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ON THE SYSTEMATIC DIFFERENCES BETWEEN THE BELGRADE CATALOGUE OF LATITUDE STARS AND THE AGK3R

S. SADŽAKOV, M. DAČIĆ, D. ŠALETIĆ, V. PROTIĆ-BENIŠEK

SUMMARY:

The comparison of the Belgrade Catalogue of Latitude Stars (KŠZ) with the AGK3R was analysed by right ascension, declination, magnitude and spectral type. The change of the constant of refraction in dependence on the colour of the star is pointed out.

INTRODUCTION

The catalogue AGK3R contains about 21 500 stars with magnitude 5,7—9,5 between $+90°$ and $-5°$ of declination. It was observed in the interval 1956—1964, with 11 meridian circles at 10 various astronomical observatories, whereof two instruments of the U. S. Naval Observatory (Washington). Usually, every star was observed twice, and in a number of cases, up to four times. The observations were sent to USNO where they were analysed and reduced into a fundamental system, for every observatory separately.

On this basis a general catalogue AGK3R was formed. The mean epoch of it is 1958, the mean error in right ascension is $\pm 0^s.0050 \sec \delta$, and in the declination $\pm 0''.116$.

The Belgrade Catalogue of Latitude Stars (KŠZ) covers the celestial sphere between $+13°$ and $+90°$. It contains 3 957 stars with magnitude of 3.0 to 9.4. Every star was observed four times on the average, in the interval 1968—1971. The mean epoch of observations is 1969. 46, and the mean error in declination is $\pm\ 0''.170$.

It has to be born in mind that the mean latitude wherefrom the values in AGK3R ($\varphi=46°51'$) were determined, is close to the latitude of the Astronomical Observatory in Belgrade ($\varphi=44°\ 48'$).

There are 1 416 of stars that are common to both of them. The mean error of one difference in declination of these two catalogues is:

$$m=\sqrt{(0.12)^2+(0.17)^2}=\pm 0''.21$$

The distribution of stars by right ascension (α) and declination (δ) is nearly the same throughout the whole sky as can be seen in Tables 1 and 2.

Table 1

α	0^h-4^h	4^h-8^h	8^h-12^h	12^h-16^h	16^h-20^h	20^h-24^h
n	236	217	249	254	248	212

Table 2

δ	$<35°$	$35°-45°$	$45°-55°$	$55°-65°$	$>65°$
n	195	295	451	308	167

In order to make comparison and the analyses of declinations of these two catalogues, or of different systematic effects comprised in them, we had to decide what proper motions to use in this kind of work. At our disposal we had only proper motions calculated by Kalinina (1971.) for all stars of the catalogue AGK3R figuring on the list of latitude stars. These proper motions were computed on the basis of the comparison between the coordinates of the catalogue AGK3R and the catalogue AGK2 (the coordinates of the latter were first brought into the system FK4).

2. ANALYSIS OF SYSTEMATIC EFFECTS

The comparison of the above-mentioned catalogues was carried out through the analysis of systematic effects of the type $\Delta\delta_0$, $\Delta\delta_\delta$, $\Delta\delta_\alpha$, $\Delta\delta_m$, $\Delta\delta_{sp}$, where the indices point to their character.

It has to be noted that $\Delta\delta_0$ is the mean systematic difference of the declinations of these two catalogues from all stars that are common to both of them.

We started from the simple relation:

$$\Delta\delta=\Delta\delta_{K\check{S}Z}-\Delta\delta_{AGK3R}=$$
$$=\Delta\delta_0+\Delta\delta_\delta+\Delta\delta_\alpha+\Delta\delta_m+\Delta\delta_{sp}$$

Table 3

δ \ α	0^h-4^h		4^h-8^h		8^h-12^h		12^h-16^h		16^h-20^h		20^h-24^h		mean	values
	$\Delta\delta_0+\Delta\delta_\delta$	n	$\Delta\delta_0+\Delta\delta_\delta$	n	$\Delta\delta_0+\Delta\delta_\delta$	n	$\Delta\delta_0+\Delta\delta_\delta$	n	$\Delta\delta_0+\Delta\delta_\delta$	n	$\Delta\delta_0+\Delta\delta_\delta$	n	$\Delta\delta_0+\Delta\delta_\delta$	n
<35°	+0″.01	42	−0″.01	34	+0″.12	32	−0″.04	31	−0″.09	33	−0″.08	23	−0″.02	195
35°−45°	+ 9	49	+ 4	45	− 0	54	− 1	63	− 1	44	− 5	40	+ 1	295
45°−55°	+ 3	70	− 6	64	− 0	91	− 11	72	− 3	78	− 5	76	− 4	451
55°−65°	− 4	46	+ 8	46	− 0	49	− 8	56	− 1	64	− 7	47	− 2	308
>65°	− 2	29	− 6	28	− 6	23	− 1	32	+ 1	29	− 3	26	− 3	167

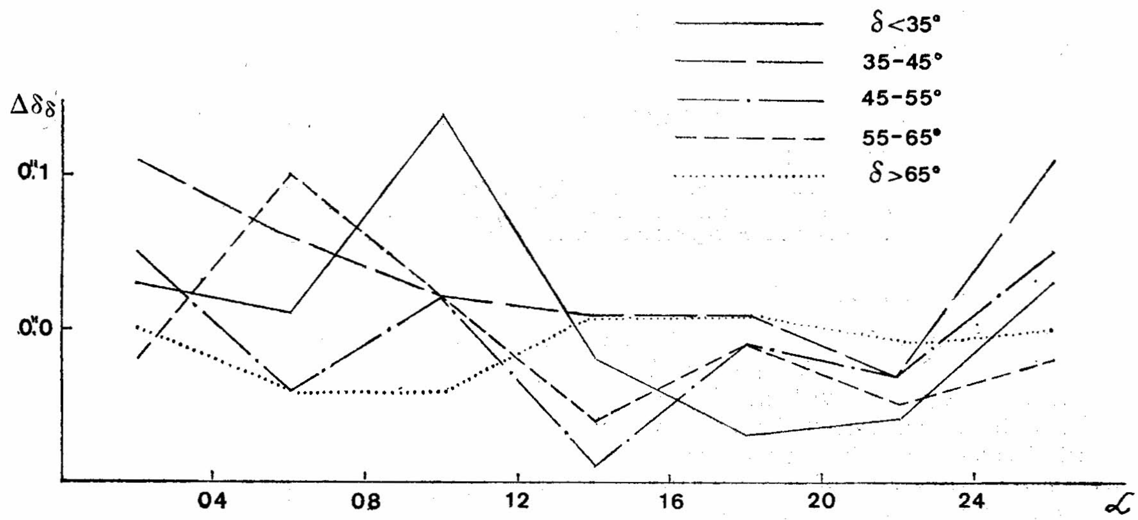

Fig. 1.

I. The systematic effects of the type $(\Delta\delta_0+\Delta\delta_\delta)$ were first singled out and numerical values were formed for individual segments of the sky. Table 3 shows values $(\Delta\delta_0+\Delta\delta_\delta)$, as well as the number of stars (n) from which they were calculated.

From the above quoted values $(\Delta\delta_0+\Delta\delta_\delta)$ we derived $\Delta\delta_\delta$ assuming that $\Delta\delta_0=-0''.02$.

The values $\Delta\delta_\delta$ vary from $+0''.12$ to $-0''.09$, and the errors of determination for all zones are $\pm0''.02$. These values were calculated with weights, on the basis of the number of stars in each interval. The values $(\Delta\delta_0+\Delta\delta_\delta)$ are predominantly of negative sign, which indicates that the declinations KŠZ require positive systematic corrections in relation to AGK3R.

On the basis of this we can draw the following conclusions:

1) The maximal divergence is in those areas of the sky in which the measurements were made in the period $0^h<\alpha<12^h$, which covers the winter period (evening hours).

2) The values for north and south zones point to the possibility of the existence of local anomalies of refraction or, which is more likely, that a certain measured element, which is significant in the calculation, is unreal. It is possible that the measurements of the air temperature in the pavilion were not adequate.

3) The minimal divergencies and the intersections of curves for the zones in farthest north and farthest south fall in the warmer period, when the observation conditions are more favourable, the number of clear nights higher, and the temperature variation minimal.

II. Through elimination of values $(\Delta\delta_0+\Delta\delta_\delta)$ the values $\Delta\delta_\alpha$ were obtained with the mean error of determination: $\pm0''.02$ (see Table 4).

$$\Delta\delta_\alpha=\Delta\delta-(\Delta\delta_0+\Delta\delta_\delta)$$

Table 4

$\delta \backslash \alpha$	0^h-4^h		4^h-8^h		8^h-12^h		12^h-16^h		16^h-20^h		20^h-24^h	
	$\Delta\delta_\alpha$	n	$\Delta\delta_\alpha$	n	$\Delta\delta_\alpha$	n	$\Delta\delta_\alpha$	n	$\Delta\delta_\alpha$	n	$\Delta\delta_\alpha$	n
$<35°$	$+0''.03$	42	$+0''.01$	34	$+0''.14$	32	$-0''.02$	31	$-0''.07$	33	$-0''.06$	23
$35°-45°$	+ 8	49	+ 3	45	− 1	54	− 2	63	− 2	44	− 6	40
$45°-55°$	+ 7	70	− 2	64	+ 4	91	− 7	72	+ 1	78	− 1	76
$55°-65°$	− 2	46	+ 10	46	+ 2	49	− 6	56	+ 1	64	− 5	47
$>65°$	+ 1	29	− 3	28	− 3	23	+ 2	32	+ 4	29	− 0	26
mean values:	$+0''.04$	236	$+0''.02$	217	$+0''.03$	249	$-0''.04$	254	$-0''.00$	248	$-0''.03$	212

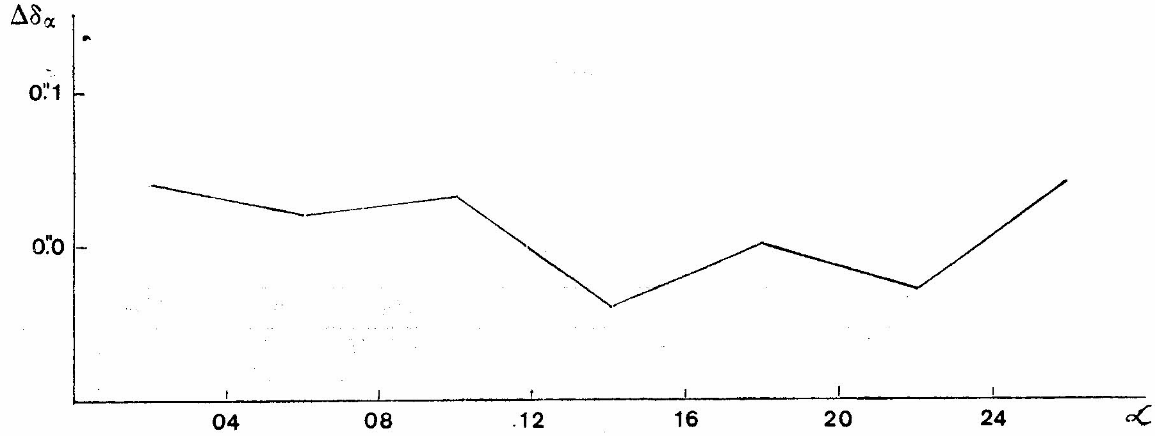

Fig. 2.

The values $\Delta\delta_\alpha$ vary from $+0''.14$ to $-0''.07$ in individual segments of the sky. The mean value of $\Delta\delta_\alpha$ in the zones of 4 hours each shows that the curve takes sinusoidal form. In the zone from 0^h to 12^h in right ascension, the values $\Delta\delta_\alpha$ are positive, and from 12^h to 24^h hours they are negative (see Fig. 2).

III. Considering that during the observations for the Catalogue of Latitude Stars (KŠZ) the screen grids were not used, the research in systematic effects of the type $\Delta\delta_m$ is justified. These values have been obtained by means of the formula:

$$\Delta\delta_m = \Delta\delta - (\Delta\delta_0 + \Delta\delta_\delta + \Delta\delta_\alpha)$$

and given in Table 5.

Table 5

Magnitude	$\Delta\delta_m$	ε	n
$m<7.0$	$-0''.01$	$\pm0''.02$	381
$7^m.0-7^m.5$	− 0	2	358
$7^m.^m-8^m.0$	− 1	2	294
$8^m.0-8^m.5$	− 1	2	249
$m>8.5$	$-0''.01$	$\pm0''.03$	131

The values given in Table 5 confirm the conclusion of former authors (Podobed, 1968) that the effects of type $\Delta\delta_m$ do not exist or they are so small that they are negligible in this kind of work.

IV. The values of the type $\Delta\delta_{sp}$ were obtained by elimination of preceding systematic effects from differences of declinations of stars common to both of them:

$$\Delta\delta_{sp} = \Delta\delta - (\Delta\delta_0 + \Delta\delta_\delta + \Delta\delta_\alpha + \Delta\delta_m)$$

The obtained $\Delta\delta_{sp}$ values are grouped by spectral type (Table 6) as follows:

A — all stars of the spectral type from A0 to A9, including also some stars of the spectral type B and 0;

F — all stars of the spectral type from F0 to F9;

G — all stars of the spectral type from G0 to G9;

K — all stars from K0 to K9, including some stars of the spectral type M0 and M9.

The analysis of $\Delta\delta_{sp}$ shows that the stars of different spectral types have different values (see Fig. 3).

The curve for the stars of the spectral type A has distinctly declining course greatly dependent upon the declination of stars. With stars of the spectral type K the case is inverse. Perhaps, this could be ascribed to different indices of refraction for various colours.

