ASTRONOMISCHE NACHRICHTEN.

N^o 3515.

Band 147.

II.

Meridian Circle Observations of Close Circumpolar Stars.

By *R. H. Tucker.*

In the *Astronomische Nachrichten* No. 3440, a request was made by Dr. Auwers, for observations of a selected list of 21 close circumpolar stars, to be added to the list of 10, included in the ephemeris of the *Berliner Jahrbuch*. The list has been observed here during the past nine months, and the 10 B. J. stars have also been observed as fundamentals. Eight observations, four circle East and four West, have been given each star, at each culmination, sixteen

determinations in all; with the exception of a few observations, which were lost by clouds. Three of the fundamentals have received double the above number of observations.

In using the fundamentals, the provisional corrections to the B. J. places, given by Dr. Auwers (p. 115, No. 3440), have been adopted. There result the following mean places for the epoch 1898.0. The B. J. proper motions are included in the reductions.

Table I. Places of the Fundamental Stars. 1898.0.

No.	Star	α 1898.0	δ 1898.0	Obs. Corrections	No.
1	43 H. Cephei	0 ^h 54 ^m 46 ^s .75	+85° 42' 35".54	—0".02 —0".13	16
2	α Ursae min.	1 21 43.21	+88 45 49.03	—0.03 —0.09	16
3	Groombr. 750	4 4 30.99	+85 17 9.18	—0.04 +0.02	32
4	51 H. Cephei	6 52 44.62	+87 12 29.82	—0.08 —0.18	32
5	1 H. Draco.	9 22 33.35	+81 46 37.91	—0.12 —0.10	16
6	30 H. Cam.	10 18 39.37	+83 4 39.29	—0.04 —0.14	16
7	ϵ Ursae min.	16 56 24.82	+82 12 18.73	+0.04 —0.09	16
8	δ Ursae min.	18 5 11.72	+86 36 46.81	+0.05 —0.19	16
9	λ Ursae min.	19 24 45.13	+88 59 1.63	—0.10 —0.10	31
10	76 Draco.	20 49 58.67	+82 9 12.84	—0.03 —0.01	16

The table includes, also, the observed corrections to the adopted places, derived from the present series. Some explanation of these corrections is required, and the method of reduction will need to be considered.

In Right Ascension the azimuth correction has been determined from the above list of circumpolars, at least three stars having been included on each night. Since the clock correction has been derived from Equatorial stars, the observed places of the azimuth stars will not reproduce the assumed places, if there are systematic errors in these last; or if there are errors of observation, systematic or accidental. The adopted azimuth error, moreover, depends upon three stars, and its application to the observations will not satisfy the correction required for each separate star, in all cases.

Three observations of the Mire have been made each night, and the determinations of azimuth, which these supply, have been used to strengthen the values from stars direct, and to determine the change or rate.

The clock correction has been obtained from the same list of B. J. Equatorial stars that was employed in the series of observations, made here by me in the years 1893 to 1896; being part of a list selected by Dr. Auwers,

some years previously. In general, eight stars were used each night.

For other instrumental corrections, one determination of collimation has been made for each night, and three determinations of the level over Nadir.

The corrections to the assumed Right Ascensions of the fundamental circumpolar stars, bear evidence of systematic difference. This may be due to real systematic difference, between the Right Ascensions of circumpolar and clock stars: or to systematic errors of observation. The differences are nearly the same for both culminations (Table II), hence they do not appear to be due to errors in the determination of instrumental corrections, nor to personal equation depending upon the direction of the stars motion in transit. Both such sources of error may exist; but if so, they evidently balance in their effect. And the observed differences may be represented by a tendency to record all slow moving stars too early, in both directions of transit. Such a form of personal equation, if real and constant, would not affect the determination of the azimuth, from pairs of stars of the same declination. It will be of interest, as additional evidence, to quote the results of the earlier series, 1893 to 1896. The mean systematic correction to the B. J. places

of 45 circumpolar stars, used for azimuth determination was found to be $-0.008 \text{ sec } \delta$, (Obs. — B. J.). For the present series, with Auwers' corrections applied to B. J. the mean correction is $-0.003 \text{ sec } \delta$, (Obs. — A.), for ten stars.

