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Herausgeber: Prof. Dr. C. A. F. Peters.

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16.

New Elements of Brunhilda (123).

Communicated by Prof. J. H. C. Coffin, U. S. N. Superintendent of the American Ephemeris and Nautical Almanac.

The system of elements, communicated by Dr. C. H. F. Peters in the Astr. Nachr. No. 1911 forms the basis of the following discussion by:

Epoch. Aug. 1.5 1872 Berl. m. Time.

$M = 262^{\circ}13' 9''41$

$\pi = 71\ 51\ 32.93 + 50''211\ T$
 $\Omega = 308\ 42\ 13.02 + 53.168\ T$ m. Eq. 1872.0
 $i = 6\ 28\ 32.48 + 0.333\ T$

$\varphi = 6\ 30\ 23.32$

$\mu = 803''1187$

$\log a = 0.4301512$

These elements represent the observations of 1872, as follows:

Date.	$\Delta\alpha(C-0)$	$\Delta\delta(C-0)$	Authority.
1872 Aug. 1	— 4"0	+ 1.1	Hamilton College.
2	— 2.4	+ 0.0	" "
4	— 7.1	+ 3.3	" "
5	— 8.6	+ 1.4	" "
7	— 4.1	+ 0.6	" "
8	— 6.3	+ 1.1	" "
9	— 6.0	— 0.6	" "
21	— 2.5	— 7.6	" "
23	— 4.8	+ 3.2	" "
27	— 1.3	— 0.6	" "
28	— 6.5	— 2.8	" "
Sept. 2	+ 0.9	— 0.4	" "
2	+ 1.6	— 2.8	Berlin.
4	(+13.5)	— 2.8	Leipsic.
5	— 2.1	(— 8.7)	" "
6	+ 0.7	— 5.4	" "
7	— 0.6	— 0.9	Hamilton College.
17	+ 4.0	— 0.9	Marseilles.
20	+ 7.5	— 2.3	" "
21	+ 4.9	— 0.7	" "
22	— 2.1	— 0.1	Hamilton College.
23	— 4.4	+ 0.6	" "

Date.	$\Delta\alpha(C-0)$	$\Delta\delta(C-0)$	Authority.
1872 Aug. 29	— 4"7	— 1.1	Marseilles.
30	— 3.6	— 1.6	"
Oct. 1	— 6.1	— 2.2	"

As these seems to be some doubt about the Marseilles Observations in the form published in the Astr. Nachr. No. 1910 two hypotheses will be adopted in the present discussion, the first depending on all the observations, and the second resting only on those made at Hamilton College Observatory.

The following are the normal residuals:

	Hypothesis I.		Hypothesis II.	
	$\Delta\alpha(C-0)$	$\Delta\delta(C-0)$	$\Delta\alpha(C-0)$	$\Delta\delta(C-0)$
Aug. 5.5	— 5"5	+ 1"0	— 5"5	+ 1"0
25.5	— 3.8	— 2.0	— 3.8	— 2.0
Sept. 4.5	+ 0.1	— 2.5	+ 0.1	— 0.6
20.5	+ 2.0	— 0.5	+ 0.3	+ 0.3
30.5	— 4.8	— 1.6	—	—

To these residuals are applied the following corrections due to the perturbations; the elements osculating for Sept. 7 1872.

Aug. 5.5	+ 0"9	+ 0"1
25.5	+ 0.5	+ 0.1
Sept. 4.5	+ 0.3	+ 0.0
20.5	+ 0.0	+ 0.0
30.5	— 0.2	+ 0.0

Whence

	Hypothesis I.		Hypothesis II.	
	$d n \cos \vartheta$	$d \vartheta$	$d n \cos \vartheta$	$d \vartheta$
Aug. 5.5	— 3.59"	— 2.98	— 3.59"	— 2.98
25.5	— 3.74	— 0.34	— 3.74	— 0.34
Sept. 4.5	— 0.70	— 2.43	+ 0.11	— 0.70
20.5	+ 1.60	— 1.26	— 2.83	+ 1.62
30.5	— 4.29	+ 0.52	—	—

Equations of Condition.

