28 − 8.53 − 0.92 + 8.71 = −1.99
0 = −5.20 − 6.24 + 10.63 − .20 + 2.67 − 1.45 + .21 = +0.42

lg(1−cos i') 8.95255
lg dΩ' 1.06429n
lg dΩ'(1−cos i') 0.05684n
dΩ'(1−cos i') − 1.14
dχ − 3 50.40
dπ' − 3 51.54
dΩ' − 11.60
dω' − 3 39.94

lg cos i' 9.95508
lg dΩ' 1.06429n
−lg cos i' dΩ' 1.01937
−cos i' dΩ' +10.46
dχ −3 50.40
dω' −3 39.94

dℒ +1 55.01
(1−cos i' dΩ') − 1.14
dℒ' +1 53.87
dπ' −3 51.54
dM +5 45.41

lg 3/2 0.17609
lg dψa 2.14046
lg μ 2.97009
lg sin 1" 4.68557
lg dμ 9.97221n
dμ − .93802
μ₀ 934.37700
μ 933.43898
lg μ 2.9700859
lg C 5.5500066
5799225
1933069
.3866138

lg Mu" 4.32335
lg dψa 2.14046
lg dψa 6.46381
dψa .0002909
lg a₀ .3863230
lg a .3866139

1870 Sept. 24.5

	M	μ	Ω'	i'	ω'	ℒ
	25 12 03.2	934.37700	176 26 55.81	25 36 36.76	341 04 21.03	7 16 6.10
	+5 45.41	−.93802	−11.60	+13.30	−3 39.94	−2 24.58
	25 17 45.73	933.43898	176 26 44.21	25 36 50.06	341 00 41.09	7 13 41.52
1872 Mar 5.5		933.77397	176 26 53.74	25 36 45.00	341 27 30.52	7 19 30.35
	161 53 05.79	−.93802	−11.60	+13.30	−3 39.94	−2 24.58
	+5 45.41	932.83595	176 26 42.14	25 36 58.30	341 23 50.58	7 17 5.77
	161 58 51.20					

Oct. 18.5
M 31 25 45.37
+5 45.41
31 31 30.78
− 22.51
31 31 8.27

161 58 51.20
−8 15.27
161 50 35.93

	1870	1872		1870	1872		1870	1872
sin Ω'	8.7923684	8.7924335	−cos Ω'	9.9991638	9.9991635	−sin Ω'	8.7923634	8.7924345
cos i'	9.9550753	9.9550671	cos i' sin Ω'	8.7474387	8.7475006	−cos i' cos Ω'	9.9542391	9.9542306
cos Ω'	9.9991638n	9.9991635n	tan A	1.2517251	1.2516629	tan B	8.8381243	8.8382039
sin i'	9.6357899	9.6358260	A	86 47 38.92	86 47 37.28	B	3 56 26.13	3 56 28.74
			lg a	9.9998440	9.9998439	lg b	9.9552670	9.9552589
						B	356 03 33.87	356 3 31.26

A+ω'
B+ω'
ω'
lg a
lg b
lg c
1870 1872

	1870	1871		1870	1872
lg e = lg sin φ	9.0997549	9.1031323	φ	7 13 41.52	7 17 5.77
e	.1258215	.1268038	½φ	3 36 50.76	3 38 32.88
1+e	1.1258215	1.1268038	45−½φ	41 23 9.24	41 21 27.12
1−e	.8741785	.8731962	lg tan(45−½φ)	9.9450654	9.9446317
lg(1+e)	.0514695	.0518483	lg e	9.0997549	9.1031323
lg(1−e)	9.9416000	9.9411118	lg C	5.3144251	5.3144251
lg √(1+e)	.0257347	.0259242	lg e″	4.4141800	4.4175574
lg √a	.1933069	.1934005			
lg √(1−e)	9.9768000	9.9705559			
lg √a(1+e)	.2190416	.2193247			
lg √a(1−e)	.1641069	.1639564			