It has been possible to determine the effect of personal equation, depending upon the direction of a stars apparent motion, at the zenith. The correction, for transits facing North, of which the details will be given later, is -0.03 at the zenith, opposite in sign to the observed correction to the assumed Right Ascensions of the circumpolar stars.

The determinations of Declination are differential, the fundamentals observed each night furnishing a mean value of the reference point. Accidental errors of observation will produce deviations in the observed places, from those assumed, for individual stars. And it is evident, moreover, that while the plus and minus residuals for one night, or

for a group of nights, must balance; yet residuals of opposite signs will produce corrections of the same sign, to two stars at opposite culminations. If there be a decided error in the assumed declination of any fundamental star, it will appear, with the same sign in the observations at the two culminations. In the above table, there is evidence of a systematic difference between the assumed declinations, and the determinations made in this series.

The comparison of the values of the Normal Latitude, ϕ_0 , at the two culminations furnishes a determination of the correction to the assumed declination of each fundamental star. This differs from the correction directly derived, in that it is independent of the places of the other stars employed as fundamental. Both values are exhibited in the following table. The values of $(\phi - \phi_0)$ have been computed from Chandler's formulae. No corrections for flexure have been applied.

Table II. Observed Corrections to Fundamental Places.

No.	Star	Obs. — A.			Obs. — A.			Normal Latitude ϕ_0			
		U. C.	L. C.	Mean	U. C.	L. C.	Mean	U. C.	L. C.	Δ	Corr.
1	43 H. Cephei	$-0.002 \text{ sec } \delta$	$-0.002 \text{ sec } \delta$	$-0.002 \text{ sec } \delta$	-0.03	-0.23	-0.13	25.61	25.32	$+0.29$	-0.14
2	α Ursae min.	-0.005	$+0.003$	-0.001	-0.06	-0.12	-0.09	25.26	25.13	$+0.13$	-0.07
3	Groombr. 750	-0.001	-0.007	-0.004	0.00	$+0.05$	$+0.02$	25.37	25.31	$+0.06$	-0.03
4	51 H. Cephei	$+0.004$	-0.012	-0.004	-0.04	-0.32	-0.18	25.46	25.06	$+0.40$	-0.20
5	1 H. Draco.	-0.014	-0.020	-0.017	-0.09	-0.12	-0.10	25.42	25.38	$+0.04$	-0.02
6	30 H. Cam.	0.000	-0.011	-0.005	-0.10	-0.18	-0.14	25.64	25.41	$+0.23$	-0.12
7	ϵ Ursae min.	$+0.012$	0.000	$+0.006$	-0.14	-0.04	-0.09	25.39	25.17	$+0.22$	-0.11
8	δ Ursae min.	0.000	$+0.006$	$+0.003$	-0.13	-0.25	-0.19	25.39	25.25	$+0.14$	-0.07
9	λ Ursae min.	-0.005	$+0.001$	-0.002	-0.26	$+0.06$	-0.10	25.63	25.47	$+0.16$	-0.08
10	76 Draco.	-0.012	$+0.004$	-0.004	-0.16	$+0.13$	-0.01	25.73	25.73	0.00	0.00
	Means	-0.002	-0.004	-0.003	-0.10	-0.10	-0.10	25.49	25.32	$+0.17$	-0.08

Following, in Table III, are given the observed Right Ascensions of the additional list of circumpolar stars. No proper motion has been applied in the reduction of these observations, but the values provisionally adopted by Dr. Auwers, A. N. 3440, are given in this table; and the requisite correction, for the epoch of observation, can be easily

applied. The direct mean of the two culminations has been taken, one observed in 1897, and one in 1898.

In the final column is given the observed Right Ascension, with the systematic correction, $+0.003 \text{ sec } \delta$, applied; the amount of this correction being given in the column preceding.

Table III. Observed Right Ascensions of 21 Stars. 1898.0.