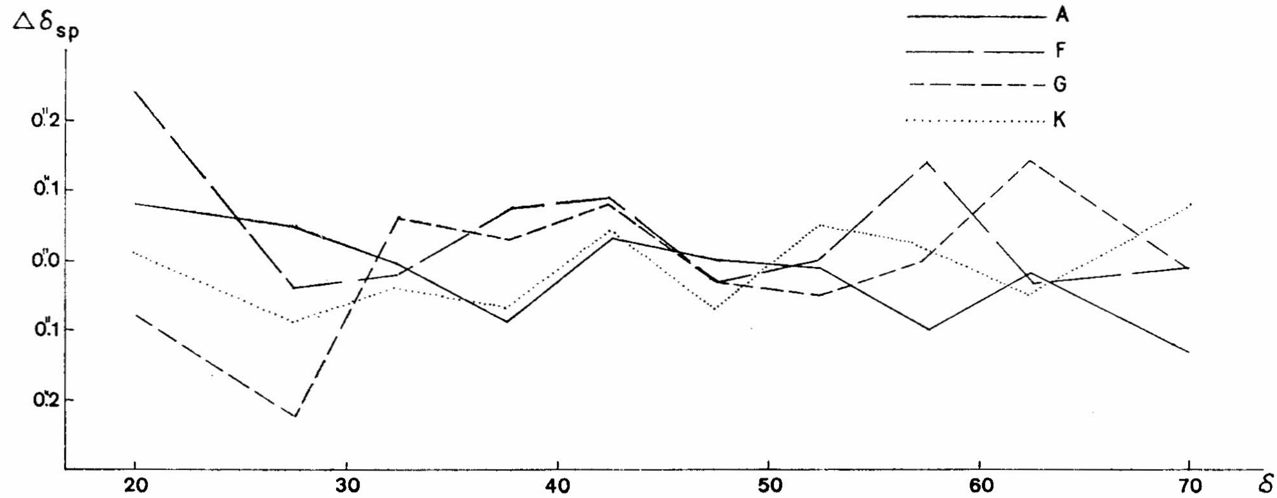

Fig. 3.

Table 6

$\delta \diagdown S_p$	A		F		G		K	
	$\Delta\delta_{sp}$	n	$\Delta\delta_{sp}$	n	$\Delta\delta_{sp}$	n	$\Delta\delta_{sp}$	n
<25°	+0".08	9	+0".24	6	−0".08	7	+0".01	17
25°−30°	+ 5	35	− 4	17	− 23	9	− 9	28
30°−35°	− 0	11	− 2	12	+ 6	8	− 4	35
35°−40°	− 8	39	+ 7	32	+ 3	26	− 7	75
40°−45°	+ 3	32	+ 9	12	+ 8	18	+ 4	59
45°−50°	+ 0	44	− 3	37	− 3	29	− 7	83
50°−55°	− 1	79	+ 0	51	− 5	35	+ 5	89
55°−60°	− 10	44	+ 14	22	+ 0	27	+ 2	88
60°−65°	− 2	29	− 3	24	+ 14	18	− 5	48
>65°	− 13	39	− 1	25	− 1	32	+ 8	57

The values $\Delta\delta_{sp}$ (Fig. 3.) change the sign at $\delta=45°$, approximately. The stars of the spectral type *A* have positive sign, while stars of the spectral type *K* have negative one. This phenomenon is noticeable also with other spectral types.

It is well known that the effect of colour is causing the change in the refraction constant. Therefore, it was attempted to make an analysis of the differencies in declinations of a given spectral type by means of the following equations of condition:

$$\Delta\delta_{sp}=x+\varkappa \operatorname{tg} z$$

where is: x — constant difference between the catalogues;
$\varkappa$ — correction for the refraction constant;
z — zenith distance of the middle of the zone.

This analysis yielded results as shown in Table 7.

Table 7

	A	*F*	*G*	*K*
x	−0".017	+0".024	−0".010	−0".016
ε_x	±0".010	±0".010	±0".011	±0".014
$\varkappa$	+0".018	+0".005	−0".008	−0".013
ε_x	±0".004	±0".004	±0".004	±0".006

By comparison of the position of stars of earlier and later types in relation to the position between the spectral types F and G, it is stated that the positions of the stars of earlier spectral types are shifted towards the zenith, and those of the later ones back from the zenith.

Taking into consideration that in the calculation of the refraction Pulkovo tables had been used, where the applied constant of refraction is:

$K = 60''.154$

from our results it follows:

$K = 60''.172$ for the spectral type A

$K = 60''.159$ for the spectral type F

$K = 60''.149$ for the spectral type G

$K = 60''.141$ for the spectral type K.

The change in refraction constant (according to the formula for the index of refraction) may vary from A to K by about $0''.02$ (Teleki, 1967), and by this procedure it is obtained that it varies by about $0''.03$.

CONCLUSION

On the basis of the above laid out, we can say that systematic effects of types $\Delta\delta_\alpha$ and $\Delta\delta_\delta$ are evident and, most probably, they result from:

1. seasonal systematic errors (possible systematic difference of the measured real air temperature in the pavilion);
2. possible systematic errors in proper motions;
3. systematic errors resulting from observations of declinations, made by zones.

Systematic error $\Delta\delta_m$ is not evident, or ,it is less than $0''.01$.

Systematic effect $\Delta\delta_{sp}$ exists and most probably it results from:

1. inaccurate value of the refraction (in relation to its dependence upon the distance from the zenith);
2. chromatic qualities of the object-glass.

*

* *

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INVESTIGATION OF DECLINATIONS AND OF PROPER MOTIONS OF THE BELGRADE GENERAL CATALOGUE OF LATITUDE STARS BSKŠZ1 AND BSKŠZ2

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SUMMARY:

This study is concenred with the examination of catalogue positions of stars of the International Latitude Service, through the z-term which is considered to be comulative effect of catalogue errors and small periodic terms (Wako, 1969).

The relationship of the z term and catalogue errors

It is well known that at all observational stations of the International Latitude Service the latitude is determined by Talcott method on the basis of the formula:

$$\varphi = \frac{1}{2}(\delta_N + \delta_S) + \frac{1}{2}(z_N - z_S)$$

where

δ_N and δ_S — apparent declinations of the north and south star in the pair;

$\Delta Z = (z_S - z_N)$ — the measured difference of corresponding zenith distances.

Departing from the assumption that apparent declinations of stars are loaded with errors, we have the following formula for all stations of the International Latitude Service

$$\varphi = \delta_m + \Delta Z = \varphi_{tr} - (\delta_{tr} - \delta_m) \qquad (1)$$

where are:

φ_{tr} — true value of the latitude;

δ_{tr} — true value of the declination.

Polar motion effect on the geographic latitude at the moment t, at the station A with the longitude λ_A will be:

$$\varphi_{t,A}-\varphi_A=\Delta\varphi_{t,A}=x_t\cdot\cos\lambda_{t,A}+y_t\cdot\sin\lambda_{t,A} \quad (2)$$

where are:

φ_A = mean latitude of the station A,

x_t, y_t = rectangular coordinates of the pole.

Since 1902 *Kimura* has introduced non-polar change z_t into equation (2), common for all stations of the International Latitude Service, in the following form:

$$\Delta\varphi_{t,A}=x_t\cdot\cos\lambda_A+y_t\cdot\sin\lambda_A+z_t \quad (3)$$

By comparison of the formula (1) and (3) (Wako, 1969), we obtain:

$$z_t=-\ (\delta_{tr}-\delta_m)$$

If the catalogue declination is loaded with errors, then the same author assumes that non-polar z-term can be represented in the form:

$$z_t=-\{\overline{d\,\delta}+\overline{d\,\mu'}\,(t-t_0)+\text{Periodic term}\}$$

where are:

$\overline{d\,\delta}$, $\overline{d\,\mu'}$ = catalogue errors in the declination and proper motion;

t = epoch of observation;

t_0 = mean epoch of the adopted catalogue (1950.0).

From latitude observations, using the data obtained by chain method, we derive the values of z-term, which are not identical with catalogue errors. The annual mean values of z-term derived in this way, that we shall denote by z, were used by Wako (1969) for the calculation of $d\,\delta$ and $d\,\mu'$, using the formula:

$$z=d\,\delta+d\,\mu'\,(t-1950.0). \quad (5)$$

The values z for international stations for the period 1900—1966 are shown in Table 1, according to Table 5 of Wako's work from 1969.

Table 1

Annual mean z term (1900—1966): *Unit* 0″001

Per.	t	z	Per.	t	z	Per.	t	z	Per.	t	z	Per.	t	z	Per.	t	z
I	1900	055		1912	003		1923	−013		1935	−013		1949	−050		1955	−073
	1901	061		1913	−004		1924	−015		1936	−014		1950	−043		1956	−116
	1902	023		1914	017		1925	−021		1937	−032		1951	−061		1957	−121
	1903	037		1915	012		1926	002		1938	−017		1952	−066		1958	−143
	1904	047		1916	−013		1927	−013		1939	−032		1953	−087		1959	−170
	1905	039		1917	−040		1928	−012		1940	−011		1954	−078		1960	−140
			III	1918	007	IV	1929	−010	V	1941	−026				VI	1961	−126
	1906	013		1919	−006		1930	−012		1942	−025					1962	−129
	1907	−002		1920	−030		1931	−023		1943	−040					1963	−135
II	1908	−001		1921	−052		1932	−025		1944	−042					1964	−138
	1909	011		1922	−013		1933	−019		1945	−034					1965	−132
	1910	022					1934	−034		1946	−018					1966	−125
	1911	011								1947	−017						
										1948	−028						

The comparison between the catalogue GC, BSKŠZ1 and BSKŠZ2

Since the establishment of the International Latitude Service the observing programmes, as well as the list of stars, have been changed several times due to the precessional motion of stars:

I	1899.9 — 1906.0
II	1906.0 — 1912.0
III	1912.0 — 1922.9
IV	1922.9 — 1935.0
V	1935.0 — 1955.0
VI	1955.0 — 1967.0
VII	1967.0 — (1979.0)

Our task is to make an analysis of the data for the first six programmes (we have complete data for them). This is possible to do as all stars of all programmes are registered in the catalogue GC wherefrom the stars for the International Latitude Service have been chosen since 1935.0. This offers the possibility for the comparison with any system that includes the stars of latitude programme.

The differences (GC — BSKŠZ1) are given for every programme in tables 2 and 3, and for (GC — BSKŠZ2) in tables 4 and 5.

BSKŠZ1 and BSKŠZ2 designate the general catalogues, derived from observational data, gathered from 1929 to 1972 (Sadžakov, Šaletić, 1974). It has to be noted that BSKŠZ1 is based upon visual observational data only, while in establishing BSKŠZ2, photographic positions were taken into account.

Table 2

Mean differences of declinations (GC−BSKŠZ1)

month \ period	I	II	III	IV	V	VI
1	−0″.0113	−0″.0371	−0″.0057	+0″.0238	−0″.0442	−0″.1491
2	− .2254	− .1966	− .1914	− .0915	− .3199	− .2696
3	+ .0655	+ .0366	+ .0366	+ .0120	− .0332	− .2692
4	− .0662	− .0859	− .0937	− .0916	− .0057	− .0172
5	− .1942	− .4029	− .3296	− .3056	− .3860	− .2117
6	− .3278	− .0796	− .0682	− .0449	− .0859	− .2775
7	− .3736	− .2867	− .1788	− .0913	− .1700	− .2487
8	− .1695	− .0994	− .1168	− .0815	− .1545	− .1098
9	− .0771	− .2089	− .2172	− .2467	− .3273	− .2348
10	− .2220	− .1960	− .1926	− .1025	− .1830	− .2487
11	− .1295	− .0877	− .0777	− .1945	− .0968	− .2132
12	+ 0.0846	− 0.0303	− 0.0514	− 0.1884	+ 0.0160	− 0.0018
Mean	−0″.1372	−0″.1395	−0″.1238	−0″.1169	−0″.1491	−0″.1876

Table 3

Mean differences of annual proper motions (GC−BSKŠZ1)

month \ period	I	II	III	IV	V	VI
1	−0″.0045	−0″.0034	−0″.0037	−0″.0034	−0″.0054	−0″.0051
2	− .0085	− .0111	− .0144	− .0052	− .0121	− .0028
3	− .0003	− .0000	− .0000	− .0015	− .0036	− .0102
4	+ .0023	− .0003	+ .0008	+ .0017	+ .0037	− .0000
5	− .0017	− .0005	+ .0013	− .0011	− .0031	+ .0040
6	− .0007	+ .0005	− .0000	− .0009	− .0066	− .0044
7	− .0018	− .0019	− .0025	− .0021	− .0031	− .0047
8	− .0061	− .0066	− .0071	− .0039	− .0024	− .0051
9	− .0030	− .0037	− .0073	− .0024	− .0013	− .0000
10	− .0005	− .0006	− .0010	− .0012	− .0011	− .0020
11	− .0059	− .0048	− .0051	− .0052	− .0048	− .0036
12	− .004[illegible]	− .0048	− .0012	− .0055	− .0028	− .0042
Mean	−0″.0030	−0″.0031	−0″.0033	−0″.0026	−0″.0027	−0″.0032

Table 4

Mean differences of annual declinations (GC−BSKŠZ2)

month \ period	I	II	III	IV	V	VI
1	−0″.0216	−0″.0335	−0″.0560	+0″.0351	−0″.0315	−0″.2253
2	− .2035	− .1398	− .1433	− .1598	− .3578	− .3450
3	+ .1351	− .0878	+ .0878	+ .0806	+ .0818	− .2368
4	− .1458	− .1616	− .1673	− .1673	− .1534	− .0234
5	− .2646	− .4121	− .3422	− .2589	− .3368	− .1854
6	− .4442	− .1104	− .0494	− .0239	− .0500	− .2334
7	− .3628	− .2793	− .1743	− .0948	− .2019	− .3342
8	− .3420	− .2299	− .3130	− .2206	− .2759	− .1856
9	− .1947	− .2753	− .2882	− .3151	− .3478	− .3246
10	− .3185	− .2708	− .2740	− .1975	− .2111	− .2670
11	− .2119	− .2814	− .2681	− .4091	− .1358	− .2331
12	+ .0142	− .0827	− .0512	− .1565	− .0753	+ .0522
Mean	−0″.1967	−0″.1824	−0″.1699	−0″.1573	−0″.1746	−0″.2118

Table 5

Mean differences of annual proper motions (GC−BSKŠZ2)

month \ period	I	II	III	IV	V	VI
1	−0″.0043	−0″.0041	−0″.0049	−0″.0022	−0″.0074	−0″.0040
2	− .0005	+ .0000	− .0029	− .0013	− .0068	− .0089
3	+ .0002	+ .0005	.0005	− .0004	− .0029	− .0009
4	+ .0023	+ .0022	+ .0003	+ .0007	+ .0007	+ .0009
5	+ .0003	− .0073	.0000	− .0010	.0047	+ .0012
6	.0019	+ .0010	+ .0003	+ .0015	+ .0037	.0042
7	.0025	.0032	.0034	+ .0030	+ .0043	.0005
8	− .0081	.0052	.0056	− .0028	− .0031	.0054
9	− .0011	− .0034	.0047	− .0054	.0035	.0021
10	− .0048	.0044	− .0047	.0034	− .0029	.0047
11	− .0073	− .0103	− .0097	− .0107	− .0024	.0028
12	− 0.0021	− 0.0033	− 0.0062	− 0.0057	− 0.0024	− 0.0035
Mean	−0″.0024	−0″.0028	−0″.0028	−0″.0023	−0″.0023	−0″.0029

It is noticeable that the mean differences in declinations in Table 4 are systematically lower than in Table 2, and the mean differences of proper motions, shown in Table 3, are systematically lower than those, shown in Table 5. This points to the significant effect of the positions in photographic catalogues, although the weight which was taken into account was very light. The values in Table 5 are nearer to those derived by Wako (1969, p. 542) in his analysis of the catalogue *MD*.