$0 = -3''59 + 1.485 dB - 0.136 d \log a - 2.945 d\varphi + 0.729 dx_{10}$	
$0 = -3.74 + 1.497 \text{ ,, } - .165 \text{ ,, } - 2.982 \text{ ,, } + .737 \text{ ,, }$	
$0 = -0.70 + 1.457 \text{ ,, } - .090 \text{ ,, } - 2.915 \text{ ,, } + .717 \text{ ,, }$	
$0 = +1.60 + 1.350 \text{ ,, } - .062 \text{ ,, } - 2.725 \text{ ,, } + .641 \text{ ,, }$	
$0 = -4.29 + 1.271 \text{ ,, } - .062 \text{ ,, } - 2.584 \text{ ,, } + .571 \text{ ,, }$	
$0 = -2.98 + .000 \text{ ,, } - .009 \text{ ,, } - .001 \text{ ,, } - .010 \text{ ,, } - .730 di' - .648 d\Omega'$	
$0 = -0.34 + .007 \text{ ,, } - .042 \text{ ,, } - .016 \text{ ,, } - .044 \text{ ,, } - .630 \text{ ,, } - .676 \text{ ,, }$	
$0 = -2.43 + .013 \text{ ,, } - .055 \text{ ,, } - .026 \text{ ,, } - .058 \text{ ,, } - .564 \text{ ,, } - .672 \text{ ,, }$	
$0 = -1.26 + .023 \text{ ,, } - .071 \text{ ,, } - .041 \text{ ,, } - .070 \text{ ,, } - .448 \text{ ,, } - .648 \text{ ,, }$	
$0 = +0.52 + .027 \text{ ,, } - .075 \text{ ,, } - .047 \text{ ,, } - .074 \text{ ,, } - .376 \text{ ,, } - .624 \text{ ,, }$	

Solution by least squares gives:

Hypothesis I.	Hypothesis II.
$dB = +2'43''41$	$+1'15''81$
$dx = -23\ 29.61$	$-3\ 1.82$
$d\varphi = +49.27$	$+34.81$
$d \log a = -1\ 3.81$	-47.69
$di' = -39.38$	-9.77
$d\Omega = +50.40$	$+14.65$

whence:

Hypothesis I.	Hypothesis II.
$dM = +26'13''02$	$+4'17''63$
$d\pi' = -23\ 23.74$	$-3\ 0.11$
$d\mu = +.37271$	$+.27854$
$d \log a = -.0001344$	$-.0001004$

The normal equations are satisfied as follows:

	Hypothesis I.		Hypothesis II.	
	$dn \cos \varrho$	$d\varrho$	$dn \cos \varrho$	$d\varrho$
Aug. 5	$-0''1$	$+1''0$	$-0''3$	$+1''2$
25	$+0.6$	-0.4	-0.4	-1.3
Sept. 4	-1.6	-1.5	-0.5	-1.3
20	$+1.5$	-0.1	$+1.5$	$+1.5$
30	-0.4	$+1.8$	$-$	$-$

Perturbations.

From Sept. 7 1872 to April 5 1875.

$dM = -34'55''25$
$d\pi = +34\ 22.34$
$d\Omega = -3\ 46.14$
$di = -20.44$
$d\varphi = +8.03$
$d\mu = -.64727$

Reducing the corrected elements to the ecliptic we have:

Hypothesis I.

Epoch. April 5.5 1875 Berl. m. T.

$M = 120^\circ 7'56''75$	} mean Eq. 1875.0
$\pi = 72\ 4\ 55.78$	
$\Omega = 308\ 39\ 47.22$	
$i = 6\ 27\ 28.39$	
$\varphi = 6\ 31\ 20.62$	
$\mu = 802''.84614$	
$\log a = 0.4302504$	

Hypothesis II.

Epoch. April 5.5 1875 Berl. m. T.

$M = 119^\circ 44'29''79$	} mean Eq. 1875.0
$\pi = 72\ 25\ 23.96$	
$\Omega = 308\ 40\ 54.27$	
$i = 6\ 28\ 1.15$	
$\varphi = 6\ 31\ 6.16$	
$\mu = 802''.74997$	
$\log a = 0.4302842$	

Ephemeris for the Opposition 1875 Brunhilda.

Berl. 12 ^h m. T.	AR. (123)	Δ_1	δ (123)	Δ_1	Log Δ	Aberr. Time.
1875 March 14	13 ^h 39 ^m 27 ^s .47	$-34^s.69$	$-19^\circ 39' 5''.1$	$+0'14''9$	0.299350	16 ^m 31 ^s .
15	13 38 52.78	35.98	19 38 50.2	0 25.1	.297772	16 28
16	13 38 16.80	37.21	19 38 25.1	0 35.2	.296238	16 25
17	13 37 39.59	38.42	19 37 49.9	0 45.5	.294746	16 21
18	13 37 1.17	39.59	19 37 4.4	0 55.6	.293300	16 18
19	13 36 21.58	40.74	19 36 8.8	1 5.9	.291900	16 15
20	13 35 40.84	-41.85	19 35 2.9	1 16.2	.290545	16 12
21	13 34 58.99		$-19\ 33\ 46.7$.289240	16 9