No.	A.	Star	Pr. Mot.	Obs.	U. C.	L. C.	Epoch	Mean	Syst. Corr.	RA.
1	a	Ceph., Br. 256	$+0.025$	2 ^h 1 ^m	7.62	7.59	1898.09	7.60	$+0.02$	7.62
2	b	Ceph. 147 Hs.	$+0.048$	3 8	7.90	8.01	98.09	7.96	$+0.03$	7.99
3	c	Ceph. 149 Hs.	$+0.160$	3 33	14.91	14.92	98.09	14.92	$+0.05$	14.97
4	d	Ceph. 157 Hs.	$+0.023$	4 55	36.13	36.16	98.18	36.14	$+0.04$	36.18
5	e	Ceph. 158 Hs.	$+0.014$	5 29	16.78	16.86	98.18	16.82	$+0.03$	16.85
6	f	Ceph. 109 Hs.	-0.006	7 52	31.26	31.69	98.18	31.47	$+0.03$	31.50
7	g	Urs. min. 4 B.	-0.068	7 55	50.97	49.87	97.90	50.42	$+0.16$	50.58
8	h	Ceph. 121 Hs.	$+0.021$	8 54	5.61	5.28	97.90	5.44	$+0.03$	5.47
9	i	Cam., s. 664	-0.033	11 2	13.66	13.62	97.98	13.64	$+0.05$	13.69
10	k	Urs. min. 3 Hs.	-0.069	12 14	22.71	22.28	97.98	22.49	$+0.10$	22.59
11	l_1	32 H. Cam.	-0.011	12 48	14.69	14.53	97.98	14.61	$+0.03$	14.64
12	l_2	32 H. Cam.	-0.015	12 48	22.34	22.12	98.09	22.23	$+0.03$	22.26
13	m	Ceph. 135 Hs.	$+0.021$	13 45	14.17	14.03	98.09	14.10	$+0.03$	14.13
14	n	Urs. min. 57 B.	-0.007	15 10	1.83	1.93	98.18	1.88	$+0.07$	1.95

No.	A.	Star	Pr. Mot.	Obs.	U. C.	L. C.	Epoch	Mean	Syst. Corr.	RA.
15	<i>o</i>	Urs. min. 33 Hs.	+0.013	15 ^h 53 ^m	60.08	59.90	1898.09	59.99	+0.03	60.02
16	<i>p</i>	Ceph. 3 Hs.	-0.011	20 14	16.04	16.18	97.90	16.11	+0.03	16.14
17	<i>q</i>	Ceph., Gr. 3548	+0.020	21 19	57.48	57.70	97.98	57.59	+0.05	57.64
18	<i>r</i>	32 H. Ceph.	+0.051	22 21	26.20	26.29	97.90	26.24	+0.04	26.28
19	<i>s</i>	36 H. Ceph.	+0.064	22 55	13.31	13.31	97.98	13.31	+0.03	13.34
20	<i>t</i>	39 H. Ceph.	+0.093	23 27	49.06	49.04	97.98	49.05	+0.05	49.10
21	<i>u</i>	Ceph. 125 Hs.	+0.029	23 51	39.96	40.09	97.98	40.02	+0.02	40.04

The places of No. 11 and 12, components of 32 H. Cam., were observed separately, in distinct series. But the difference of the two components, in Right Ascension, was also observed each night. This furnishes 32 values of $\Delta\alpha$, which are entirely independent of the Right Ascensions actually determined for each star. The mean $\Delta\alpha$ is 7.56 with the probable error for one determination ± 0.087 . The probable error of the mean value would be

$$\pm 0.015, \text{ or } \pm 0.0016 \text{ sec } \delta.$$

In Table IV, following, are collected the observations of Declination for the additional list. No proper motions have been used in the reduction of the observations, but the requisite correction may be applied for the epoch of

observation, if desired. The direct mean of the two culminations has been taken.

The systematic correction for each star has been derived, by applying to the fundamental stars, used for the differential determination, the corrections found by comparison of the Latitudes observed at U. C. and L. C. These corrections will be found in the last column of Table II.