We note that the derived mean errors of declinations and of proper motions in BSKŠZ1 are $\varepsilon_\delta = \pm 0''0071$, $\varepsilon_\mu = \pm 0''0023$; for BSKŠZ2 they are somewhat lower and are $\varepsilon_\delta = \pm 0''0070$, $\varepsilon_\mu = \pm 0''0020$. All this justifies the use of the position of stars from photographic catalogues. It has to be noted that the use of photographic catalogues gives rise to one not so simple problem, i. e., the determination of weights of such positions. Therefore, a critical analysis of formula for weights, given by L. Boss (1903), is necessary, because some catalogues are favoured.

Analysis of results

The final mean annual values $\overline{d\delta}$ and $\overline{d\mu}$, obtained from differences between (*GC*−BSKŠZ1) and (BSKŠZ2) and *z*-term according to formula (5) are shown in Tables 6 and 7.

Table 6

Mean annual values $\overline{d\delta}$ and $\overline{d\mu}$ from differences (GC −BSKŠZ1) and *z* term (GC−BSKŠZ1)

N°	Period	GC −BSKŠZ1 1950.0 $\overline{d\delta}$	GC −BSKŠZ1 1950.0 $\overline{d\mu}$	*z*-term 1950.0 $\overline{d\delta}$	*z*-term 1950.0 $\overline{d\mu'}$	1900.0 GC − BSKŠZ1	1900.0 *z*
I	1900−1905	−0″.1372	−0″.0030	−0″.1086	−0″.0032	+0″.0128	0″.0514
II	1905−1911	− .1395	.0031	− .0960	− .0021	.0155	.0090
III	1912−1922	− .1238	.0033	.1377	− .0041	.0412	+ .0673
IV	1923−1934	.1269	− .0026	− .0473	.0015	.0031	− .0277
V	1935−1954	.1491	.0027	− .0529	.0030	.0141	.0946
VI	1955−1966	− 0 .1876	0 .0032	0 .0999	−0 .0028	0 .0276	−0 .0396
	1900−1966	0 .1424	− 0 .0030	− 0 .0657	0 .0020	0 .0051	0 .0343
GC− FK4		0 .1776	0 .0030	(+20° 60°) zone		0 .0276	
GC− FK4		.1544	.0025	Common 36 stars		.0294	
GC− FK4S		.2686	.0049	Common 81 stars		.0236	
GC− BSKŠZ1		.2598	.0055	Common 81 stars		.0152	
GC− MD		.2772	− .0049	Common 81 stars		.0322	
FK4S−BSKŠZ1		−0 .0088	0 .0006	Common 81 stars		−0 .0388	

Table 7

Mean annual value $\overline{d\delta}$, $\overline{d\mu}$ from differences (GC−BSKŠZ2) and z term

N°	Period	GC−BSKŠZ2 1950.0 $\overline{d\delta}$	GC−BSKŠZ2 1950.0 $\overline{d\mu}$	z-term 1950.0 $\overline{d\delta}$	z-term 1950.0 $\overline{d\mu}$	1900.0 $\overline{\text{GC−BSKŠZ2}}$	1900.0 z
I	1900−1905	−0″.1967	−0″.0024	−0″.1086	−0″.0032	−0″.0767	+0″.0514
II	1906−1911	− .1824	− .0028	+ .0960	+ .0021	− .0424	.0090
III	1912−1922	− .1699	− .0028	− .1377	.0041	.0299	− .0673
IV	1923−1934	− .1573	− .0023	.0473	− .0015	− .0423	+ .0277
V	1935−1954	− .1746	− .0023	− .0529	− .0030	− .0596	− .0946
VI	1955−1966	−0 .2119	−0 .0029	−0 .0999	−0 .0028	−0 .0669	+0 .0396
	1900−1966	−0″.1921	−0″.0026	−0″.0657	−0″.0020	−0″.0530	+0″.0343
	GC−FK4	−0 .1776	−0 .0030	(+20°−60°) zone		−0 .0276	
	GC−FK4	− .1544	− .0025	Common 36 stars		− .0294	
	GC−FK4S	− .2686	− .0049	Common 81 stars		− .0236	
	GC−BSKŠZ2	− .2585	− .0060	Common 81 stars		+ .0415	
	GC−MD	− .2772	− .0049	Common 81 stars		− .0322	
	FK4S−BSKŠZ2	−0 .0101	−0 .0011	Common 81 stars		0 .0651	

The contents of Tables: in the column I—period of observations; columns II and III — mean annual values $\overline{d\delta}$ and $\overline{d\mu}$ for 1950.0 of all stars that were used in individual periods, as well as the total mean value for the past period of observations derived from the data (*GC* — BSKŠZ1) or (*GC* — BSKŠZ2); columns IV and V show the values $\overline{d\delta}$ and $\overline{d\mu}$ calculated from the z-term, reduced to C. I. O. system, while columns VI and VII contain the differences of corresponding values reduced to the year 1900.0.

In the lower part of the Tables are given the differences of the mean values of declinations and proper motions of stars that are common, in our and several well-known systems.

Obvious is good concordance of mean differenoes of declinations and proper motions of stars that are common to our catalogues and the catalogues FK4S and MD (in the lower part of Tables 8 and 9).

The authors express their gratitude to Dr. G. Teleki for useful advices and suggestions in the course of the working out of this study.

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RESEARCH IN CHANGES OF BELGRADE Z—TERM IN DIFFERENT DECLINATION SYSTEMS IN CORRELATION WITH THE ATMOSPHERIC CONDITION

R. GRUJIĆ

1. *Introduction*

Former investigation of the effects on results of latitude showed that one of the main causes of the appearance of the z-term is the atmospheric effect (Shevarlich, 1961 *a*; Sugawa et al., 1972). For this reason the central point of investigation for solution of z-term problem at Observatory in Belgrade is directed to the investigation of the atmospheric effect. This paper is the continuation of the research into the z-term problem with the latitude observations in Belgrade which was presented in the paper of Teleki and Grujić (1969). In that paper it was recommended to search for and to investigate intensively the cause of arising of nonpolar change (z-term) by directing it in two directions: 1. To get completely acquainted with the characteristics of the lowest atmospheric layers above and near the observing pavilion which require intensive micro-climatic and aerologic examinations, and 2. To carry out research into the behaviour of zenit-telescope and its parts in the temperature field, with special consideration of the horizontal gradient. Among other main possible causes of the arising of z-term is the incorrect value of the declination corrections which enter into z-term entirely. In order to eliminate these declination errors the working out of the catalague of latitude stars is undertaken on an international scale.

The Astronomical Observatory of Belgrade has participated in this undertaking and has finished its catalogue (Sadžakov, Shaletich, 1972).

The Latitude Service of Belgrade Astronomical Observatory was established in 1949. The values of latitude are determined by means of a Bamberg 110/128 mm Zenith-telescope according to Talcott method every clear night. The gathered observation material was submitted to many analyses. Among other subjects the non-polar term was studied in Belgrade latitude variation. Shevarlich (1961 b) has discused the residuals $\Delta\varphi_p = \varphi\text{pair} - \varphi_N$, i. e. the deviation of the instant latitude by pairs from the mean smoothed month values. In this work a good correlation between $\Delta\varphi_p$ and the wind velocity in the immediate surroundings of the pavilion was determined. Teleki (1967) has continued this investigation by using the meteorological data refering to air flow of the same type over Yugoslavia and also over Belgrade established by Dobrilovich (1960). It was established that the observation conditions are very good by the warm »košava« (from *S* quadrant), while *NW* flow leads to larger scattering of the latitude data.

In this paper we shall also re-examine the meteorological data of Dobrilovich (1960) with purpose to continue the investigation of Belgrade z-term.

2. *The theoretical consideration of the set out purprose*

The relation between the latitude results and z-term can be written as follows:

$$\varphi_{p,i} - \varphi_{t,i} = z'_i + d\,\delta_i$$

or abbreviated

$$\varphi_{p,i} - \varphi_{t,i} = z_i$$

where: $\varphi_{p,i}$ is the observed instant latitude in the ith-declination system, $\varphi_{t,i}$ is the calculated latitude in the ith-declination system, z_i' is the non-polar change of latitude in the ith-declination system, and $d\,\delta_i$ is the respective declination correction. As we take these values separately from the evening and morning observations, as well as their mean values, we introduce new indices for them: v, j and s (evening, morning and mean values). The above expression is enlarged and with the introduced denotations reads as follows

$$\begin{aligned} \varphi_{p,i,v} - \varphi_{t,i} &= Z_{i,v} \\ \varphi_{p,i,j} - \varphi_{t,i} &= Z_{i,j} \\ \varphi_{p,i,s} - \varphi_{t,i} &= Z_{i,s} \end{aligned} \qquad (1)$$

We use four declination systems ($i = 1, 2, 3, 4$). The first declination system ($i = 1$) represents the value of declinations from the basic catalogue AGK2A in the FK3 system corrected by $\Delta\delta$ derived from the chain method observation itself (Shevarlich, 1961 *a*). The second declination system ($i = 2$) is obtained by means of declination corrections by using Harin's Catalogue of latitude stars (Harin, 1963). The third system is derived by using $\Delta\delta$ obtained by chain method as well as proper motions obtained from observation itself (Shevarlich, 1961 *a*). The fourth system ($i = 4$) is formed by using the declinations from „Stars Catalogue of Smithsonian Astrophisical Observatory", 1966. The first three systems are shown in Teleki's paper (1966).

Values $Z_{i,k}$ ($k = v, j, s$) according to (1) calculated only for those days when a certain air flow of over Yugoslavia was established. We had at our disposal the three years' observation material foi the period 1955 – 1957 covering four main groups of air flows (Dobrilovich, 1960).

For two groups of flows (marked with II and III) we have but a small number of observational data, so that in this analysis we use only the flow marked by I and IV. In the first group of flows over Yugoslavia are days when the cold air near the soil flows from NW quadrant in Belgrade while the storm bura blows in Split. The distribution of these flow days is even according to the year's seasons. With the IV group of flows, the warmer air from the *S* quadrant (the warm košava) flows in Belgrade, and in Split blows the south wind „jugo". During these south *S* circulations, we have the highest number of days when the observations of latitude are possible. By the day of flow we understand only such a day when the wind blows from 16^h of one day till 16^h the next day in Belgrade and Split, or when only in Belgrade and Split some of the mentioned winds blow without interruption for at least 13 hours.

On the other hand the Z-term was studied (in the usual way) as a periodical yearly variation from all the latitude observations in the given declination system and the values obtained in this way were compared with Z form (1):

$$Z_{k,i} - z''_{k,i} = d_{k,i} \qquad (2)$$

where: $Z_{k,i}$ is the value according to (1) for the *kth*-dcy in the *ith*-declination system, and $z''_{k,i}$ is the corresponding value obtained for the *kth*-day from the curve of the variation Z-term.

The mean year values of Z-term needed for determination of the value $z''_{k,i}$ in (2), for the first three systems, for every 0.1 part of the year are shown inTeleki's paper (1966). Here they are derived for the fourth system too. These values are shown in Table 1. and in Figure 1.

Table 1.

