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8.

Systematic corrections to the AG. Zones and the Cordoba General Catalogue.

By *R. H. Tucker.*

The reduction of the observations of Dr. Gill's List of Zodiacal Stars, furnishes a basis for comparison with the AG. Catalogues, and with the Cordoba Catalogue. The Lick Observatory observations were made in the years 1901-1904, and have been reduced with the places of Newcomb's Fundamental Stars. The older observations have been brought forward with the Catalogue Precession Constants, and proper motions have been applied, as far as possible from existing material.

The AG. Catalogues were reduced to the epoch 1875, and the observations were made, in general, at about that date, or somewhat later. Since they were reduced with Auwers places of the Fundamental Stars, the comparison of the reduced positions includes the difference of the two fundamental systems, the general effect of proper motion for about twenty five years, and the systematic errors of the respective observations. The means of the systematic differences are remarkably small; $0^{\circ}006$, and $0^{\circ}18$; but there are distinct periodic variations, as indicated in the tables following.

The details of the comparison, by hours of right ascension, are given below. The Warsaw 1904 Catalogue, which was reduced to the same fundamental system, is included in the comparison, but the results are not included in the means of the AG. Zones. In general, residuals of $\pm 0^{\circ}25$, and $\pm 2^{\circ}5$, have been excluded from the means. These stars will probably be found to have proper motions, larger than the general average of the faint stars. The average residuals are $\pm 0^{\circ}05$ in right ascension, ranging from $\pm 0^{\circ}04$ to $\pm 0^{\circ}07$, for the means of different catalogues; and in declination, $\pm 0^{\circ}6$, with a range of $\pm 0^{\circ}5$ to $\pm 0^{\circ}9$.

The tabulation below gives the number of stars in each catalogue comparison, the mean right ascension and

declination, and the average hourly differences. The hourly means of the AG. comparisons are then combined, in Table II, which includes the adjustment for periodic variation in the differences, and the comparison of the observed differences with those obtained by this adjustment. The stars are included between the limits 0^h to 14^h , and 21^h to 23^h , the remainder of the Zodiacal list being in higher southern declinations than have yet been published in the AG. Catalogues. A large proportion of these southern stars will be included in the comparison with Cordoba.

In Table III the catalogue differences have been combined separately, in groups of two to four hours. The groups for the same catalogue are usually separated by an interval, but in the Berlin Zones the groups are adjacent, for the purpose of indicating more clearly the periodic variation. The adjusted differences, from Table II, have also been entered; and the comparison with the separate catalogue differences gives the correction necessary to reduce the individual catalogues to the AG. system, as determined by the medium of the present series of observations.

It is possible that a closer adjustment of the differences, in Table II, might have been obtained by the use of periodic terms depending upon $\sin \alpha$, and $\cos \alpha$; but the simple numerical variation, as expressed, reduces the average of the hourly differences to two-thirds of the tabulated values, as indicated in the column of observed minus computed. Since right ascension and declination vary together, in the zodiacal list, the periodic variation may depend upon either, or both.

The differences due to the use of Newcomb's precessions, instead of those of the catalogues, for the interval of this comparison, would be:

$$-0^{\circ}01 - 0^{\circ}009 \sin \alpha; \text{ and } -0^{\circ}13 \cos \alpha.$$

I. Obs. — AG. Zones.

Cat.	No.	RA.	Decl.	$\Delta\alpha$	$\Delta\delta$
Ottak.	3	0^h1	$-5^{\circ}9$	$(+0^{\circ}007)$	$(-0^{\circ}43)$
Warsaw	14	0.3	-3.3	$(+0.021)$	(-0.18)
Nicol.	26	0.5	-0.5	$+0.075$	$+0.02$
Alb.	31	0.5	$+3.0$	$+0.021$	$+0.15$
Leip. II	40	0.6	$+7.7$	-0.039	-0.09
Leip. I	19	0.8	$+12.3$	$+0.005$	$+0.28$
Nicol.	2	1.1	-0.4	$(+0.165)$	(-1.55)
Alb.	28	1.4	$+3.6$	$+0.014$	-0.20