These corrections to the fundamental declinations may be due to errors of graduation, rather than to errors in the assumed places. The prevalence of the same sign indicates a systematic character. Whatever the source of the differences, the correction may evidently be treated as systematic, with respect to the places of the stars for which these have served as fundamental.

Table IV. Observed Declinations of 21 Stars. 1898.0.

No.	A.	Pr. Mot.	Obs.	U. C.	L. C.	Epoch	Mean	Syst. Corr.	Decl.
1	<i>a</i>	-0.056	+83° 4'	55.39	55.25	1898.09	55.32	0.00	+83° 4' 55.32
2	<i>b</i>	-0.125	+84 32	59.33	59.51	98.09	59.42	0.00	+84 32 59.42
3	<i>c</i>	-0.066	+86 19	33.18	33.17	98.09	33.18	0.00	+86 19 33.18
4	<i>d</i>	-0.078	+85 49	35.12	35.04	98.18	35.08	-0.02	+85 49 35.06
5	<i>e</i>	+0.009	+85 8	44.31	44.21	98.18	44.26	-0.02	+85 8 44.24
6	<i>f</i>	-0.004	+84 21	8.65	8.85	98.18	8.75	-0.02	+84 21 8.73
7	<i>g</i>	+0.020	+88 56	18.11	18.97	97.90	18.54	-0.05	+88 56 18.49
8	<i>h</i>	+0.033	+84 35	26.06	26.18	97.90	26.12	-0.05	+84 35 26.07
9	<i>i</i>	0.000	+86 11	36.69	36.80	97.98	36.74	+0.01	+86 11 36.75
10	<i>k</i>	+0.066	+88 15	55.15	55.06	97.98	55.11	+0.01	+88 15 55.12
11	<i>l</i> ₁	+0.016	+83 58	20.52	20.93	97.98	20.73	+0.01	+83 58 20.74
12	<i>l</i> ₂	+0.019	+83 58	2.38	2.66	98.09	2.52	0.00	+83 58 2.52
13	<i>m</i>	-0.042	+83 15	51.43	51.47	98.09	51.45	0.00	+83 15 51.45
14	<i>n</i>	+0.029	+87 37	31.01	30.98	98.18	31.00	+0.02	+87 37 31.02
15	<i>o</i>	-0.001	+83 15	18.66	18.91	98.09	18.78	0.00	+83 15 18.78
16	<i>p</i>	-0.038	+84 22	15.76	16.00	97.90	15.88	+0.05	+84 22 15.93
17	<i>q</i>	+0.022	+86 36	53.64	53.67	97.98	53.66	-0.01	+86 36 53.65
18	<i>r</i>	+0.048	+85 35	40.38	40.56	97.90	40.47	+0.05	+85 35 40.52
19	<i>s</i>	+0.018	+83 48	0.97	1.32	97.98	1.14	-0.01	+83 48 1.13
20	<i>t</i>	+0.017	+86 44	41.23	41.16	97.98	41.20	-0.01	+86 44 41.19
21	<i>u</i>	+0.015	+82 37	23.13	23.42	97.98	23.28	-0.01	+82 37 23.27

In Table V, following, there are collected the observed Right Ascensions of the clock stars. The observations have been reduced so that the final observed place is independent of the use of the star as a fundamental or clock star; and each Right Ascension thus depends upon the places of seven other stars, within a period of four hours. Accordingly, it is not possible to discuss the observed places, for systematic error depending upon RA. The B. J. places have been

adopted; with the exception of 25 Monoc., 7^h 32^m, for which the B. J. place was corrected by +0.10. This correction was derived in the earlier series, 1893 to 1896, and its reality is confirmed by the present series. Dr. Auwers has given me an explanation of this error in B. J., which arises from the accumulation of erroneous proper motion, derived from Greenwich 1866 and Bradley.

Table V.
Observed Right Ascensions of Clock Stars.
1898.0.