	1870	1872
A+ω'	67 48 20.01	68 11 27.86
B+ω'	337 4 14.96	337 27 21.84
ω'	341 00 41.09	341 23 50.58
lg a	9.9998440	9.9998439
lg b	9.9552670	9.9552589
lg c	9.6357899	9.6358260

lg 932.83595 2.9698052
3.5500066
5802064
1934006

	1870 Sept. 24.5	1870 Oct 11.5	1872 Mar 5.5		Sept. 24.5
M	25 17 45.73	31 31 8.27	161 58 51.20	161 50 35.93	25 17 45.73
E'	28 46 5.87	35 43 43.25	163 59 7.00	163 51 45.52	28 45 54.65
	9.6829876	9.7663739	9.4407271	9.4439526	9.6823447
	4.4141800	4.4141800	4.4175574	4.4175574	4.4141800
	4.0965676	4.1805539	3.8582845	3.8615700	4.0966247
	3 28 10.15	4 12 34.93	2 0 15.80	2 1 9.59	3 28 8.94
E'	28 46 5.88	35 43 43.20	163 59 7.00	163 57 45.52	28 45 54.67
½ E'	14 23 2.94	17 51 51.60	81 59 33.50	81 55 52.76	14 22 57.33
sin ½ E'	9.3951899	9.4868047	9.1439521	9.9956493	9.3951439
cos ½ E'	9.9861677	9.9785391	9.9957449	9.1472484	9.9861707
log √(1+e) sin ½ v	9.6142315	9.7058968	9.2150646	.2150040	9.6141855
log √(1−e) cos ½ v	8.1502746	.1426400	9.3077085	9.3111998	.1502776
log tan ½ v	9.4639569	9.5605468	~~9.2035~~	0.9038042	9.4639079
½ v	16 13 28.12+	20 05 26.45	0.9071611		16 13 31.88
v	32 27 16.25	40 10 52.92	82 54 26.84	82 53 11.657	32 27 3.76
log r	3358612	3398220	165 52 53.68	165 46 23.31	3358596
			4367482	.2183594	
				~~4367~~ 4367194	
v+Ω+ω'	100 15 36.26	107 59 12.92	234 04 21.54	233 57 57.17	100 15 23.77
v+β+ω'	9 31 31.21	17 15 7.87	143 20 15.52	143 13 45.15	9 31 18.72
v+ω'	13 27 57.34	21 11 34.00	147 16 44.26	147 10 13.89	13 27 44.85
sin(v+Ω+ω')	9.9929992	9.9782386		9.9077604	9.9930040
log r a	3357052	.3396660	4365923	4365633	3357036
sin v+β+ω'	9.2187552	9.4721384		9.7771479	9.2185985
log r b	2911282	2950890	3920073	3919783	2911266
sin(v+ω')	9.3671087	9.5581168		9.7341119	9.3669983
log r c	9716511	9.9756117	.0725744	0725454	9.9716491
x	+2.1815936	+2.0792397		+2.2096501	+2.1316090
X	−1.0019707	−.8994842		+.9620910	−1.0019707
x'		1.1797545		+1.4761354	
y	+.3235068	+.5850968		−.2244323	+.3223869
Y	±.0268533	−.3913523		+.6407039	−.0268533
y'	±.2181520	+.1937438		−.0973822	+.2180960
z	±.0116479	+.3419654			−.0116479
Z		−.1698059			
z'		+.1919602			
log Δ cos δ cos α	0529330	0717917		.0960612	.0529898
log Δ cos δ sin α	9.4722495	9.2872278		.0975014	.4720768
log tan α	9.4193160	9.3154361		.0014402	9.4191373
α	14 42 51.68	9 19 33.91		45 05 42.00	14 42 30.83
α	18.82	20.75	134 54 18.00	−6.52	16.82
	14 43 10.50	9 19 54.66	6.52	45 5 35.62	14 42 47.65
			~~134 54 11.36~~		
			~~135 04 2.84~~		
			9 51.48		
			134 54 11.48		
log Δ sin δ	0674153	0775705		.2472975	0674000
log Δ sin α	9.8149287	9.2354279		9.7350577	9.3148110
log tan δ	9.2475734	9.1578574		9.4897500	9.2479012
δ	10 01 37.16	8 11 5.65		17 5 22.78	10 01 28.00
		8.44		~~2 2.26~~	7.21
		8 11 14.09		3 19.68	10 01 35.21
				+3.82	
				17 05 26.00	

Normals.