Cat.	No.	RA.	Decl.	$\Delta\alpha$	$\Delta\delta$
Leip. II	36	1^h5	$+7^{\circ}9$	$-0^{\circ}016$	$-0^{\circ}10$
Leip. I	44	1.4	$+12.8$	-0.018	-0.04
Berl. A	18	1.5	$+16.3$	$+0.038$	-0.93
Leip. II	21	2.3	$+8.4$	-0.020	-0.16
Leip. I	44	2.5	$+12.9$	$+0.018$	-0.28
Berl. A	46	2.5	$+18.1$	$+0.053$	-0.61
Berl. B	22	2.6	$+22.1$	$+0.009$	-0.06
Leip. I	25	3.4	$+13.7$	$+0.002$	-0.27

Cat.	No.	RA.	Decl.	$\Delta\alpha$	$\Delta\delta$
Berl. A	38	3 ^h 5	+18°1	+0°021	-0°54
Berl. B	49	3.5	+22.8	+0.016	-0.38
Cambr.	3	3.9	+26.0	(+0.007)	(+0.13)
Leip. I	4	4.2	+14.9	(+0.060)	(-0.72)
Berl. A	50	4.5	+17.4	+0.088	-0.54
Berl. B	48	4.5	+22.7	+0.055	-0.41
Cambr.	25	4.5	+27.1	+0.008	-0.36
Berl. A	38	5.5	+18.3	+0.025	-0.84
Berl. B	41	5.5	+22.6	+0.008	-0.42
Cambr.	31	5.5	+27.5	-0.019	-0.23
Berl. A	33	6.4	+18.1	+0.023	-0.56
Berl. B	46	6.5	+22.5	+0.019	-0.29
Cambr.	34	6.5	+27.4	-0.019	+0.05
Berl. A	35	7.5	+17.7	+0.003	-0.78
Berl. B	38	7.5	+22.6	-0.004	-0.24
Cambr.	23	7.4	+26.8	-0.021	+0.03
Leip. I	16	8.6	+13.5	-0.024	-0.31
Berl. A	38	8.5	+17.4	-0.024	-0.46
Berl. B	34	8.4	+22.6	-0.019	-0.46
Cambr.	3	8.1	+25.8	(-0.020)	(+0.07)
Leip. II	20	9.7	+ 8.1	-0.045	-0.01
Leip. I	34	9.5	+12.1	-0.080	-0.52
Berl. A	35	9.5	+17.5	-0.024	-0.37
Berl. B	17	9.3	+21.4	-0.076	+0.28
Nicol.	5	10.9	- 0.1	(-0.048)	(+0.12)
Alb.	19	10.6	+ 3.0	-0.034	-0.11

Cat.	No.	RA.	Decl.	$\Delta\alpha$	$\Delta\delta$
Leip. II	39	10 ^h 5	+ 7°4	-0°047	-0°19
Leip. I	37	10.5	+12.2	-0.069	-0.09
Berl. A	18	10.3	+16.3	-0.028	-0.37
Ottak.	3	11.8	- 6.7	(+0.020)	(+0.10)
Warsaw	12	11.7	- 3.9	(-0.025)	(+0.02)
Nicol.	20	11.5	- 0.7	+0.010	-0.08
Alb.	34	11.5	+ 2.7	-0.026	+0.02
Leip. II	32	11.5	+ 7.0	-0.041	+0.06
Leip. I	13	11.2	+11.8	-0.072	-0.45
Ottak.	23	12.5	- 7.7	+0.018	+0.15
Warsaw	28	12.5	- 4.1	(-0.013)	(-0.22)
Nicol.	23	12.5	- 0.8	-0.025	+0.44
Alb.	27	12.5	+ 2.2	-0.046	+0.25
Leip. II	4	12.1	+ 5.2	(-0.020)	(+0.15)
Ottak.	36	13.5	- 8.2	+0.011	+0.04
Warsaw	22	13.5	- 4.4	(-0.030)	(+0.02)
Nicol.	7	13.2	- 0.8	-0.051	+0.16
Ottak.	22	14.3	- 8.4	+0.013	-0.10
Ottak.	22	21.6	- 8.6	+0.051	+0.22
Ottak.	32	22.5	- 7.8	+0.067	-0.17
Warsaw	21	22.6	- 4.0	(+0.047)	(+0.86)
Ottak.	29	23.4	- 7.7	+0.058	-0.19
Warsaw	23	23.5	- 3.7	(+0.018)	(-0.13)
Nicol.	26	23.4	- 0.3	+0.031	-0.14
Alb.	25	23.6	+ 3.0	+0.022	+0.12
Leip. II	6	23.8	+ 6.8	(-0.052)	(-0.10)