Star	Obs. RA.	No.	Obs. — B.J.
γ Pegasi	0 ^h 7 ^m 58 ^s .924	8	—0.023
12 Ceti	0 24 49.997	8	+0.008
ϵ Piscium	0 57 38.890	8	—0.006
α Ceti	2 14 11.571	8	+0.036
ξ^2 Ceti	2 22 44.045	7	—0.024
δ Ceti	2 34 15.213	8	—0.011
α Ceti	2 56 56.796	8	+0.053
α Tauri	3 19 19.373	15	—0.021
ϵ Eridani	3 28 7.491	8	+0.061
ν Tauri	3 57 43.763	8	—0.022
ν Eridani	4 31 13.318	16	+0.068
π 5 Orionis	4 48 56.222	16	—0.052
γ Orionis	5 19 39.584	7	+0.039
8 Monoc.	6 18 21.757	13	—0.061
S Monoc.	6 35 21.623	15	—0.034
18 Monoc.	6 42 32.539	15	—0.003
λ Gemin.	7 12 13.844	8	—0.045
25 Monoc.	7 32 12.394	8	+0.109 *)
Br. 1197	8 20 33.835	7	+0.031
θ Hydrae	9 9 3.451	14	—0.018
6 Sextantis	9 46 5.637	7	—0.039
π Leonis	9 54 49.433	16	+0.027
α Leonis	10 2 56.426	16	+0.025
1 Leonis	10 43 53.746	7	—0.035
σ Leonis	11 15 52.615	7	—0.017
β Virginis	11 45 22.930	8	+0.047
α Virginis	12 0 0.827	8	+0.018
ϵ Virginis	12 57 5.923	8	—0.040
ζ Virginis	13 29 29.701	8	+0.026
ι Virginis	14 10 39.880	7	+0.045
μ Virginis	14 37 41.014	8	+0.011
109 Virginis	14 41 5.467	8	+0.021
P. 221	14 51 24.276	8	—0.100
α Serpentis	15 39 14.547	7	—0.028
ϵ Serpentis	15 45 43.812	16	+0.003
ζ Ophiuchi	16 31 32.474	16	+0.016
α Herculis	17 9 59.729	8	—0.023
β Ophiuchi	17 38 25.974	8	+0.001
η Serpentis	18 16 1.908	8	+0.066
λ Aquilae	19 0 50.161	7	+0.054
ω Aquilae	19 13 1.695	8	—0.014
γ Aquilae	19 41 24.573	8	—0.025
θ Aquilae	20 6 2.516	8	+0.042
ϵ Delphini	20 28 20.359	8	—0.021
ϵ Aquarii	20 42 9.293	8	+0.034
β Aquarii	21 26 11.346	7	—0.011
ϵ Pegasi	21 39 10.531	16	—0.038
θ Aquarii	22 11 27.092	16	—0.003
η Aquarii	22 30 6.888	16	+0.009
λ Aquarii	22 47 17.619	8	+0.055
ι Piscium	23 34 42.205	8	+0.014

*) Ephemeris place corrected +0.010.

The probable errors of these places may be summarized as follows.

P. E. one observation of clock star, ± 0.020 ; from comparison East and West, 51 stars.

P. E. mean RA. of clock star, ± 0.008 ; by comparing the results of this series, with those of the earlier series, 1893 to 1896, 47 stars.

P. E. one transit of circumpolar star ± 0.06 at 84° , or $\pm 0.006 \sec \delta$; from $\Delta \alpha$ for No. 11 and 12.

P. E. one obs. RA. circumpolar star $\pm 0.015 \sec \delta$; from comparison of four observations in the same position, 21 stars.

P. E. mean of 4 observations $\pm 0.008 \sec \delta$; from comparison of results East and West.

P. E. mean of 8 observations $\pm 0.008 \sec \delta$; by comparing the two culminations.

Adopted P. E. mean of 16 observations, $\pm 0.005 \sec \delta$.

P. E. one observation of Declination ± 0.20 U. C., ± 0.22 L. C.; from comparison of observations in the same position, 21 stars. The effect of graduation error is not included.

P. E. mean of 4 observations ± 0.15 ; from comparison of East and West. The effect of graduation error is here included, and may be reckoned at ± 0.11 for one circle reading, four microscopes upon two adjoining divisions. The actual measurement of all the 1° divisions of this circle gives ± 0.15 , as the probable error of graduation for a single circle reading, four microscopes, one division each, (A. N. 3374).