Part of year	Declination system			
	1	2	3	4
0.0	−0″.007	−0″.024	−0″.095	+0″.074
0.1	−0 .042	+0 .061	+0 .007	+0 .076
0.2	+0 .125	+0 .155	+0 .182	+0 .105
0.3	−0 .099	+0 .090	+0 .185	+0 .155
0.4	+0 .020	+0 .033	−0 .114	+0 .085
0.5	0 .080	−0 .045	−0 .002	+0 .019
0.6	−0 .143	−0 .124	−0 .117	−0 .048
0.7	0 .112	−0 .126	−0 .137	−0 .119
0.8	−0 .069	−0 .096	−0 .144	−0 .176
0.9	−0 .029	−0 .060	−0 .128	−0 .027

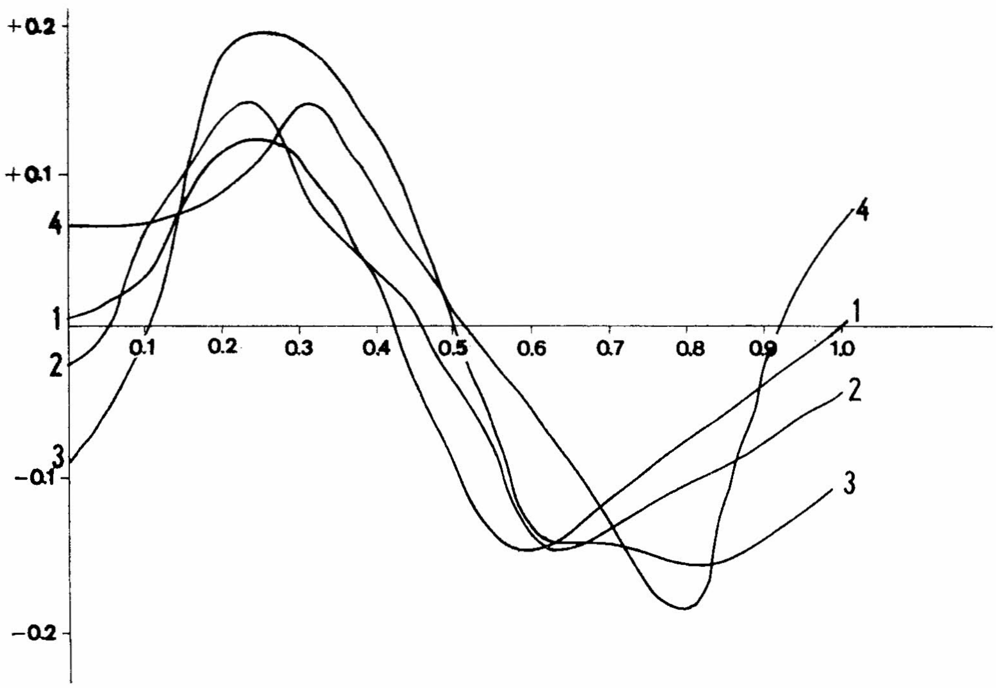

Fig. 1

From the above diagram it is obvious that there exists a certain difference between the course of curves representing of Z-term in the first three declination systems, and the curve course of Z-term in the fourth declination system. The investigations of the mean error of values $Z_{k,i}$ and $d_{k,i}$, as it can be seen in the next paragraph, shows that these declination systems differ by their values, too. Namely, the greatest mean errors were obtained for the fourth system. This can prove that the catalogue of the fourth system is loaded with greater errors than the other three.

Accordingly, the basic material for our investigation are the data obtained by means of expression (1) and (2) for those days when the observation for latitude was possible, and when a certain characteristic flow existed. This material was submitted to a statistical analysis for the purpose of finding possible systematical influences in it. If the sistematic influence of some flow existed then it should be seen in all declination systems. In addition to these investigations we have evaluated the declination system on the basis of the obtained mean errors of the determined values $Z_{k,i}$ and $d_{k,i}$.

3. *The results of investigation.*

For the investigation of the existence of the systematic influence in the distribution of values $Z_{k,i}$ and $d_{k,i}$ we used two criteria to determine the degree of agreement of distribution of these values with the normal ones: through the accuracy coefficient (H) Šhchigolev, 1969) and with Pearson's criterion X^2 through determining the probability of agreement (p) (Mitropol'skij, 1961). Besides, the additional parameters showing the deviation of our distribution values from normal one in the corresponding directions were determined, such as for example the excess, the asymmetry, the median, the mode (Bol'shakov, 1965). We present here the obtained values for the accuracy coefficient H and the probability p agreement in Table 2. and Figure 2. for the two flow groups and for all four declination systems (notations on abscissa 1—4), and for evening, morning and mean values of groups (notations v, j, s). Owing to excessiveness of data we omit here the value of additional parameters.

Table 2

The acc. coeff. and the prob.	system 1 I gr.	system 1 IV gr.	system 2 I gr.	system 2 IV gr.	system 3 I gr.	system 3 IV gr.	system 4 I gr.	system 4 IV gr.
				Values $Z_{k,i}$				
H_v	0.48	0.83	3.76	0.92	1.18	0.70	0.05	0.86
H_j	0.90	0.35	0.07	2.17	1.02	0.74	0.37	0.40
H_s	0.33	0.50	2.10	1.07	0.25	0.45	0.05	0.26
p_v	0.23	0.12	0.01	0.20	0.06	0.32	0.97	0.23
p_j	0.10	0.30	0.77	0.01	0.17	0.15	0.29	0.46
p_s	0.29	0.22	0.01	0.15	0.40	0.53	0.97	0.51
				Values $d_{k,i}$				
H_v	2.69	0.37	1.53	0.65	4.02	0.53	0.51	0.71
H_j	0.21	1.77	0.76	1.97	0.51	0.76	0.23	0.44
H_s	1.31	0.83	2.02	1.23	0.38	1.31	0.75	0.65
p_v	0.02	0.29	0.04	0.17	0.01	0.46	0.38	0.32
p_j	0.44	0.02	0.14	0.02	0.37	0.14	0.40	0.40
p_s	0.05	0.12	0.02	0.04	0.13	0.09	0.13	0.17

From the data in Table 2 and Figure 2 as well as from other parameters which are not shown in the Table, it is obvious that in most of cases the distribution of values $Z_{k,i}$ and $d_{k,i}$ deviate from the normal one as a results of the existence of systematic influence within them. Some larger deviation from the normal distribution is established with the data $d_{k,i}$ than with the data $Z_{k,i}$, and more homogeneous results are obtained in the distribution during the fourth group of flow. This can be the consequence of the more stable conditions during the fourth group of flow, than during the first group, which could be expected in accordance with the results obtained by Teleki (1967). A few cases only point to the normal distribution.

We wish to emphasize that the point is in the composite effect of the air flow, the declination corrections and other causes as is shown in the basic relation of the Section 2.

Concerning the distribution of $d_{k,i}$ it seems that the systematic effects appearing in distribution $Z_{k,i}$ are transmitted to them also. The distribution $d_{k,i}$ can have its own systematic effects which do not come from $Z_{k,i}$ distribution but whether it has them or not and to what amount we cannot say with certainty.

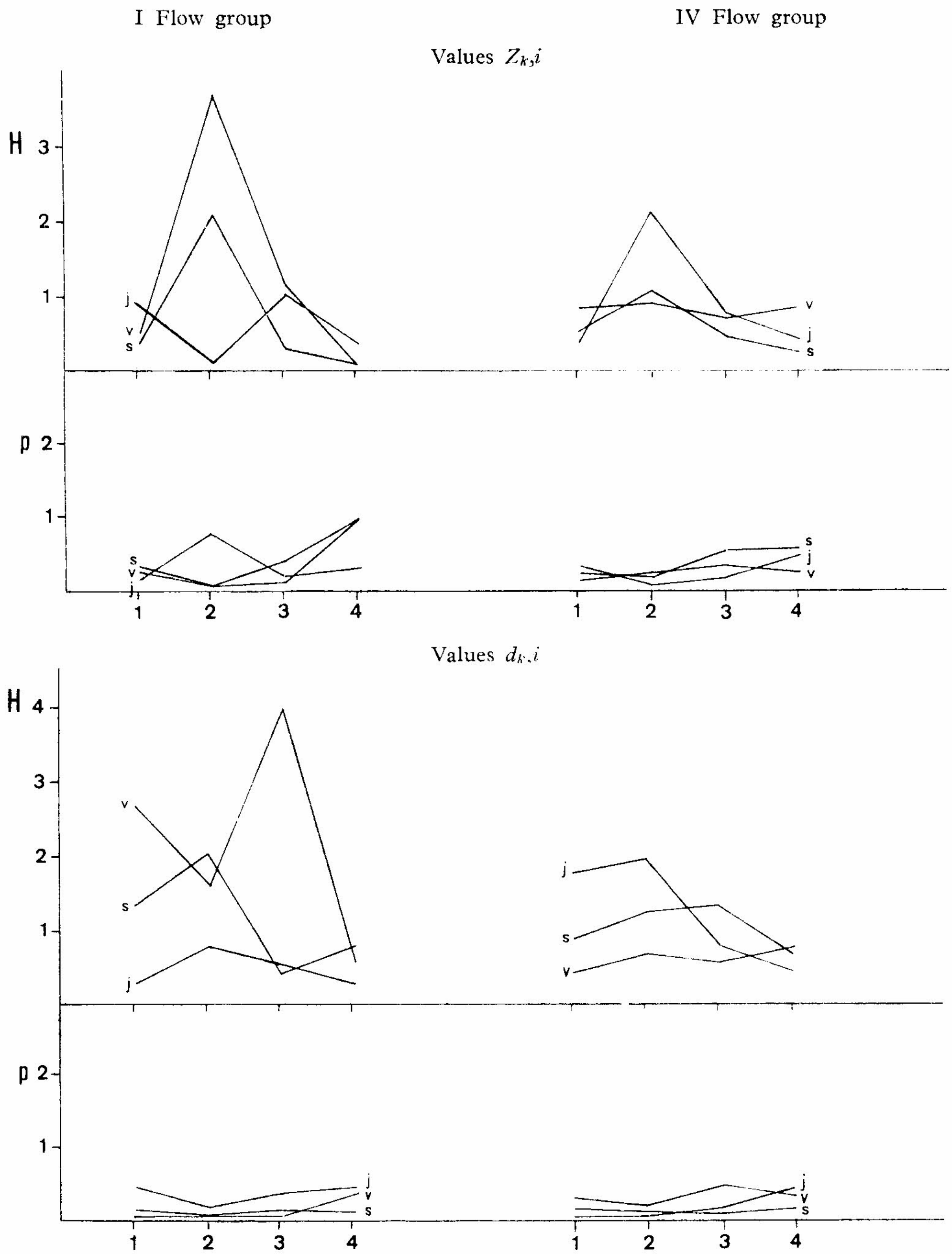

Fig. 2

However it is necessary to mentiont hat relative scarcity of observational data were the limiting factor in these investigations.

4. *Estimation of particular declination systems.*

For the purpose of comparison of the accuracy of separate declination systems the data on the mean errors of determining $Z_{k,i}$ and $d_{k,i}$ will be used. We will consider that system beter which has less mean square differences (σ), or the system with less scattered data. The mean values of these values according to declination systems for both groups of flow from all data are hown in Table 3.

This Table shows that the errors are relatively the smallest in the first declination system, while in the fourth system they are the greatest. Other two systems are between these two limits. The second system is more precise than the third.

In accordance with Teleki's paper (1967) more stable observing conditions should be expected in the group IV than when group I is present. It is difficult to prove this statement on the bases of these data because of relatively high values of errors of catalogues.

Table 3.

		system 1	system 2	system 3	system 4
$\sigma_M(Z_{k,i})$	I gr.	0″.165	0″.171	0″.229	0″.259
	IV gr.	0 .171	0 .197	0 .203	0 .235
$\sigma_M(d_{k,i})$	I gr.	0 .165	0 .176	0 .216	0 .215
	IV gr.	0 .157	0 .177	0 .207	0 .207

Our conclusions related to the order of accuracy of catalogues of the first three systems are in accordance with conclusions in the Teleki's paper (1966) on the declination systems of these catalogues.

5. *Conclusions and proposals.*

On the basis of the analysis of the distribution of the values $Z_{k,i}$ and $d_{k,i}$ the possible systematic effects on z-term, *i. e.* on latitude observations, are revealed in the lst and the 4th group of air flow. In connection with these conclusions we wish to emphasize the following circumstances which influenced the obtained results: 1) the material which we had at our disposal is modest in amount for any definitive conclusion. 2) $Z_{k,i}$ is affected by systematic errors of catalogue while $d_{k,i}$ is free from these errors to a considerable extent. 3) the accidental errors of catalogue, as is obvious from our data (Table 3) are different, which certainly has its effect upon the analysis and the reliability of conclusions.

Accordingly we can say in the end that some systematic effects can be noticed in the differences $Z_{k,i}$ and $d_{k,i}$. This can just be caused by the effect of the kind of flow.

As the flows exercise influences in two ways: directly on the instrument and its parts and through the anomalous refraction the obtained effects should be separated and analysed apart. This analysis, however, is to be done later on.

All conclusions shown here and the results from the other quoted studies point to the need to study this problem in more details. For this purpose it is necessary to purchase precise measuring instruments for the investigation of atmospheric conditions over the zenith-telescope during the observation in order to obtain very detailed and precise data in a sufficient number. In this way a more complete and more reliable analysis of the air flow effect on z-term or upon latitude can be obtained.

I thank Dr G. Teleki for the extended help, and suggestions during the working out of this paper; and also to Dr V. Milovanovich for some consultations, as well as to Nada Đokić for the help in one part of the calculation work.

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PARALLEL DETERMINATION OF THE COLLIMATION OF THE LARGE TRANSIT INSTRUMENT WITH THE VACUUM MERIDIAN MARK AND THE NEW OPTON COLLIMATOR

Z. KNEŽEVIĆ

SUMMARY:

By means of a vacuum meridian mark and OPTON collimator of modern design general and daily variations of the collimation of Large Transit Instrument have been determined in four different ways.

In this paper results of these determinations are given and discussed, and also precisions of pointings of the vacuum meridian mark (mean square error of one pointing IM $=0^s.0038$) and the collimator (IO $=0^s\cdot0049$) with LTI, and of the vacuum mark with collimator (OM $=0^s\cdot0059$) are compared.

In November 1973 the Large Transit Instrument (LTI) Division of Belgrade Observatory acquired a new OPTON collimator. This modern instrument will be used for precise determination of collimation, when regular observations with the LTI do start.

As it is known (Pakvor, I., 1972/73), in 1970 the LTI vacuum meridian marks were erected. For the time being we can work with the south one only, namely, the north one is still lacking an adequate lens. By interposing vacuum tubes between the meridian marks and the LTI a permanently totaly steady image of the marks has been attained, which enables one to make very precise pointings of this image. Consequently, the determination of collimation by means of such vacuum meridian marks can be performed with high accuracy.

Thus an interesting possibility appeared to compare the results of determination of collimation by means of two independent, both of a high precision, reference systems, i. e. vacuum meridian mark and collimator.

In the period from 13. 2. 1974. untill 15.3. 1974. collimation was determined in four different ways:

a.) by means of vacuum meridian mark only
b.) by means of collimator only
c.) by means of vacuum mark and collimator combined in one reference system, *before* reversing the LTI in its supports
d.) by means of vacuum mark and collimator combined in one reference system, *after* reversing the LTI in its supports

It is necessary to note here that because of rather short period of time covered by our measurements the collected material is not complete. Consequently, a very detailed analysis of the results was not possible, and only some evident facts were established.

1. *COLLIMATOR*

Considering that the tehnical description of vacuum meridian marks is given elsewhere (Herk, G. van, Munck de, J. C., 1954, Pakvor, I., 1972/73), here we give only some basic features of the new collimator.