II. Obs. — AG. Zones. Hourly differences.

RA.	No.	Decl.	$\Delta\alpha$	Adjusted	O—C	$\Delta\delta$	Adjusted	O—C	AG.C.
21 ^h	22	- 8°6	+0°051	+0°050	+0°001	+0°22	-0°04	+0°26	1
22	32	- 7.8	+0.067	+0.058	+0.009	-0.17	-0.08	-0.09	1
23	86	- 1.7	+0.037	+0.050	-0.013	-0.07	-0.12	+0.05	3
0	119	+ 5.6	+0.010	+0.042	-0.032	+0.05	-0.16	+0.21	4
1	128	+10.1	-0.001	+0.034	-0.035	-0.23	-0.20	-0.03	4
2	133	+15.4	+0.022	+0.026	-0.004	-0.33	-0.24	-0.09	4
3	115	+18.2	+0.014	+0.018	-0.004	-0.41	-0.28	-0.13	3
4	127	+22.4	+0.059	+0.010	+0.049	-0.45	-0.32	-0.13	3
5	110	+22.8	+0.007	+0.002	+0.005	-0.52	-0.36	-0.16	3
6	113	+22.7	+0.009	-0.006	+0.015	-0.27	-0.32	+0.05	3
7	96	+22.4	-0.005	-0.014	+0.009	-0.40	-0.28	-0.12	3
8	91	+17.8	-0.022	-0.022	0.000	-0.43	-0.24	-0.19	3
9	106	+14.8	-0.054	-0.030	-0.024	-0.24	-0.20	-0.04	4
10	118	+ 9.7	-0.049	-0.038	-0.011	-0.17	-0.16	-0.01	4
11	102	+ 5.2	-0.029	-0.030	+0.001	-0.05	-0.12	+0.07	4
12	77	- 0.3	-0.018	-0.022	+0.004	+0.28	-0.08	+0.36	3
13	43	- 4.5	+0.001	-0.014	+0.015	+0.06	-0.04	+0.10	2
14	22	- 8.4	+0.013	-0.006	+0.019	-0.10	0.00	+0.10	1
Sum	1640	Mean	+0.006	+0.006	0.000	-0.18	-0.18	0.00	
		<i>v</i>	±0.025		±0.014	±0.18		±0.12	