P. E. mean of 8 observations, ± 0.11 ; by comparing the results at both culminations. The constant difference, U. C. — L. C. = -0.16 , has been adopted in this series.

Resulting p. e. mean of 16 observations, ± 0.08 .

This may be pretty exactly distributed between p. e. of observation, ± 0.06 ; and p. e. of graduation, ± 0.06 .

Every observation has been included, in both Right Ascension and Declination, and no residuals have been rejected in this discussion. The p. e. of one observation of ϕ , independent of error of Declination, and of graduation errors, is ± 0.19 at U. C. and ± 0.23 at L. C.

Mr. E. F. Coddington, holding a fellowship at this Observatory, has assisted in various details of the reduction of these observations.

The Latitude obtained by observations of the circumpolar stars, at both culminations, is free from the effect of errors in the assumed declinations. The effect of the annual term of the Latitude Variation is also largely eliminated, since the two culminations will, in general, be observed with an interval of half a year.

But this value of the Latitude is affected by various sources of systematic error, such as may arise from refraction, flexure, and the bisection error. The comparison of the results at the two culminations affords a check upon the first two sources of error. There is no check upon the last mentioned, which does not assume absolute declinations, beyond the method of determining the effect of bisection error at the zenith.

In accord with my practice for previous series of observations, a set of determinations of bisection error at the zenith has been made, including also the effect of direction of motion upon the observed transit. The results of all the sets are collected here, to exhibit the general evidence of personal equation. A single determination consists of four observations, one pair of zenith stars upon two nights; and in the reduction, every other source of difference, except accidental error of observation, has been eliminated.

The resulting $\Delta\alpha$ (S-N) indicates the correction to be applied to transits, or to Right Ascensions, for zenith stars observed facing North. And the $\frac{1}{2}\Delta Z$ indicates the correction to be applied to observed zenith distances. For some of the sets, transits were not observed.

Epoch	No. det.	$\Delta\alpha$	No. det.	$\frac{1}{2}\Delta Z$
1894.1	8	-0.035	8	-0.13
1894.6	—	—	5	+0.03
1895.6	10	-0.020	10	-0.13
1896.4	8	-0.026	8	-0.03
1896.5	8	-0.035	8	+0.02
1897.4	—	—	7	-0.10
1898.3	5	-0.033	5	-0.07
1898.3	—	—	5	-0.02
Means		-0.030		-0.06
		-0.025 sec δ .		

There is evidence of a consistent correction, in transits, of -0.03, for stars at the zenith, due to the direction of motion. But it does not appear to be sensible in the determinations of circumpolar stars, at both culminations; although its existence may be masked by other errors.

The zenith distance correction, if constant at all altitudes, will not affect determinations of declination based upon fundamental stars on the same side of the zenith. But the correction would be applicable to determinations of the Latitude; plus for φ observed with North stars, and minus for φ observed with South stars.

The Poulkova Refractions have been employed in reducing this series of observations.

The flexure has been determined, as in previous series, by observing upon the two collimators, about equally in both positions of the instrument, circle East and West. The correction has always been small, and for the present set of declinations it would be entirely insensible, from the differential character of the work. The following values have been obtained, the correction, f = semi horizontal flexure, being here given with the sign applicable to observed zenith distances.

1893 to 1896	25 det.	$f = -0.09$
1896 > 1897	11 >	$f = +0.05$
1897 > 1898	8 >	$f = +0.08$

Probable error of one determination ± 0.1 .

In Table VI is collected the series of Latitude results, from these observations of the ten close circumpolar stars. Each value corresponds to the mean of two nights, one observed circle East, and one West, for the elimination of

the graduation error of the Nadir reading. The groups of four consecutive dates include the observations of the same set of stars. Groups one and five correspond to the same sets at the opposite culminations.