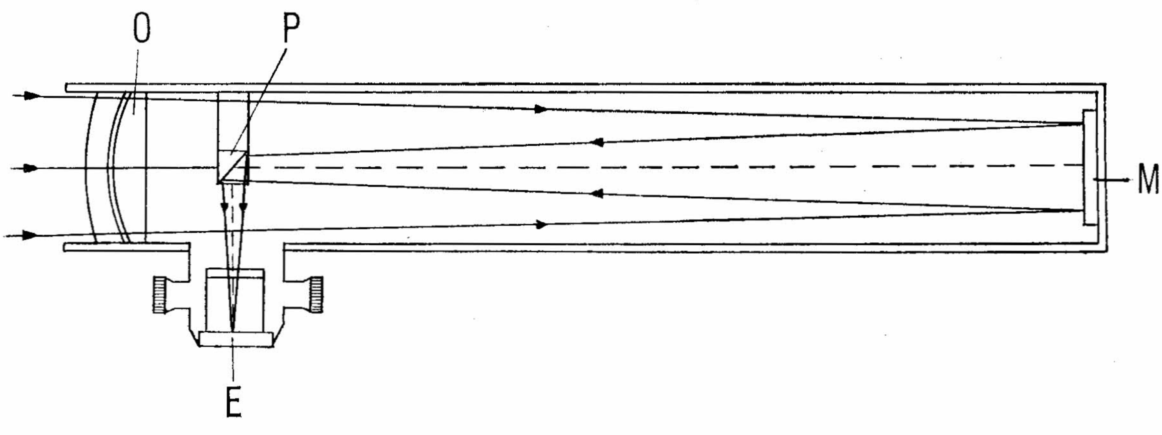

Fig. 1.

New OPTON collimator (Fig. 1.) meets substantial demands of modern astrometry for such an instrument. The diameter of collimator's objective 0 (190 mm) and its focal length (2578 mm) are equal to those of LTI. Moreover a plane mirror *M*, which reflects light rays to the little prism *P* facing the eyepiece, has enabled the length of collimator to be cut by two. The prism breaks these lightrays at the right angle to the eyepiece micrometer E. This micrometer has one moveable double thread and a fixed thread cross. The micrometer drum has 100 divisions, and by means of a small magnifying glass one can estimate a tenth of one division.

The collimator was mounted on the north pillar so that its optical axis was the prolongation of the south mark optical axis. Therefore the inclination of collimator optical axis with reference to the horizon was approximatively 3°42′, equalling the depression angle of the south mark. The whole disposition of the collimator and the south mark is represented on the Fig. 2.

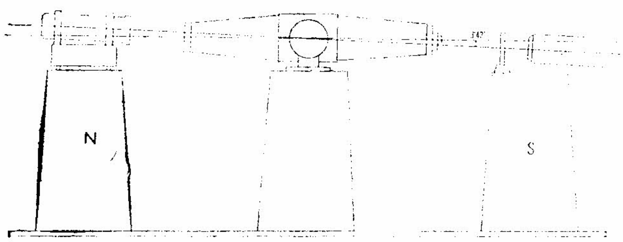

Fig. 2.

2. *MEASUREMENTS*

With a few exceptions, the measurements were performed 3 times a day, and as a rule in 8, 11, 14, 18 or 22 hours. Namely, LTI required after reversing a certain time to restore its stability. The total number of measurements was over 2500.

The measuring procedure was as follows:

— first, note was taken on weather conditions, temperature outside and inside the pavilion and the pressure in the south vacuum tube was read.

— then LTI was directed to the zenith, the instrument cube opened, and pointings of mark image in the collimator with its double thread were carried out. Setting on the image was repeated 5 times, and then the double thread was placed in the position which corresponded to the mean of 5 readings. Thus the collimator line of vision was fixed.

— now, the image of the mark and the image of collimator double thread were alternatively pointed with LTI moving wire. This procedure was repeated after reversing the LTI in its supports.

— at the end, LTI was always left directed to the south meridian mark.

3. *RESULTS*

3.1. Precision of pointing

As above stated, the pointings of images of the south vacuum mark and collimator double thread were highly precise, so the mean square errors of one pointing are small. Table 1. contains:

IM — mean square error of one pointing of the mark with LTI

IO — mean square error of one pointing of the OPTON collimator with LTI

OM — mean square error of one pointing of the mark with the OPTON collimator

Table 1.

IM	IO	OM
$0^s.0038$	$0^s.0049$	$0^s.0059$

One can immediately notice that the mean square error of one pointing of mark image is smaller than the mean square error of one pointing of collimator double thread, i. e. the pointing of mark image was slightly more precise than the pointing of collimator double thread.

This is a consequence of several factors. On the one hand, permanent and total steadiness of the mark image and its good definition in the LTI made pointings of high accuracy possible. On the other hand, the collimator optics is obviously unperfect so that the definition of the collimator double thread in the LTI as well as the image of the mark in the collimator itself were insufficient.

With respect to the mean square error of one pointing of the mark with the OPTON collimator, we can say that, although the value of one revolution of collimator micrometer screw is smaller than that of the LTI ($2^s.4$ and $2^s.7$), the precision of pointing of the mark with the collimator lagged considerably behind the precision of pointing with the LTI. This was caused by the above-mentioned poor definition of the mark image in the collimator.

In connection with this, we give for comparison the mean square error of one pointing of the old ASKANIA 80/1000 collimator with the LTI, IA= $=0^s.0102$. This collimator was used in 1964 for preliminary determinations of LTI's collimation. We see that the precision of the pointing and, consequently, the accuracy of determination of collimation, was inferior to that of the OPTON collimator and considerably inferior to that of vacuum meridian mark.

3.2. General trend and daily variations of the collimation

High precision of pointing of mark image and of the collimator double thread made an accurate determination of the variations of the collimation possible.

Fig. 3. represents the general trend of the collimation with the notations:

CM — collimation determined by means of the vacuum mark only

CC — collimation determined by means of the collimator only

CMC1 — collimation determined by means of vacuum mark and collimator *before* reversing the LTI in its supports

CMC2 — collimation determined by means of vacuum mark and collimator *after* reversing the LTI in its supports

t_s — temperature outside the pavilion

t_u — temperature inside the pavilion

Points through which the curves were drawn represent the means of all measurements performed in 3 days interval.

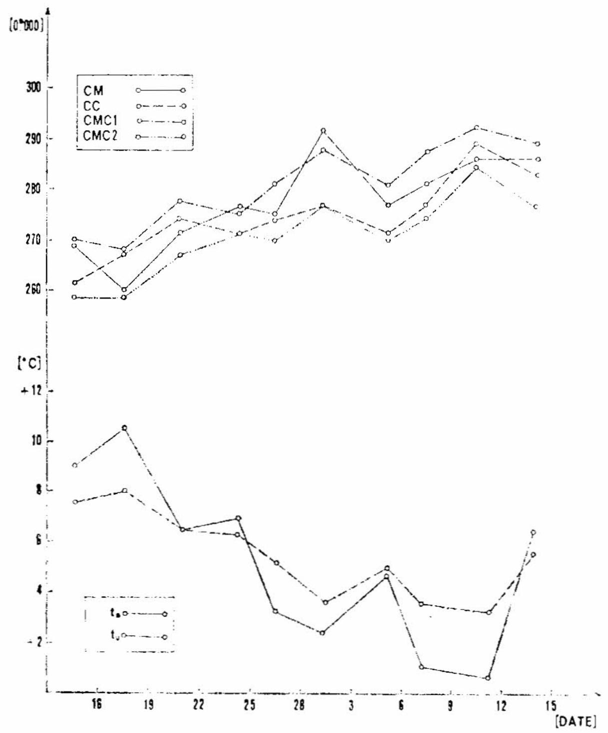

Fig. 3.

It is evident that the general variations of collimation, determined in four various ways, differ between themselves, but these differences are less than $0^s.01$, which may be considered satisfactory with regard to the present condition of the LTI. On the whole, all four curves agree among themselves and follow the general trend of the temperature. An increase of $0^s.003$ of the collimation corresponds to a decrease of 1°C of the temperature approximatively.

Daily variations of the collimation (Fig. 4.) do not follow daily variations of temperature, and differ between themselves more than general ones. But, as the order of magnitude of these variations is $0^s.01$, one can hardly expect better concordance because of many various causes which are apt to affect the results, and because the measurements were performed during the time when daily variations of temperature were not excessive.

4. *CONCLUSION*

The results, which we were able to collect in this work, were expected in their substance and they confirm other results of similar kind carried out in previous time. Although the period of measuring was very short, the goal of this work is achieved.

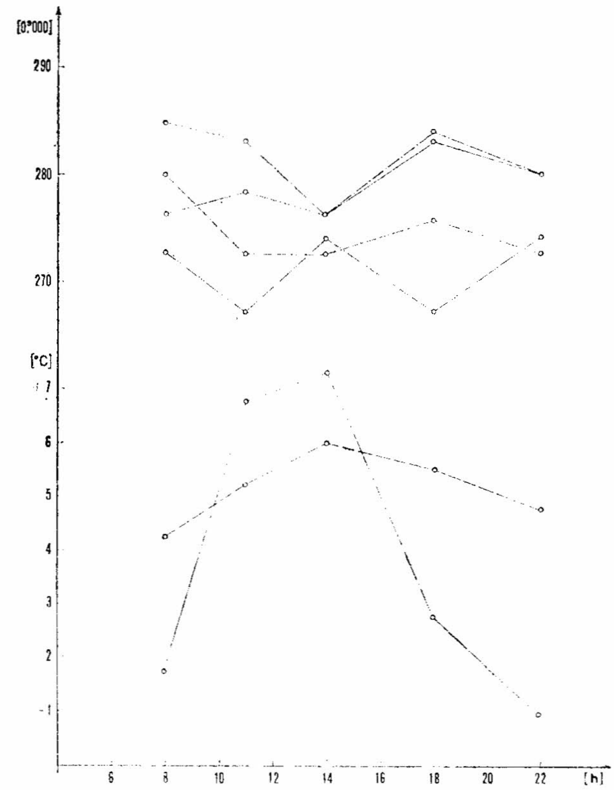

Fig. 4.

Naturally, if measurements had lasted longer, the problem would have been treated in a more detailed way.

The author has the pleasure to express his acknowledgment to Dr. Lj. Mitić for all advice and instructive discussions in connection with the treated problem.

The suggestion for the comparison of the collimations by means of the vacuum meridian mark and the new OPTON collimator, which was subject of this work, came from the assistant I. Pakvor, to whom author also owes his gratitude.

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DETERMINATION ASTRONOMIQUE DE L'HEURE