	Sept. 24	Oct 18	Mar 5
C	14 42 50.3	9 19 53.6	135 04 28.4
C−O	+ ~~9 51.8~~	−1.4	+9 51.8
O	~~52 42.1~~	9 19 55.0	134 54 11.0
	14 42 51.4		
C	10 01 33.8	8 11 13.5	17 2 6.38
C−O	+ 0 +0.3	−2.5	−3 18.0
O	10 01 33.5	8 11 16.0	17 5 24.4

Conversion to the Ecliptic

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

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

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

A = 32 45 57

i = 2 37

log cos A 9.92474
log di'' 1.12380
log I 1.04854

I +11.180
II + 2.71
di + 13.89
i 2 36 34.40
i° 2 36 48.29

log sin A 9.73337
log sin i' 9.63578
log dΩ' 1.06429n
log II ~~9.45723~~
0.43344

log sin i' 9.63578
cos A 9.92474
log dΩ' 1.06429n
log I 0.62481n

sin A 9.73337
di' 1.12380
log II 0.85717

I − 4.215
II + 7.196
Sum + 2.981

log sin 0.47454
log sin i 8.65892
log dΩ 1.81559
dΩ = +100.540
Ω₀ 323 58 54.10
323 59 59.50

Ω' 176 26 44.21
½Ω' 88 13 22.10

i' 25 36 50.06
ε 23 27 22.06
i'+ε 49 04 12.12
i'−ε +2 09 28.00
½(i'+ε) 24 32 6.06
½(i'−ε) 1 4 44.00

cos ½(i'−ε) 9.9999230
C cos ½(i'+ε) .0410982
tan ½Ω' 1.5082484
sin ½(i'−ε) 8.2748284
C cos ½(i'+ε) 0.3816911

tan ½((Ω−ω)+a) 1.5492696
tan ½((Ω−ω)−a) .1647679
(Ω−ω)+a 88 22 58.43
(Ω−ω)−a 55 37 1.38
A 32 45 57.05
Ω−ω 143 59 59.81
Ω 323 59 59.81

sin ½Ω' 9.9997910
cos ½(i'−ε) 8.2748284
sin ½(Ω'−a) ~~9.7518843~~ 9.6888579
sin ½i 8.0264537
½i ~~0 36 22.13~~
sin ½i 8.3580173
½i 1 18 24.14
i 2 36 48.28

log cos i 9.99955
cos i .99897
1−cos i .00103
log(1−cos i) 7.01284
log dΩ 1.81559
~~log~~ 8.82843
log dΩ(1−cos i) + .06
dχ − 3' 50.40
dπ₁ − 3' 50.34
π₀ 307 50 28.20
π 337 46 38.86

A = 32 45 57.05
ω' 341 00 41.09
ω 13 46 38.14
Ω 323 59 59.81
π 337 46 37.95

Corrected Elements.

May 2.587773
279 27 28.83
14 10 51.81
324 02 25.64
2 36 57.24
7 19 41.62
933.64278
338 13 17.45

Epoch = Feb. 24.5 B.M.T. 1870
M = 251 7 45.73
ω = 13 46 38.19
Ω = 323 59 59.81
i = 2 36 48.28
φ = 7 13 41.52
μ = 933.43598 log μ 2.9700859
π = 337 46 37.95

Ω 324 0 2 25.64
Ω−ω 144 02 25.63
½(Ω−ω) 72 01 12.81
i 2 36 57.24
ε 23 27 20.66
i+ε 26 04 17.90
i−ε −20 50 23.42
½(i+ε) 13 02 8.95
½(i−ε) −10 25 11.71

sin ½(Ω−ω) 9.9782561 cos ½(Ω−ω) 9.4895102
sin ½(i+ε) 9.3532623 sin ½(i−ε) 9.2578451n
sin ½i' sin ½(Ω'+a) 9.3315784 8.7468553
sin ½i' cos ½(Ω'+a) 8.7468553 sin ½i' 9.3457457
tan ½(Ω'+a) 0.5846637 ½i' .12 48 29.88
½(Ω'+a) 104 35 ½i'
½(Ω'−a) 71 51 36.48 i' 25 36 59.76
Ω' 176 26 45.72
A 32 43 32.06
ω 14 10 51.81
ω' 341 27 19.05

sin ½(Ω−ω) 9.9782561 cos ½(Ω−ω) 9.4895102
cos ½(i+ε) 9.9886611 cos ½(i−ε) 9.9927783
cos ½i' sin ½(Ω'−a) 9.9668172 9.4822885
cos ½i' cos ½(Ω'−a) 9.4822885
tan ½(Ω'−a) 0.4846287
½(Ω'−a)