The probable error of a pair of nights is sensibly diminished by the application of the correction for Latitude Variation. Treated as a consecutive series of determinations, the probable error of φ_0 , for one pair of nights, is ± 0.12 , including the error of declinations. By taking out the group residuals, the probable error of a single pair of nights is ± 0.09 ; the error of declination being thus eliminated, this represents the observation errors only, and there would result, accordingly, the probable error of observation for one night, ± 0.13 .

The probable error of a Nadir reading has been derived from 159 determinations, upon 53 nights, not counting the nights when a rate has been adopted. For one reading the p. e. is ± 0.14 and for the mean of three readings, ± 0.08 . The use of a rate, in the zenith reading, will usually produce residuals smaller than the normal accidental values.

In the second part of the table, are given the values of the Latitude, from the separate stars. The probable error includes the errors of observation, and of graduation, only; since the error of declination is eliminated from the mean of both culminations. The separate culminations have been given in Table II, in the derivation of the systematic error. Three of the stars have been observed in duplicate; by weighting these stars, the mean φ and φ_0 are each 25.40 .

Table VI. Latitude.

By Nights (pairs).

1897	φ	φ_0	1898	φ	φ_0
Sept. 5	25.28	25.53	Febr. 3	25.36	25.24
» 7	25.29	25.55	» 5	25.61	25.48
» 11	25.05	25.31	» 6	25.49	25.35
» 13	25.34	25.61	» 11	25.38	25.23
Sept. 28	25.33	25.61	Mar. 11	25.69	25.45
» 30	25.06	25.34	» 13	25.81	25.57
Oct. 5	25.41	25.69	» 17	25.81	25.56
» 9	25.37	25.65	» 21	25.89	25.63
Nov. 3	24.82	25.06	April 26	25.52	25.25
» 7	25.24	25.47	» 28	25.45	25.18
» 9	24.89	25.11	» 30	25.54	25.27
» 12	24.97	25.18	May 4	25.59	25.33
Dec. 12	25.26	25.37	May 16	25.47	25.23
» 20	25.51	25.58	» 18	25.51	25.28
» 23	25.62	25.68	» 24	25.33	25.11
» 25	25.34	25.39	» 26	25.57	25.36
			Mean	25.40	25.40

p. e. 1 pair ± 0.17 ± 0.12

By groups, p. e. 1 pair ± 0.09

By Stars.

No.	Star	φ	φ_0
1	43 H. Cephei	25°44'	25°46'
2	α Ursae min.	25.21	25.19
3	Groombr. 750	25.38	25.34
4	51 H. Cephei	25.26	25.26
5	1 H. Draco.	25.34	25.40
6	30 H. Cam.	25.51	25.52
7	ϵ Ursae min.	25.30	25.28
8	δ Ursae min.	25.39	25.32
9	λ Ursae min.	25.55	25.55
10	76 Draco.	25.71	25.73
Mean		25.41	25.41
p. e. 1 star		± 0.10	± 0.11
Mean by weights		25.40	25.40

Lick Observatory, University of California, 1898 May 31.

The results of my previous determinations of the Latitude, by Meridian circle observations of circumpolar stars at both culminations, are given here for comparison. In the first series, flexure to the amount $0''.1 \sin Z$ had been applied.

Flexure applied Without flexure

1893 to 1896	32 B. J. stars	$\varphi_0 = 25^\circ 52'$	$\varphi_0 = 25^\circ 44'$
1896 > 1897	11 stars, Boss		25.37
1897 > 1898	10 stars, Auw.		25.40

The adoption of the bisection error, determined from observations of zenith stars, would increase the above values by $+0''.06$. The probable error of the determination from one star is $\pm 0''.1$, and the probable error of the mean of the above values, $+37^\circ 20' 25''.40$, is less than $\pm 0''.02$.

The discussion of the Latitude, derived from other stars, must be reserved until the results of the latest investigations of standard places are available. They are in general larger than the values given by the circumpolar observations.

R. H. Tucker.

Observations of Comet 1898 . . . (Coddington-Pauly)

made at Sydney Observatory.