par M. JOVANOVIĆ, D. VESIĆ

1972

	Date	Date Julienne 2440000	TU	TUO-TUC	t_l	Obs
I	3	1320.16	$16^{h}.0$	9943	+4°.2	V
	3	1320.20	16.8	9838	+ 4.0	V
	14	1331.18	16.3	9889	− 3.0	V
	14	1331.22	17.3	9912	− 5.1	V
II	2	1350.23	17.5	9061	− 2.0	V
	2	1350.26	18.3	9105	− 3.1	V
	3	1351.19	16.5	8831	− 1.7	V
	3	1351.22	17.4	8894	− 2.4	V
	8	1356.23	17.5	8476	+ 2.1	V
	17	1365.20	16.7	8020	+ 5.8	V
	17	1365.24	17.6	8057	+ 5.2	V
	18	1366.36	20.6	8402	+ 3.4	J
	18	1366.39	21.5	8458	+ 3.2	J
	21	1369.20	16.8	7658	+ 5.2	V
	24	1372.23	17.4	7600	+ 6.3	V
	26	1374.28	18.7	8130	+ 5.8	J
III	1	1378.20	16.7	7534	+ 8.1	V
	1	1378.23	17.6	7709	+ 7.1	V
	2	1379.21	17.0	7625	+ 6.8	V
	6	1383.22	17.4	7306	+ 5.2	V
	7	1384.32	19.6	7212	+ 7.2	V
	9	1386.25	18.1	7120	+15.3	V
	9	1386.30	19.2	7231	+15.0	V
	13	1390.24	17.8	7082	+ 2.4	V
	13	1390.38	21.2	6849	0.0	J
	13	1390.42	22.0	7121	− 0.7	J
	14	1391.23	17.6	6980	+ 4.8	V
	14	1391.27	18.5	7053	+ 4.5	V
	15	1392.23	17.5	7051	+ 9.1	V
	15	1392.30	19.3	6962	+ 8.4	J
	15	1392.34	20.1	6968	+ 7.5	J
	16	1393.45	22.7	6963	+ 7.9	J
	16	1393.49	23.7	6878	+ 8.6	J
	17	1394.25	18.0	6990	+10.1	V
	17	1394.29	18.9	6923	+11.0	V
	18	1395.40	21.7	6884	+10.0	J
	18	1395.45	22.5	6915	+ 9.4	J
	19	1396.44	22.5	6799	+ 5.6	J
	19	1396.46	23.4	6500	+ 5.1	J
	20	1397.26	18.2	6931	+ 9.3	V
	20	1397.29	19.0	6943	+ 8.1	V
	22	1399.36	20.6	6673	+10.4	J
	22	1399.39	21.4	6703	+10.1	J
	23	1400.24	17.9	6985	+12.2	V
	24	1401.35	20.5	6640	+ 8.7	J
	24	1401.43	22.4	6457	+ 6.3	J
	25	1402.35	20.4	6593	+ 7.0	J
	25	1402.39	21.3	7051	+ 6.9	J
	26	1403.35	20.4	6554	+13.2	J
	26	1403.38	21.2	6552	+13.5	J
	28	1405.30	19.3	6515	+15.0	V
	29	1406.27	18.5	6662	+10.0	V
	29	1406.31	19.4	6612	+10.0	V
	30	1407.42	22.0	6812	—	J
	30	1407.45	22.7	6640	+11.6	J
	31	1408.29	19.0	6785	+15.3	J
IV	2	1410.36	20.7	6580	+10.7	J
	2	1410.39	21.5	6400	+10.1	J
	3	1411.24	$17^{h}.7$	6433	+14°.0	V
IV	3	1411.27	$18^{h}.5$	6442	+14°.0	V
	4	1412.35	20.5	6578	+15.0	J
	4	1412.40	21.6	6496	+14.9	J
	5	1413.26	18.3	6340	+18.8	V
	7	1415.26	18.3	6356	+13.8	V
	8	1416.24	17.7	6128	+16.2	V
	8	1416.27	18.6	6346	+16.2	V
	10	1418.24	17.8	6052	+14.7	V
	11	1419.35	20.3	6176	+16.0	J
	11	1419.38	21.1	6129	+15.7	J
	12	1420.33	19.9	5987	+17.4	V
	17	1425.26	18.3	5910	+15.0	V
	19	1427.32	18.6	5885	+13.3	V
	22	1430.43	22.3	5733	+12.3	J
	22	1430.46	23.1	5562	+11.9	J
	23	1431.38	21.2	5802	—	J
	23	1431.42	22.1	5480	+12.3	J
	28	1436.33	19.9	5701	+ 9.5	J
	28	1436.37	20.8	5528	+ 9.1	J
	30	1438.36	20.7	5608	+11.9	J
V	6	1444.35	20.3	5139	+13.8	J
	7	1445.38	21.2	5599	+14.0	J
	8	1446.25	18.0	5236	+16.0	V
	8	1446.29	19.0	5607	+16.0	V
	8	1446.33	19.9	5493	+15.0	V
	8	1446.46	22.9	5151	+14.1	J
	13	1451.37	20.8	5459	+14.8	J
	13	1451.40	21.7	5162	+14.8	J
	15	1453.29	19.0	4863	+19.7	V
	16	1454.33	19.8	5079	+21.4	V
	17	1455.28	18.8	5106	+19.0	V
	17	1455.32	19.6	5013	+17.8	V
	22	1460.29	18.9	4984	+17.9	V
	22	1460.33	19.9	5023	+17.0	V
	23	1461.29	18.9	4985	+17.3	V
	23	1461.31	19.4	5085	+16.8	V
	24	1462.28	18.7	5303	+19.9	V
	24	1462.31	19.5	5187	+19.0	V
	25	1463.37	20.9	4572	+19.8	J
	25	1463.41	21.8	4501	+19.4	J
	26	1464.37	20.8	4985	+21.2	J
	29	1467.28	18.8	4467	+15.4	V
	29	1467.32	19.7	4339	+14.9	V
	29	1467.36	20.6	4938	+14.8	J
	30	1468.40	21.5	4304	+16.4	J
	31	1469.28	18.8	4307	—	V
VI	5	1474.31	19.4	4294	+19.6	V
	5	1474.34	20.2	4261	+19.0	V
	6	1475.30	19.2	4487	+21.1	V
	6	1475.34	20.1	4297	+20.0	V
	7	1476.37	21.0	4403	+19.0	J
	7	1476.41	21.9	4502	+18.2	J
	8	1477.29	19.1	4231	+21.7	V
	8	1477.33	20.0	4343	+21.3	V
	8	1477.41	21.9	4632	+20.3	J
	8	1477.45	22.8	4487	+20.3	J
	9	1478.37	20.9	4304	+22.7	J
	9	1478.41	21.8	4180	+21.7	J
	15	1484.43	22.4	4332	+25.2	J
	15	1484.47	23.3	4134	+24.8	J
	21	1490.38	$21^{h}.0$	4265	+20°.5	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
VI	21	1490.42	22^h.0	4435	+19°.8	J
	23	1492.37	20.9	4465	+24.3	J
	23	1492.41	21.8	4380	+23.8	J
	25	1494.36	20.7	4540	+17.8	J
	26	1495.36	20.7	3958	+18.0	V
	28	1497.28	18.7	3741	+19.2	V
	29	1498.35	20.5	3824	+22.2	J
	29	1498.40	21.5	4099	+21.6	J
VII	5	1504.33	19.8	4093	+20.0	V
	10	1509.40	21.6	3395	+22.8	J
	16	1515.39	21.3	3394	+22.2	J
	19	1518.38	21.1	3392	+21.5	J
	24	1523.31	19.6	3418	+23.1	J
	30	1529.39	21.3	2759	+20.4	J
VIII	5	1535.38	21.0	3139	+17.7	J
	6	1536.37	20.9	3029	+18.1	J
	7	1537.37	20.8	3074	+20.2	J
	7	1537.41	21.9	3115	+19.6	J
	11	1541.28	18.7	3013	+24.2	J
	11	1541.36	20.6	3001	+25.4	J
	27	1557.26	18.2	2321	+17.9	V
	27	1557.31	19.3	2299	+16.2	V
	31	1561.26	18.2	2412	+17.2	V
IX	1	1562.24	17.8	2448	+16.8	V
	1	1562.28	18.7	2285	+16.2	V
	2	1563.24	17.7	2464	+16.6	V
	2	1563.28	18.6	2452	+16.1	V
	6	1567.27	18.5	2208	+19.8	V
	14	1575.24	17.9	2494	+13.0	V
	14	1575.29	19.0	2046	+11.6	V
	18	1579.29	19.0	2017	+15.2	V
	20	1581.30	19.1	2072	+16.6	V
	22	1583.27	18.6	1732	+15.4	J
	22	1583.37	21.0	1919	+13.8	J
	24	1585.37	20.9	1580	+10.0	J
	25	1586.24	17.7	1644	+11.9	V
	25	1586.28	18.8	1333	+10.8	V
	28	1589.36	20.6	1909	+10.0	J
	28	1589.40	21.7	1846	+ 9.0	J
X	19	1610.46	23.0	1558	+ 4.5	J
	20	1611.19	16.6	0746	+ 7.2	V
	20	1611.22	17.3	1009	—	V
	24	1615.37	20.9	0569	+ 8.0	J
	26	1617.25	18.0	0946	+10.0	J
	26	1617.29	18.9	0768	+10.0	J
	27	1618.21	17^h.1	0997	+11°.0	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
X	27	1618.25	17^h.9	0925	+10°.2	J
	31	1622.17	16.0	0264	+10.7	V
	31	1622.20	16.8	0529	+10.8	V
	31	1622.24	17.6	0508	+10.4	V
XI	1	1623.16	15.9	0466	+11.0	V
	1	1623.20	16.8	0564	+10.3	V
	1	1623.23	17.6	0425	+ 9.9	V
	3	1625.26	18.3	0721	+ 9.4	J
	3	1625.30	19.3	0567	+ 8.9	J
	7	1629.18	16.4	0926	+12.5	V
	7	1629.22	17.2	0910	+11.9	V
	9	1631.20	16.8	0867	+10.6	V
	9	1631.24	17.7	0863	+10.2	V
	10	1632.29	18.9	0872	+10.3	J
	12	1634.24	17.8	0492	+ 7.7	J
	16	1638.22	17.5	0351		J
	16	1638.27	18.5	0216		J
	21	1643.18	16.3	9816	+ 8.0	V
	21	1643.21	17.1	9854	+ 7.7	V
	27	1649.15	15.6	9844	+ 3.0	V
	27	1649.18	16.4	9605	+ 2.4	V
	28	1650.16	15.8	9553	+ 3.2	V
	28	1650.19	16.7	9558	+ 2.9	V
	29	1651.15	15.7	9461	+ 4.0	V
	29	1651.19	16.6	9553	+ 4.0	V
	30	1652.19	16.7	9486	+ 5.4	J
XII	3	1655.18	16.3	9883	+ 8.8	J
	3	1655.22	17.3	9437	+ 8.3	J
	4	1656.18	16.2	9574	+ 9.3	V
	4	1656.22	17.3	9685	+ 9.9	V
	5	1657.14	15.5	9126	+ 9.0	V
	5	1657.18	16.2	9208	+ 8.5	V
	7	1659.21	17.1	9343	+ 5.1	J
	7	1659.25	18.0	9341	+ 5.1	J
	20	1672.18	16.2	8653	+ 0.1	J
	20	1672.22	17.2	9032	0.0	V
	20	1672.25	17.9	9226	— 0.6	V
	21	1673.17	16.2	9228	— 1.4	V
	21	1673.21	17.1	8812	— 1.1	V
	22	1674.43	22.3	9463	— 1.6	J
	23	1675.21	17.0	8819	— 0.6	J
	23	1675.24	17.8	8595	— 0.8	J
	28	1680.16	15.8	8660	— 0.4	V
	28	1680.19	16.6	9013	— 1.9	V
	28	1680.22	17.3	8867	— 2.8	J
	29	1681.19	16.6	8176	— 2.9	J
	29	1681.22	17.3	8684	— 3.6	J
	30	1682.15	15.6	8448	— 2.0	V
	30	1682.19	16^h.5	8532	— 2°.0	V

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Date		Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
I	13	1696.18	16^h.4	8352	0°.0	J
	13	1696.22	17.3	7945	— 0.2	J
	14	1697.18	16.3	8598	— 1.0	J
	17	1700.17	16.2	7513	— 0.3	V
	25	1708.20	16.6	7392	— 1.2	V
	25	1708.23	17.5	7439	— 2.2	V
	26	1709.18	16.4	7524	— 1.1	V
	26	1709.22	17.2	7504	— 2.0	V
	27	1710.18	16^h.4	7562	— 1°.5	V

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
I	27	1710.22	17^h.2	7515	— 1°.9	V
	28	1711.18	16.3	7636	— 0.9	V
	28	1711.21	17.1	7534	— 0.4	V
	29	1712.18	16.2	7217	— 0.9	V
	29	1712.23	17.5	7416	— 0.8	V
	31	1714.18	16.2	7286	+ 3.6	V
	31	1714.21	17.1	7460	+ 2.0	V
II	8	1722.36	20^h.7	6718	+ 6°.8	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
II	8	1722.40	21h.6	6836	+ 6°.9	J
	12	1726.20	16.7	6556	+ 3.3	V
	12	1726.24	17.7	6782	+ 2.3	V
	13	1727.18	16.4	6764	+ 4.4	V
	13	1727.23	17.5	6909	+ 4.1	V
	19	1733.20	16.8	7018	+ 3.0	V
	19	1733.24	17.7	6978	+ 2.5	V
	24	1738.28	18.8	6572	+ 3.4	J
III	22	1764.36	20.6	5251	+ 6.8	J
	22	1764.39	21.5	5279	+ 6.6	J
	23	1765.25	17.9	5817	+10.1	J
	23	1765.28	18.8	5829	+ 9.3	J
	24	1766.35	20.3	5578	+10.1	J
	27	1769.42	22.0	5464	+10.6	J
	31	1773.37	20.9	5654	+10.7	J
	31	1773.41	21.8	5693	+10.3	J
IV	2	1775.23	17.6	5418	+14.1	V
	2	1775.27	18.5	5639	+14.0	V
	6	1779.39	21.4	5153	+ 8.7	J
	6	1779.43	22.3	5075	+ 8.3	J
	7	1780.39	21.3	5202	+11.6	J
	7	1780.43	22.2	5080	+11.1	J
	17	1790.28	18.8	4550	+10.0	V
	17	1790.32	19.7	4555	+ 8.6	V
	22	1795.27	18.4	4703	+ 9.2	V
	27	1800.37	20.9	4647	+10.9	J
	27	1800.41	21.8	5141	+10.6	J
	30	1803.30	19.2	5015	+16.1	V
	30	1803.34	20.1	4982	+16.0	V
V	5	1808.30	19.3	4257	+22.8	J
	13	1816.40	21.7	4224	+11.5	J
	13	1816.44	22.6	4116	+11.5	J
	14	1817.28	18.8	3735	+15.1	V
	14	1817.33	19.8	3751	+14.2	V
	15	1818.28	18.7	3875	+17.0	V
	15	1818.32	19.6	4111	+14.2	V
	15	1818.36	20.7	3985	+15.4	J
	17	1820.27	18.5	3671	+11.1	V
	17	1820.31	19.5	3736	+10.1	V
	17	1820.36	20.5	3798	+ 9.4	J
	20	1823.39	21.3	3737	+20.0	J
	20	1823.42	22.2	3733	+19.1	J
	21	1824.27	18.4	4097	+21.6	V
	21	1824.31	19.3	4128	+20.9	V
	22	1825.38	21.2	3512	+21.2	J
	24	1827.30	19.1	3514	+21.6	V
	24	1827.34	20.1	3487	+19.4	V
	24	1827.38	21.0	3617	+19.6	J
	29	1832.29	19.1	3252	+17.3	V
	29	1832.33	20.0	3323	+17.0	V
	31	1834.36	20.5	3035	+19.6	J
	31	1834.39	21.5	3419	+18.6	J
VI	1	1835.28	18.6	3305	+21.6	V
	1	1835.32	19.6	3307	+20.0	V
	2	1836.39	21.3	3500	+21.7	J
	2	1836.43	22.3	3303	+20.3	J
	7	1841.41	21.8	3138	+22.0	J
	12	1846.29	19.0	2846	+19.4	V
	12	1846.33	19.9	2911	+18.6	V
	13	1847.28	18.8	3144	+20.9	V
	13	1847.32	19.7	3046	+19.2	V
	13	1847.38	20.6	3104	+19.7	J
	14	1848.35	20.5	3184	+21.2	J
	14	1848.40	21.5	3271	+20.4	J
	16	1850.38	21h.1	2850	−15°.6	V