Berl. 12 ^h m. T.	AR. (123)	Δ_1	δ (123)	Δ_1	Log Δ	Aberr. Time.
1875 March 21	13 ^h 34 ^m 58 ^s .99	— 42 ^s .91	— 19 ^o 33' 46''7	+ 1' 26''3	0.289240	16 ^m 9 ^s
22	13 34 16.08	43.93	19 32 20.4	1 36.4	.287985	16 6
23	13 33 32.15	44.91	19 30 44.0	1 46.5	.286779	16 3
24	13 32 47.24	45.86	19 28 57.5	1 56.5	.285626	16 1
25	13 32 1.38	46.76	19 27 1.0	2 6.6	.284525	15 58
26	13 31 14.62	47.61	19 24 54.4	2 16.5	.283479	15 56
27	13 30 27.01	48.40	19 22 37.9	2 26.3	.282489	15 54
28	13 29 38.61	49.15	19 20 11.6	2 35.9	.281555	15 52
29	13 28 49.46	49.85	19 17 35.7	2 45.3	.280677	15 50
30	13 27 59.61	50.50	19 14 50.4	2 54.7	.279858	15 48
31	13 27 9.11	51.10	19 11 55.7	3 4.1	.279098	15 46
April 1	13 26 18.01	51.64	19 8 51.6	3 13.1	.278399	15 45
2	13 25 26.37	52.13	19 5 38.5	3 22.1	.277761	15 43
3	13 24 34.24	52.56	19 2 16.4	3 30.9	.277184	15 42
4	13 23 41.68	52.90	18 58 45.5	3 39.6	.276669	15 41
5	13 22 48.78	53.20	18 55 5.9	3 47.6	.276220	15 40
6	13 21 55.58	53.45	18 51 18.3	3 55.3	.275833	15 40
7	13 21 2.13	53.62	18 47 23.0	4 2.5	.275512	15 39
8	13 20 8.51	53.71	18 43 20.5	4 10.1	.275255	15 39
9	13 19 14.80	53.76	18 39 10.4	4 17.1	.275063	15 38
10	13 18 21.04	53.76	18 34 53.3	4 23.6	.274937	15 38
11	13 17 27.28	53.69	18 30 29.7	4 30.0	.274874	15 38
12	13 16 33.59	53.54	18 25 59.7	4 35.9	.274878	15 38
13	13 15 40.05	53.35	18 21 23.8	4 41.6	.274947	15 38
14	13 14 46.70	53.10	18 16 42.2	4 46.8	.275082	15 38
15	13 13 53.60	52.79	18 11 55.4	4 51.7	.275280	15 38
16	13 13 0.81	52.43	18 7 3.7	4 56.3	.275544	15 38
17	13 12 8.38	52.01	18 2 7.4	5 0.6	.275872	15 39
18	13 11 16.37	51.55	17 57 6.8	5 4.4	.276265	15 40
19	13 10 24.82	51.02	17 52 2.4	5 7.9	.276722	15 41
20	13 9 33.80	50.45	17 46 54.5	5 11.0	.277242	15 42
21	13 8 43.35	49.84	17 41 43.5	5 13.7	.277825	15 43
22	13 7 53.51	49.17	17 36 29.8	5 16.2	.278469	15 45
23	13 7 4.34	48.44	17 31 13.6	5 18.1	.279175	15 46
24	13 6 15.90	47.67	17 25 55.5	5 19.8	.279943	15 48
25	13 5 28.23	46.85	17 20 35.7	5 21.2	.280771	15 50
26	13 4 41.38	45.99	17 15 14.5	5 21.9	.281658	15 52
27	13 3 55.39	45.10	17 9 52.6	5 22.3	.282604	15 54
28	13 3 10.29	44.18	17 4 30.3	5 22.4	.283606	15 56
29	13 2 26.11	43.19	16 59 7.9	5 22.2	.284668	15 59
30	13 1 42.92	42.17	16 53 45.7	5 21.7	.285785	16 1
May 1	13 1 0.75	41.12	16 48 24.0	5 20.7	.286958	16 3
2	13 0 19.63	— 40.04	16 43 8.3	+ 5 19.4	.288185	16 5
3	12 59 39.59		— 16 37 43.9		.289467	16 8

The elements under the second hypothesis give for April 5.5 1875: $\alpha = 13^h 22^m 45^s.2$ $\delta = -18^\circ 55' 40''$.

Harvard College Observatory, Febr. 11 1875.

William A. Rogers.