III. Obs. — AG. Zones. Separate catalogues.

Cat.	No.	Limits		$\Delta\alpha$	II	Corr.	$\Delta\delta$	II	Corr.
Cambr.	116	4 ^h to 8 ^h	+25° +30°	-0°013	-0°002	-0°011	-0"13	-0"34	+0"21
Berl. B	160	2 » 6	+20 +25	+0.025	+0.014	+0.011	-0.36	-0.30	-0.06
»	135	6 » 10	»	-0.011	-0.018	+0.007	-0.23	-0.26	+0.03
Berl. A	190	1 » 6	+15 +20	+0.048	+0.018	+0.030	-0.66	-0.28	-0.38
»	159	6 » 11	»	-0.010	-0.022	+0.012	-0.51	-0.24	-0.27
Leip. I	136	0 » 4	+10 +15	+0.001	+0.030	-0.029	-0.10	-0.22	+0.12
»	100	8 » 12	»	-0.066	-0.034	-0.032	-0.33	-0.18	-0.15
Leip. II	103	0 » 3	+ 5 +10	-0.026	+0.034	-0.060	-0.11	-0.20	+0.09
»	95	9 » 12	»	-0.044	-0.038	-0.006	-0.07	-0.16	+0.09
Alb.	84	23 » 2	+ 1 + 5	+0.019	+0.042	-0.023	+0.02	-0.16	+0.18
»	80	10 » 13	»	-0.034	-0.030	-0.004	+0.07	-0.12	+0.19
Nicol.	54	23 » 1	- 2 + 1	+0.053	+0.046	+0.007	-0.06	-0.14	+0.08
»	55	11 » 13	»	-0.008	-0.026	+0.018	+0.23	-0.10	+0.33
Ottak.	86	21 » 0	-10 - 6	+0.060	+0.058	+0.002	-0.08	-0.08	0.00
»	87	12 » 15	»	+0.014	-0.014	+0.028	+0.03	-0.04	+0.07
8	1640	Average		±0.029		±0.019	±0.20		±0.15
Warsaw	58	22 » 1	- 6 - 2	+0.030	+0.050	-0.020	+0.23	-0.12	+0.35
»	62	11 » 14	»	-0.021	-0.022	+0.001	-0.08	-0.08	0.00

The comparisons with the Cordoba General Catalogue have been combined in groups of declination: 0° to 10°, 10° to 20°, 20° to 25°, and 25° to 30°, in order to exhibit any variation depending upon declination. The mean corrections to this catalogue are small, but there is a decided periodic variation with respect to right ascension. The separate values are given in Table IV; and the hourly adjustment, with the respective residuals, in Table V. The variation depending upon right ascension resembles very closely the variation, found in this catalogue, by the comparison of the observed places of the southern stars of Piazzini, with the Cordoba places. This comparison is tabulated in Vol. VI

of the Publications of this Observatory, p. 176, where the column of residuals may be consulted. The variation there exhibited is clearly due to the difference between the Cordoba places, and the Fundamental system employed in the reduction of the L. O. observations.

The right ascension and declination of the tabular groups vary symmetrically, and the systematic variation may be due to either, or both. But the combination, according to declination, in Table VI would indicate that the variation depends principally upon right ascension. The Cordoba Catalogue contains, in some hours, as high as seventy per cent of the stars of the Zodiacal list.

IV. Obs. — Cord. Gen. Cat.

RA.	No.	Decl.	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$
12 ^h 5	14	- 4°7	-0°047	-0"15	—	—	—	—	—	—
13.5	7	- 4.3	-0.027	-0.51	—	—	—	—	—	—
»	22	-13.8	—	—	-0°028	-0"31	—	—	—	—
14.5	31	-14.7	—	—	-0.048	-0.56	—	—	—	—
»	11	-21.7	—	—	—	—	-0°014	-0"62	—	—
15.5	33	-16.4	—	—	-0.012	-0.32	—	—	—	—
»	21	-23.1	—	—	—	—	-0.026	-0.44	—	—
»	12	-25.7	—	—	—	—	—	—	-0°054	-0"75
16.5	20	-17.4	—	—	-0.025	-0.09	—	—	—	—
»	26	-23.0	—	—	—	—	-0.038	-0.18	—	—
»	24	-26.9	—	—	—	—	—	—	-0.032	-0.25
17.5	14	-17.7	—	—	+0.006	-0.39	—	—	—	—
»	29	-23.2	—	—	—	—	-0.006	-0.45	—	—
»	32	-27.6	—	—	—	—	—	—	-0.004	-0.43
18.5	15	-18.6	—	—	-0.007	-0.19	—	—	—	—
»	32	-22.6	—	—	—	—	+0.047	-0.43	—	—
»	28	-27.9	—	—	—	—	—	—	+0.051	-0.59
19.5	24	-17.5	—	—	+0.058	-0.19	—	—	—	—