1898	Sydn. M. T.	Δ RA.	Δ NPD.	Cp.	Obs.	RA. app.	$\log p.A$	NPD. app.	$\log p.A$	Red. ad l. app.	*	
June	16	9 ^h 15 ^m 52 ^s	-1 ^m 34 ^s 14	+7' 20".6	5	S	16 ^h 10 ^m 28 ^s 11	9.253 _n	117° 54' 57".4	0.029	+4 ^s 24 +13".5	1
	23	8 47 30	+0 22.46	-0 27.4	8	S	15 45 42.26	9.110 _n	122 7 37.5	9.528	+4.29 +17.1	2
	23	9 38 57	Meridian		—	S	15 45 34.45	—	122 8 53.7	9.372	—	—
	24	8 44 10	+0 38.98	-7 33.0	8	S	15 42 7.91	9.077 _n	122 41 43.7	9.373	+4.28 +17.6	3
	24	9 31 27	Meridian		—	S	15 42 0.08	—	122 42 49.6	9.172	—	—
	27	9 9 5	Meridian		—	L	15 31 24.36	—	124 21 37.6	9.018 _n	—	—
July	4	9 30 14	-0 11.10	+2 47.8	3	S	15 7 17.73	9.286	127 51 3.6	9.617 _n	+4.15 +22.1	4
	5	8 10 30	Meridian		—	S	15 4 11.64	—	128 16 43.1	9.848 _n	—	—
	6	8 3 21	Meridian		—	S	15 0 58.15	—	128 43 8.5	9.888 _n	—	—
	7	7 56 15	Meridian		—	S	14 57 47.71	—	129 8 56.9	9.923 _n	—	—
	11	10 12 0	-3 20.80	+5 50.2	6	S	14 45 17.49	9.627	130 48 28.4	8.942	+3.96 +24.5	5
	13	7 14 49	Meridian		—	L	14 39 54.44	—	131 31 0.4	0.079 _n	—	—
	13	8 57 52	-3 56.06	+6 47.8	7	S	14 39 42.48	9.454	131 32 33.3	9.855 _n	+3.90 +25.1	6
	13	9 33 33	-1 58.22	+6 37.5	5	S	14 39 38.27	9.571	131 33 4.0	9.523 _n	+3.87 +25.2	7
	14	9 42 23	+2 36.17	+8 20.1	7	S	14 36 50.89	9.613	131 55 8.3	9.265 _n	+3.79 +25.7	8
	15	7 1 31	Meridian		—	L	14 34 26.93	—	132 14 5.4	0.117 _n	—	—
	15	8 54 17	+0 9.80	+1 32.8	8	S	14 34 14.10	9.495	132 15 41.8	9.859 _n	+3.79 +25.8	9
	15	9 26 43	-1 29.71	-5 21.1	8	S	14 34 9.88	9.593	132 16 8.8	9.543 _n	+3.81 +25.8	10

Observer: L = H. A. Lenehan, S = R. P. Sellors.

The observations on the meridian were made with the Transit Circle.

Mean Places of Comparison Stars for 1898.0.

*	RA.	NPD.	Authority	*	RA.	NPD.	Authority
1	16 ^h 11 ^m 58 ^s 01	117° 47' 23".3	St. 8858, Cord. GC. 22077, Yarnall, 6848	5	14 ^h 48 ^m 34 ^s 33	130° 42' 13".7	Cord. GC. 20185
2	15 45 15.51	122 7 47.8	Cord. ZC. 15 ^h 3084	6	14 43 34.64	131 25 20.4	St. 8067, Cord. GC. 20081
3	15 41 24.65	122 48 59.1	Cord. GC. 21386, Wash. Z. (1846) 25.2	7	14 41 32.62	131 26 1.3	Cord. ZC. 14 ^h 2548
4	15 7 24.68	127 47 53.7	Sydney Merid. Obs. 1898	8	14 34 10.93	131 46 22.5	Cord. GC. 19858
				9	14 34 0.51	132 13 43.2	Cord. ZC. 14 ^h 2083
				10	14 35 35.78	132 21 4.1	St. 7993, Cord. GC. 19889

Observatory Sydney, 1898 July 19.

H. C. Russell.