log e 9.1056916 log μ 2.9700859
e .1275532 log C 3.5500066
1+e .5799207
1−e 8.7244678 log √a 1.8996037
log(1+e) .0521371 log a .3799207
log(1−ε) 9.9408887
log(i+ε) .0260687
log .1898603
log Ω 9.9703694

log e 9.1056916
log C 5.3144251
log e'' 4.4201167

φ 7 19 41.62
½φ 3 39 50.81
45−½φ 41 20 09.19
log tan(45−½φ) 9.9448080

sin Ω' 8.7923422
cos i' 9.9550656 −cos Ω' 9.9991640 −sin Ω' 8.7923422n
cos Ω' 9.9991640n cos i' cos Ω' ~~8.7474266~~
sin i' 9.6358324 tan χ 1.2517 tan β 9.954 2296
χ ~~86 47~~ β 8.8380826
86 47 40.54 β 3 56 20.362479
log a (β) 356 03 33.71
log sin(i+ε) .2160288
log sin(i−ε) .1603298

A+ω' 68 14 55.59 log a 9.9998442
B+a 337 30 54.20 log b 9.9552574
ω' 341 27 19.05 log c 9.6358324

May 1873

	13.5.	15.5.	17.5.	19.	21.	23.	25.	27
	274 20 47.55	274 51 54.43	275 23 13.1	275 54 81.9	276 25 150.7	276 56 219.5	277 27 28.83	277 58 35.71
			268 04 46.34	268 35 46.34	269 06 48.47	269 37 52.73	270 08 59.16	9.9999704
			9.9997560	9.9998696	9.9999480	9.9999910	9.9999985	270 40 7.78
			4.4201167	4.4201167	4.4201167	4.4201167	4.4201167	4.4201167
			4.4198727	4.4199863	4.4200647	4.4201077	4.4201152	4.4200871
			−7 18 14.97	−7 18 21.85	−7 18 26.60	−7 18 29.21	−7 18 29.66	−7 18 27.96
			268 04 46.34	268 35 46.34	269 06 48.47	269 37 52.74	270 08 59.17	270 40 7.75
			134 02 23.17	134 17 53.17	134 33 24.23	134 48 56.37	135 04 29.58	135 20 3.87
sin ½ E			9.8566428	9.8547407	9.8528190	9.8508778	9.8489167	9.8469354
cos ½ E			9.8420822	9.8440990	9.8460990	9.8480832	9.8500518	9.8520050
			.0726716	.0707695	.0688478	.0669066	.0649455	.0629642
			.0024130	.0044288	.0064288	.0084129	.0103816	.0123348
			.0702586	.0663407	.0624190	.0584938	.0545639	.0506294
½ v			49 36 52.09	49 21 33.09	49 06 11.93	48 50 48.72	48 35 23.40	48 19 55.88
			130 23 7.91	130 38 26.91	130 53 48.07	131 09 11.28	131 24 36.60	
v			260 46 15.82	261 16 53.82	261 47 36.14	262 18 22.56	262 49 13.20	
log r			3817732	3812756	.3807768	3802768	.3797758	3792734

	17.5	19	21	23	25
v + A + ω'	329 01 15.41	329 31 53.41	330 02 35.73	330 33 22.15	331 04 12.79
v + B + ω'	238 17 10.08	238 47.48.08	239 18 30.40	239 49 16.82	240 20 7.46
v + ω'	242 13 38.48	242 44 12.87	243 14 55.19	243 45 41.61	244 16 32.25
sin(v + A + ω')	9.7115150 n	9.7050633 n	9.6984016 n	9.6915856	
log r a	.3816194	.3811198	.3806210	.3801210	
sin(v + B + ω')	9.9297682 n	9.9321360	9.9344618	9.9367460	
log r b	.3370306	.3365330	.3360342	.3355342	
sin(v + ω')	9.9468428 n	9.9488590	9.9508361	9.9527740	
log r c	.0176056	.0171080	.0166092	.0161092	
x	−.12893456	−.12195027	−.11995618	.11795240	
	+.5504903	+.5218642	+.4926768	.4629004	
y	−.18484119	−.18563886	−.18642131	−.18718890	
	+.7790088	+.7958690	+.8117638	.8267634	
z	−.9214004	−.9246280	−.9277807	.9308577	
	+.3380039	+.3453065	+.3522166	.3584289	