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
VI	16	1850.42	22h.0	2883	+14°.0	V
	22	1856.37	21.0	3437	+20.4	J
	22	1856.41	21.9	3363	+19.8	J
	26	1860.28	18.8	2802	+21.5	V
	26	1860.32	19.8	2642	+20.1	V
	27	1861.28	18.8	2946	+22.0	V
	27	1861.32	19.7	2978	+21.1	V
	28	1862.36	20.6	3309	+23.2	J
	28	1862.40	21.5	3018	+22 8	J
	30	1864.36	20.5	3386	+19.4	J
VII	5	1869.28	18.8	2485	+22.2	V
	5	1869.33	19.8	2813	+21.1	V
	6	1870.30	19.1	2960	+22.5	J
	6	1870.38	21.0	2621	+22.4	J
	12	1876.30	19.2	2571	+21.6	J
	16	1880.42	22.2	2405	+24.8	J
	18	1882.38	21.1	2347	+24.9	J
	20	1884.37	20.9	2033	+22.3	J
	21	1885.37	20.9	2033	+24.2	J
	22	1886.36	20.8	2272	+25.6	J
	31	1895.39	21.3	2006	+19.4	J
	31	1895.43	22.4	2307	+18.7	J
VIII	1	1896.29	19.0	2194	+21.3	J
	2	1897.29	19.0	2086	+22.0	J
	7	1902.30	19.1	2068	+24.0	V
	7	1902.35	20.3	1772	+24.0	V
	7	1902.38	21.2	2008	+23.7	J
	9	1904.27	18.6	1654	+22.3	J
	9	1904.32	19.6	1753	+20.8	V
	10	1905.27	18.5	1678	+20.4	J
	15	1910.26	18.3	1640	+20.1	V
	15	1910.31	19.4	1367	+18.5	V
	16	1911.28	18.7	1657	+21.5	V
	16	1911.32	19.7	1503	+20.0	V
	21	1916.27	18.4	1757	+25.0	V
	21	1916.31	19.5	1592	+24.2	V
	22	1917.33	19.8	1647	+23.2	V
	22	1917.37	21.0	1887	+21.6	V
	23	1918.25	18.1	1650	+23.1	V
	23	1918.30	19.2	1695	+22.0	V
	31	1926.25	17.9	1209	+20.2	V
	31	1926.28	18 7	1310	+19.1	V
IX	3	1929.25	17.9	0803	+21.5	V
	3	1929.29	18.9	0836	+21.1	V
	4	1930.25	17.9	0939	+23.0	J
	5	1931.24	17.7	1146	+23.1	V
	5	1931.28	18.7	1194	+22.2	V
	6	1932.24	17.8	0970	+22.2	V
	6	1932.29	18.9	1014	+22.1	V
	7	1933.24	17.7	1111	+23.7	J
	7	1933.28	18.8	1163	+23.2	J
	8	1934.28	18.6	0851	+23.1	J
	10	1936.24	17.8	0798	+24.0	V
	12	1938.25	18.0	0964	+17.1	V
	12	1938.29	19.1	0704	+15.8	V
	14	1940.26	18.3	1093	+14.4	J
	20	1946.43	22.2	0945	+14.0	J
	21	1947.25	17.9	0586	+18.6	V
	21	1947.30	19.1	0530	+18.0	V
	23	1949.37	20.9	0788	+18.4	J
	23	1949.47	22.0	0636	+18.0	J
	25	1951.24	17.8	0439	+19.0	V
	25	1951.30	19.2	0598	+19.0	V
	26	1952.19	16.7	0497	+18.4	V
	26	1952.24	17.8	0489	+17.1	V
	30	1956.25	17h.9	0473	+16°.9	V

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
IX	30	1956.29	$19^h.0$	0375	+16°.0	V
X	1	1957.28	18.8	0607	+16.8	J
	2	1958.28	18.7	0498	+17.0	J
	4	1960.25	18.1	0485	+15.4	J
	5	1961.21	17.1	0017	+14.8	V
	5	1961.25	18.0	0232	+13.6	V
	6	1962.20	16.8	0224	+14.7	V
	6	1962.25	17.7	0214	+14.1	V
	8	1964.26	18.2	0024	+16.1	V
	8	1964.30	19.1	0103	+15.4	V
	9	1965.38	21.1	0336	+13.2	J
	10	1966.20	16.8	9970	+15.3	V
	10	1966.24	17.7	9899	+14.3	V
	11	1967.23	17.4	0137	+15.0	J
	11	1967.26	18.2	0215	+15.1	J
	13	1969.22	17.3	9765	+12.2	J
	13	1969.25	18.0	9904	+11.3	J
	16	1972.35	20.5	0110	+17.7	J
	17	1973.19	16.4	9534	+18.0	V
	17	1973.22	17.3	9767	+17.7	V
	19	1975.23	17.6	9764	+12.0	J
	19	1975.27	18.4	9996	+ 9.1	J
	20	1976.23	17.4	0005	+11.8	J
	23	1979.24	17.7	9424	+ 7.2	J
	25	1981.19	16.6	9577	+ 6.6	V
	25	1981.24	17.8	9388	+ 5.5	V
	26	1982.29	18.9	9464	+ 5.2	J
	27	1983.25	18.0	9763	+ 5.4	J
	27	1983.28	18.8	9302	+ 4.9	J
	28	1984.24	17.8	9538	+ 5.2	J
	29	1985.24	17.8	9422	+ 6.0	J
	29	1985.28	18.6	9337	+ 5.0	J
XI	1	1988.17	16.2	9422	+ 4.0	V
	1	1988.21	17.0	9292	+ 3.8	V
	2	1989.20	16.7	9413	+ 8.0	J
	2	1989.23	17.6	9220	+ 2.4	J
	3	1990.19	16.6	9777	+ 3.8	J
	3	1990.22	$17^h.5$	0004	+ 3°.4	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
XI	5	1992.17	$16^h.0$	9365	+ 8°.0	V
	5	1992.20	16.8	9351	+ 8.3	V
	10	1997.21	17.1	9423	+ 5.8	J
	10	1997.24	17.8	9329	+ 5.8	J
	11	1998.21	16.9	9466	+ 7.0	J
	11	1998.24	17.8	9275	+ 7.2	J
	16	2003.38	21.1	9265	+ 6.4	J
	18	2005.19	16.5	8849	+ 4.7	J
	18	2005.22	17.3	8941	+ 4.6	J
	19	2006.17	16.1	8906	+ 5.8	V
	19	2006.21	17.1	8972	+ 5.7	V
	20	2007.37	20.8	9214	+ 5.1	J
	20	2007.40	21.7	9081	+ 4.8	J
	21	2008.28	18.8	8722	+ 4.2	V
	21	2008.32	19.6	9055	+ 3.7	V
	22	2009.17	16.2	8824	+ 3.0	V
	22	2009.21	17.1	8806	+ 3.0	V
	23	2010.25	17.0	8962	+ 5.4	J
	23	2010.29	18.0	8829	+ 5.3	J
	24	2011.43	22.2	8733	+ 7.0	J
XII	5	2022.36	20.7	8519	+ 0.6	
	5	2022.39	21.5	8618	+ 0.8	
	6	2023.22	17.4	8136	+ 2.1	V
	6	2023.26	18.3	7999	+ 2.2	V
	10	2027.18	16.4	7756	− 1.0	V
	10	2027.22	17.3	7808	− 2.2	V
	11	2028.17	16.2	7658	− 2.4	V
	11	2028.21	17.1	7861	− 2.3	V
	20	2037.39	21.4	8164	+ 5.8	J
	20	2037.43	22.2	7996	+ 5.4	J
	21	2038.21	17.1	7652	+ 7.6	J
	21	2038.25	17.9	7583	+ 8.0	J
	24	2041.19	16.5	7677	+ 9.0	V
	24	2041.22	$17^h.4$	7637	+ 9°.0	V

Observateurs: J — M. Jovanović;
V — D. Vesić.

OBSERVATIONS A LA LUNETTE ZENITHALE (DE 110 mm) DU SERVICE DE LATITUDE DE L'OBSERVATOIRE DE BELGRADE EN 1970, 1971, 1972

G. GRUJIĆ, M. DJOKIĆ, V. MILOVANOVIĆ, L. DJUROVIĆ

Les observations et les réductions qui suivent ont été faites d'après le programme et le mode décrits dans un fascicule précédent (voir: Bulletin de l'Obs. astr. Belgrade, Vol. XXIV, N° 3—4, p. 19, 1959). Les valeurs de φ de la Table 3 sont réduites au système FK4 en appliquant les corrections de la Table 1, qui se rapportent aux commencements respectifs des années en question (S=FK4—FK3).

Table 1

Sous-groupes	S 1970.0	1971.0	1972.0	1973.0
I a	−0″028	−0″028	−0″028	−0″028
I b	−0.024	−0.024	−0.024	−0.025
II a	+0.088	+0.089	+0.091	+0.092
II b	+0.092	+0.094	+0.095	+0.097
III a	+0.110	+0.112	+0.114	+0.116
III b	+0.070	+0.072	+0.073	+0.074
IV a	−0.004	−0.004	−0.003	−0.003
IV b	+0.024	+0.025	+0.025	+0.026
V a	−0.018	−0.018	−0.018	−0.018
V b	−0.014	−0.014	−0.013	−0.013
VI a	−0.004	−0.004	−0.003	−0.003
VI b	+0.008	+0.008	+0.009	+0.009

Les corrections $\Delta\delta$ des déclinations des sous--groupes de la Table 2 représentent les sommes des corrections $\Delta\delta$ 1970.0 et des valeurs corrigées $\Delta(\Delta\delta)$ 1970.0 de ces données. Les corrections $\Delta(\Delta\delta)$ 1970.0 sont déterminées sur la base du matériel d'observations (couvrant la période 1969.0—1972.5) par la méthode d'enchainement. La raison pour utiliser ce matériel été déjà expliquée (voir: Bulletin de l'Obs. astr. Belgrade Vol. XXVIII, No 2, p. 159.1970), en tenant compte cette fois des évaluations des poids, données par B. Guinot dans les Rapports annuels pour 1969, 1970 et 1971.

Les erreurs progréssives et périodiques, de même que le coefficient thermique de la vis micrométriques, ne sont pas appliquées.

Table 2

Sous-groupes	$\Delta\delta$ 1970.0	$\Delta(\Delta\delta)$ (1970.0	$\Delta\delta$
I a	−0″185	+0″028	−0″157
I b	+0.309	+0.009	+0.318
II a	−0.055	−0.106	−0.161
II b	+0.136	−0.042	+0.094
III a	+0.323	+0.022	+0.345
III b	+0.436	−0.086	+0.350
IV a	+0.383	+0.084	+0.467
IV b	−0.529	+0.046	−0.483
V a	+0.060	+0.058	+0.118
V b	−0.231	+0.028	−0.203
VI a	−0.434	−0.028	−0.462
VI b	−0.215	−0.028	−0.243

Jusqu'à la date du 1. janvier 1971, les réductions des observations ont été faites en adoptant la valeur du tour $R = 40''.1061$, après cette date la valeur utilisée étant: $R = 40''.0481$.

NOTATIONS:

- τ : Partie d'année tropique.
- Obs. : Observateurs: R. Grujić (RG), M. Djokić (MD), V. Milovanović (VM), L. Djurović (LD).
- T_z : Température à l'abri météorologique, à 50 m de distances de l'instrument.
- T_i : Température de l'instrument.
- T_v : Température de l'air dans la salle d'observation (valuer moy. des lectures des thermométres sud et nord).
- B_0 : Préssion atm. en mm Hg (tenant compte de la température de baromètre).
- GR : Numéro de la groupe.
- $\varphi a, \varphi b$: La latitude respective de la sous-groupe.
- φ_d : La valeur moy. de la latitude pour la date d'observation.

Table 3

DATE		τ	OBS.	T_z	T_i	T_v	B_0	GR.	φ_a	φ_a	φ_d
										44°48′+	
1970									″	″	″
I	3	1970.008	RG	+2°4C	−0°1C	+0°8C	736.1	I	10.221	—	10.221
	8	.022	RG	3.8	−2.4	−2.9	748.0	I	10.126	10.165	
		.022	MD	−5.2	−3.9	−4.2	748.2	II	10.168	10.097	
		.023	MD	6.7	−4.8	−5.4	748.1	III	10.271	10.325	10.192
	21	.058	RG	7.2	4.8	−5.5	744.0	II	—	10.095	
		.058	RG	7.3	5.9	−6.5	743.9	III	10.318	—	10.206
	24	.066	VM	4.5	4.0	4.2	743.8	II	10.214	10.244	10.229
	29	.080	MD	1.6	−1.1	1.3	740.6	II	10.146	10.348	10.247
	30	.082	VM	0.7	1.0	−1.0	734.8	II	10.428	10.271	10.350
II	2	.091	MD	−7.4	−4.2	−5.0	737.0	III	10.308	—	10.308
	12	.118	MD	2.0	−0.3	−1.0	737.2	II	—	10.260	10.260
	17	.132	VM	−5.0	−3.8	−4.4	741.2	II	10.038	10.258	
		.132	VM	−5.6	−5.0	5.2	741.9	III	10.165	—	10.154
III	2	.167	MD	−2.1	−2.4	—	732.5	II	—	10.321	10.321
	6	.178	VM	+6.0	+5.2	+5.6	735.8	III	10.250	—	10.250
	7	.182	RG	−2.2	−1.1	−1.6	742.3	IV	10.175	10.121	10.148
	8	.183	VM	+1.2	+1.5	+1.4	739.6	II	—	10.218	
		.184	VM	+1.0	+0.6	+0.5	739.4	III	10.228	10.177	10.208
	9	.186	MD	+2.4	+3.2	+2.6	738.9	II	—	10.281	10.281
	18	.211	RG	+5.8	+3.8	+4.5	730.8	III	10.327	—	10.327
	20	.216	VM	+1.6	+1.8	+1.8	740.8	III	10.100	10.235	
		.217	VM	−0.3	+0.2	−0.3	740.6	IV	10.231	10.085	10.163
	21	.219	RG	+6.7	+4.6	+5.4	741.8	III	—	10.301	10.301
	24	.227	VM	+14.1	+11.6	+12.2	739.5	III	10.218	10.192	
		.228	VM	+12.5	+10.8	+11.3	739.8	IV	10.207	10.296	10.228
	29	.241	MD	+2.1	+4.2	+3.1	735.8	III	10.249	—	
		.242	MD	+1.5	+1.8	+1.3	738.2	IV	10.349	10.250	10.283