RA.	No.	Decl.	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$	$\Delta\alpha$	$\Delta\delta$
19 ^h 5	28	-23°2	—	—	—	—	+0°033	-0°27	—	—
"	22	-27.1	—	—	—	—	—	—	+0°052	-0°28
20.5	37	-15.3	—	—	+0°036	-0°15	—	—	—	—
"	21	-22.8	—	—	—	—	+0.006	-0.33	—	—
"	5	-26.0	—	—	—	—	—	—	-0.006	-0.05
21.5	39	-15.4	—	—	+0.056	-0.61	—	—	—	—
"	14	-21.4	—	—	—	—	+0.046	-0.73	—	—
22.5	12	-4.8	+0°016	-1°11	—	—	—	—	—	—
"	32	-13.1	—	—	+0.049	-0.78	—	—	—	—
23.5	11	-3.6	+0.034	-0.35	—	—	—	—	—	—
"	18	-11.9	—	—	+0.064	-0.91	—	—	—	—
0.3	8	-3.4	(+0.036)	(-1.49)	—	—	—	—	—	—
Sum	642									

V. Obs. — Cord. Gen. Cat. Hourly means.

RA.	No.	Decl.	$\Delta\alpha$	v	Adjusted	O—C	$\Delta\delta$	v
12 ^h	14	-4°7	-0°047	-0°054	-0°037	-0°010	-0°15	+0°29
13	29	-11.4	-0.028	-0.035	-0.029	+0.001	-0.36	+0.08
14	42	-16.5	-0.039	-0.046	-0.021	-0.018	-0.57	-0.13
15	66	-20.2	-0.024	-0.031	-0.013	-0.011	-0.43	+0.01
16	70	-22.8	-0.033	-0.040	-0.005	-0.028	-0.18	+0.26
17	75	-23.9	-0.003	-0.010	+0.003	-0.006	-0.43	+0.01
18	75	-23.9	+0.038	+0.031	+0.011	+0.027	-0.45	-0.01
19	74	-22.6	+0.048	+0.041	+0.019	+0.029	-0.25	+0.19
20	63	-18.7	+0.022	+0.015	+0.027	-0.005	-0.20	+0.24
21	53	-16.9	+0.053	+0.046	+0.035	+0.018	-0.64	-0.20
22	44	-11.0	+0.040	+0.033	+0.043	-0.003	-0.87	-0.43
23	29	-8.6	+0.052	+0.045	+0.051	+0.001	-0.69	-0.25
Means			+0.007	—	+0.007	—	-0.44	—
Weights			+0.010	—	—	—	-0.42	—
Average			—	± 0.036	—	± 0.013	—	± 0.17

VI. Declination groups.

No.	Decl.	$\Delta\alpha$	$\Delta\delta$
44	-4°4	-0°003	-0°53
285	-15.7	+0.017	-0.42
182	-22.6	+0.006	-0.38
123	-26.9	+0.010	-0.41

Lick Observatory, University of California, 1906 April 17.

R. H. Tucker.

Observations of the sixth satellite of Jupiter

made with the 40-inch equatorial of the Yerkes Observatory.

The following positions of the sixth satellite of Jupiter are all that the unusually bad conditions of the past winter have permitted.

Under fair conditions this satellite is quite easy with the large telescope and its position can be accurately measured.

In each case, the satellite was found close to the

position assigned to it by Dr. Ross' ephemeris in Astr. Nachr. No. 4042.

On February 27, it was estimated to be 14 magnitude. It was $\frac{3}{4}$ magnitude brighter than a small star $1\frac{1}{2}' \pm$ north of it.

On March 20, from the low position of Jupiter, the satellite was more difficult and was estimated as $14\frac{1}{2}$ mag.