	17.5	19	21
	9.8381280 n	9.8393669	9.8450455
	0.0291415 n	0.0275541	.0237552
	0.1910835	.1877872	.1787097
α	+237 12 44.72	237 01 6.1	236 28 9.1
	15 48 50.0	15 48 44	15 46 28.6
	9.7657638 n	9.7642116	9.7613317
	0.1045087	.1034723	.1028032
	9.6614551	9.6607393	9.6585285
	−24 38 14.04		
	35 7.1		

19	21	25
9.8436180	9.8493498	9.8552911
.0255308	.0222020	.0191687
.1819128	.1728529	.1638776
236 39 48.6	236 06 45.0	235 33 44.3
3 46 38.0	3 44 27.0	3 42 15
9.76		
9.7629157	9.7600937	9.7574960
.1036081	.1030598	.1028508
9.6593180	9.6570426	9.6546452
24 30 48	24 25 02.7	24 17 54.8
24 31 49.0	22 36	15 50.6
29 2		

3 7   2 47   2 27   2 04

	~~Δα~~	δ ° ' "	Δδ
May 17.5		−24 38 14	
18.5		35 05	3 11
19.5		−24 31 49	3 14
20.5		28 34	3 19
21.5		−24 25 02	3 28
22.5			
23.5		−24 17 55	

29.	31.	June 2	4.	6.	8.	10.	12.
278 29 42.59	279 00 49.47	279 31 56.35	280 03 3.23	280 34 10.11	281 05 16.99	281 36 23.87	282 07 30.75
271 11 18.48	271 42 31.43	272 13 46.52	272 45 3.81	273 16 23.27	9.9990462	274 19 8.85	274 50 34.93
9.9999065	9.9998068	9.9996711	9.9994992	9.9992910	4.4201167	9.9987648	9.9984467
4201167	4.4201167	4.4201167	4.4201167	4.4201167		4.4201167	4.4201167
4.4200232	4.4199235	4.4197878	4.4196159	4.4194077	4.4191629	4.4188815	4.4185634
−7 18 24.09	7 18 18.05	7 18 9.83	−7 17 59.43	7′ 17 46.83	7′ 17 32.03	−7 17 15.03	−7 16 50.82
271 11 18.50	271 42 31.42	272 13 46.52	272 45 3.80	273 16 23.28	273 47 44.96	274 19 8.84	274 50 34.93
135 35 39.25	135 51 15.71	136 06 53.26	136 22 31.90	136 38 11.64	136 53 52.48	137 09 34.42	137 25 17.46

Normal May 26.5 B. M. T. 1873

$\alpha = 15^h\,39^m\,26^s.00 \quad \delta = -24^\circ\,05'\,6''.$

$\left(\begin{array}{l} \Delta\alpha(c-o) = +5.7 \\ \Delta\delta(c-o) = -6.3'' \end{array} \right)$

My 25.5 = 15 40 28.19 − 24 08 48.8   48.8

+ 61   − 3.5   3.8

3.8   4.7

15 40 27.58 − 24 08 45.0   45.0

235 06 53.70

1871phae.proj..432O

Capt: Daniel Ammen U.S. N
Chief of Bureau of Navigation
Navy Dept:
Washington
D.C.

	h	m	s	°	′	″	
May 12	15	53	53.99	−24	48	38.7	.161464
13	15	52	50.82	24	46	8.6	
~~15~~ 14	15	51	53.07	−24	43	32.2	159436
15	15	50	51.80	24	40	49.7	
16	15	49	50.10	−24	38	12	.157713

1½
2
1½
3
1½
1½
1
1½
3½
3½
4
1
1
2
3½
2
1½
2½
36
1
4½
1
2
1
2
47½
2½
1
1
5½
1½
59
2
1
3½
2
7
2½
77
1
1
1½
1½
6
88
2
2
2½

95½
½
2½
1½
5
105
1
2½
3½
2
3
117
3
1
1
1
2½
2½
2½
130½
1
1
1
3
3½
140½

Eph = 36
Perturb. = 7
Corr. Eph = 5.4

149½
1½
½
2½
154
1½
3
3½
162

Eph.

2½
1½
½
1½
1
9
180

2
4
2
1½
½
2
3
2
2
2
1½
1
4
4
1
1
3
4
38½

Perturbations

9
1
2½
4½
8
8½
2
1½
68½
1
1
2½
1
4½
77½
1½
5

Eph.

2½
3½
2½
2
1
1
3
4
4
1
108½
1
13½
3
1½
5
2
1½
3
5
144
3½
1½
½

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