DATE		τ	OBS.	T_z	T_i	T_v	B_0	GR.	φ_a	φ_b	φ_d
1970									″	″	″
III	30	1970.244	RG	+ 8.2	+ 6.6	+ 7.2	739.2	III	—	10.244	
		.244	RG	+ 7.2	+ 5.9	+ 6.2	739.2	IV	10.091	10.213	10.183
IV	4	.258	RG	+ 3.1	+ 3.7	+ 3.0	736.0	III	10.183	10.137	
		.258	RG	+ 3.8	+ 2.8	+ 3.1	735.8	IV	10.204	10.044	10.142
	5	.260	VM	+ 6.2	+ 5.9	+ 5.8	734.[illegible]	III	10.258	10.111	10.184
	6	.263	MD	+ 4.7	+ 4.1	+ 4.3	738.7	IV	10.289	10.229	10.259
	9	.272	RG	+10.0	+ 9.4	+ 9.1	733.4	IV	10.080	10.207	10.144
	10	.274	MD	+10.1	+ 9.5	+ 9.2	736.6	IV	10.170	10.256	10.213
	12	.280	RG	+ 5.0	+ 6.2	+ 5.3	735.5	IV	10.152	10.031	10.092
	15	.288	RG	+ 4.0	+ 5.4	+ 4.8	745.0	III	—	10.167	
		.288	RG	+ 2.6	+ 3.4	+ 3.2	745.1	IV	10.086	10.171	10.141
	17	.293	MD	+10.6	+10.0	+ 9.6	743.6	III	10.180	10.254	10.217
	19	.298	VM	+16.4	+14.6	+15.0	737.6	III	10.158	10.183	
		.299	VM	+15.4	+13.6	+14.2	737.2	IV	10.302	10.275	10.230
	20	.301	MD	+17.6	+16.8	+17.0	736.7	III	—	10.237	10.237
	22	.307	RG	+12.6	+11.6	+11.6	746.5	IV	10.173	10.168	10.170
	23	.310	MD	+18.4	+16.6	+17.5	741.0	IV	10.093	10.120	10.106
	29	.326	RG	+ 6.6	+ 8.2	+ 7.4	737.0	IV	10.267	10.230	10.248
V	6	.345	RG	+11.4	+11.2	+11.2	738.6	IV	10.166	10.179	10.172
	8	.351	VM	+16.4	+15.8	+16.2	737.4	IV	10.241	—	10.241
	10	.356	MD	+21.3	+19.8	+20.3	731.8	IV	10.148	10.211	10.180
	14	.367	MD	+15.8	+15.3	+14.8	738.6	IV	10.143	10.293	10.218
	16	.373	RG	+13.4	+15.6	+14.7	735.5	IV	—	10.274	10.274
	25	.397	MD	+10.2	+10.4	+10.0	743.5	IV	—	10.262	
		.398	MD	+10.0	+ 9.3	+ 9.5	743.3	V	10.419	10.245	10.309
	26	.400	VM	+12.5	+12.4	+12.0	740.6	IV	10.203	10.268	
		.400	VM	+12.6	+11.0	+11.0	740.7	V	10.303	—	10.258
	29	.408	VM	+12.4	+13.0	+13.0	739.2	IV	10.304	10.250	
		.408	VM	+12.1	+11.6	+11.8	738.8	V	10.239	10.252	10.261
VI	5	.427	MD	+15.2	+14.7	+14.8	739.2	IV	—	10.430	10.430
	6	.430	RG	+15.1	+15.6	+15.6	739.6	IV	—	10.264	
		.430	RG	+14.2	+14.6	+14.9	739.4	V	10.292	10.260	10.272
	15	.455	MD	+18.0	+17.6	+17.4	740.4	V	10.386	10.304	10.345
	17	.460	RG	+23.1	+21.8	+21.4	736.5	V	10.458	—	10.458
	20	.469	RG	+16.8	+18.2	+17.4	739.9	V	10.373	—	10.373
	21	.471	MD	+19.4	+19.2	+19.1	742.2	V	10.380	10.431	10.406
	25	.482	MD	+18.2	+19.7	+19.0	742.5	V	—	10.325	10.325
	27	.488	RG	+20.2	+20.4	+19.8	741.8	V	10.356	10.321	
		.488	RG	+19.0	+19.2	+18.8	741.5	VI	10.402	—	10.360
	28	.490	VM	+21.9	+21.4	+20.9	739.4	V	10.304	10.451	10.378
VII	1	.499	RG	+14.8	+17.2	+16.2	736.3	V	10.393	—	10.393
	8	.518	RG	+20.2	+19.4	+19.4	737.5	V	10.356	10.403	
		.518	RG	+19.4	+18.6	+19.0	737.5	VI	10.360	10.380	10.375
	9	.520	MD	+23.3	+22.1	+22.0	738.6	V	10.458	10.550	
		.521	MD	+21.4	+20.7	+20.6	738.5	VI	—	10.367	10.458
	10	.523	VM	+21.9	+21.6	+21.4	741.0	V	10.458	10.327	
		.524	VM	+19.3	+19.8	+19.4	741.2	VI	10.405	10.411	10.400
	11	.526	RG	+21.2	+21.6	+20.9	740.8	V	10.479	10.534	
		.526	RG	+20.7	+20.1	+20.0	740.7	VI	10.416	10.380	10.452
	12	.529	MD	+21.4	+21.8	+21.4	741.9	V	10.448	10.362	
		.529	MD	+18.8	+19.4	+18.9	742.3	VI	10.481	10.506	10.449
	15	.537	RG	+15.1	+19.5	+17.5	730.7	V	—	10.373	10.373
	19	.548	VM	+14.8	+14.6	+14.9	734.6	V	10.457	10.417	
		.548	VM	+14.9	+14.2	+14.7	734.9	VI	10.474	10.487	10.459
	20	.551	MD	+17.3	+17.2	+17.3	737.0	VI	10.414	10.535	10.474
	21	.553	VM	+21.7	+20.7	+20.8	740.0	V	10.385	10.472	
		.554	VM	+21.4	+20.1	+20.2	740.4	VI	10.515	10.420	10.448
VII	22	.556	RG	+24.1	+23.0	+23.0	740.7	V	10.424	10.472	
		.556	RG	+24.5	+22.0	+22.8	740.6	VI	10.464	10.466	10.456
	23	.559	MD	+24.5	+24.2	+23.5	741.2	V	10.532	10.559	
		.559	MD	+22.9	+22.1	+21.8	741.0	VI	10.544	10.588	10.556
	24	.562	VM	+24.4	+23.5	+23.2	737.2	V	10.550	10.485	
		.562	VM	+24.3	+22.6	+23.0	736.3	VI	10.577	10.596	10.552
	26	.567	MD	+16.3	+17.6	+16.7	739.9	V	10.436	10.438	
		.567	MD	+14.0	+15.4	+14.5	740.5	VI	10.402	10.463	10.435
	27	.570	VM	+16.8	+18.2	+17.7	742.4	V	10.465	10.461	
		.570	VM	+16.1	+16.6	+16.7	742.2	VI	10.586	10.445	10.489
	29	.575	MD	+19.5	+20.1	+19.1	740.4	V	10.554	10.516	
		.576	MD	+18.3	+18.0	+17.5	740.8	VI	10.575	10.553	10.550
VIII	3	.589	MD	+21.5	+21.7	+21.0	738.2	V	—	10.502	10.502

DATE		τ	OBS.	T_z	T_i	T_v	B_0	GR.	φ_a	φ_d	φ_d
1970									″	″	″
	4	1970.592	VM	+22.0	+21.9	+21.4	739.1	V	—	10.486	10.486
	6	.597	MD	+24.6	+24.0	+23.4	739.7	V	10.546	10.489	10.518
	7	.600	VM	+24.9	+24.8	+24.6	736.6	V	10.523	10.529	10.526
	18	.630	RG	+14.9	+15.5	+14.8	738.2	VI	10.564	10.629	10.596
	20	.636	RG	+19.7	+19.8	+19.7	735.9	VI		10.656	10.656
	26	.652	MD	+12.5	+14.2	+13.3	742.8	VI		10.627	10.627
	27	.655	RG	+15.8	+15.3	+14.9	742.3	VI	10.511	10.542	
		.655	RG	+13.3	+14.0	+14.1	741.8	I	10.521	10.609	10.546
IX	2	.671	MD	+16.0	+17.2	+16.7	740.8	VI	10.626	10.649	
		.672	MD	+15.2	+16.0	+15.4	740.6	I	10.800	—	10.692
	3	.674	RG	+19.8	+18.2	+18.6	739.8	VI	10.558	10.569	10.564
	7	.685	VM	+12.5	+13.4	+12.9	743.8	VI	10.612	—	10.612
	8	.688	RG	+18.1	+17.3	+17.6	740.0	VI	10.581	10.543	10.562
	9	.690	VM	+21.2	+20.4	+20.6	739.3	VI	10.507	10.526	
		.691	VM	+21.1	+19.8	+20.0	738.6	I	10.626	10.561	10.555
	11	.696	VM	+24.9	+22.6	+23.0	737.2	VI	10.675	10.556	
		.696	VM	+23.6	+21.8	+22.5	737.4	I	10.515	—	10.582
	15	.707	LD	+21.4	+20.3	+20.6	739.6	VI	—	10.597	10.597
	21	.723	RG	+13.1	+14.1	+13.4	741.0	VI	10.525	—	10.525
	23	.728	VM	+10.2	+10.4	+10.0	743.6	VI	10.508	10.601	
		.729	VM	+ 7.2	+ 7.8	+ 7.5	743.9	I	10.705	10.603	10.604
	29	.745	LD	+ 6.2	+ 6.4	+ 5.9	749.8	VI	10.637	10.735	
		.745	LD	+ 4.2	+ 7.4	+ 6.8	751.9	I	10.733	—	10.702
	30	.748	LD	+10.8	+ 9.9	+ 9.6	740.2	VI	10.579	10.696	
		.748	LD	+ 4.5	+ 4.4	+ 4.1	748.9	I	10.699	—	10.658
X	6	.764	VM	+15.2	+13.5	+13.9	739.9	VI	10.632	10.568	
		.764	VM	+14.6	+12.6	+13.8	739.8	I	10.546	10.597	10.586
	8	.770	VM	+17.3	+15.6	+15.6	743.0	VI	10.627	10.499	
		.770	VM	+15.9	+14.5	+14.5	743.3	I	10.553	10.745	10.606
	9	.772	MD	+14.2	+14.6	+14.2	745.4	VI	10.598	10.688	
		.773	MD	+12.8	+12.9	+12.9	745.4	I	10.677	10.431	10.598
	11	.778	MD	+13.6	+13.2	+13.0	748.1	I	10.645	10.829	10.737
	12	.780	RG	+14.7	+14.3	+14.4	747.3	VI	10.635	10.590	10.612
	13	.783	VM	+13.7	+13.2	+12.8	744.6	VI	10.590	10.619	
		.784	VM	+12.8	+11.8	+12.0	743.8	I	10.699	10.658	10.642
	19	.800	MD	+ 7.0	+ 7.3	+ 7.3	737.9	VI	10.685	—	10.685
	26	.819	MD	+10.0	+ 8.4	+ 9.0	743.2	VI	—	10.513	
		.819	MD	+ 9.4	+ 7.8	+ 8.3	743.2	I	10.622	10.582	10.572
	28	.824	RG	+ 9.0	+ 8.7	+ 9.1	744.8	I	10.677	10.592	
		.825	RG	+ 7.4	+ 7.6	+ 7.9	744.2	II	10.531	10.513	10.578
	30	.830	LD	+13.2	+11.2	+12.2	745.4	VI	10.538	10.579	
		.830	VM	+13.4	+11.6	+12.4	744.1	I	10.637	10.587	
		.830	VM	+11.0	+10.6	+11.0	743.6	II	10.613	10.532	10.581
	31	.832	RG	+14.5	+12.2	+12.7	743.5	VI	10.516	—	10.516
XI	1	.836	RG	+10.6	+10.4	+10.5	742.3	I	10.596	10.579	
		.836	RG	+ 9.3	+ 8.9	+ 9.0	742.9	II	—	10.512	10.562
	3	.841	VM	+14.1	+13.2	+13.7	737.7	I	10.590	10.458	
		.842	VM	+12.0	+11.5	+11.5	738.5	II	10.579	10.584	10.553
	4	.844	RG	+ 9.8	+ 9.4	+ 8.9	744.5	I	10.531	10.508	
		.844	RG	+ 9.2	+ 8.0	+ 8.1	744.6	II	10.483	10.603	10.531
	5	.846	LD	+12.8	+11.4	+12.4	737.8	VI	10.580	10.522	10.551
	7	.852	RG	+ 3.8	+ 4.8	+ 4.1	742.8	VI	10.500	10.499	
		.852	RG	+ 3.7	+ 3.4	+ 3.2	742.6	I	10.609	10.504	10.528
	11	.863	RG	+ 4.0	+ 3.7	+ 3.6	744.5	I	10.585	10.402	10.494
	12	.866	MD	+10.6	+ 8.0	+ 9.2	741.6	I	10.555	10.731	
		.866	MD	+10.0	+ 7.4	+ 8.2	741.6	II	10.526	10.509	10.580
	13	.868	VM	+11.4	+ 7.7	+ 8.4	740.0	I	10.514	10.651	10.582
	19	.884	MD	+14.0	+12.4	+13.2	736.8	I	10.486	10.577	10.532
	25	.901	VM	+ 5.3	+ 4.8	+ 4.6	748.3	I	10.542	10.413	
		.902	RG	+ 5.4	+ 4.0	+ 4.0	748.6	II	10.616	10.415	10.496
	29	.912	VM	+ 7.0	+ 4.8	+ 5.3	740.6	I	10.451	10.546	
		.912	VM	+ 8.4	+ 5.1	+ 7.0	740.1	II	10.487	—	10.495
1971											
I	19	1971.052	RG	+ 4.0	+ 1.0	+ 2.4	737.3	II	10.190	—	10.190
	20	.054	VM	+ 5.6	+ 3.7	+ 4.5	733.0	II	10.338	10.319	10.328
	23	.062	RG	+ 7.6	+ 6.0	+ 6.8	737.0	II	10.306	10.390	
		.063	RG	+ 8.4	+ 5.9	+ 6.7	736.7	III	10.240	10.257	10.298
	30	.082	RG	+ 7.0	+ 6.4	+ 6.3	740.2	III	10.371	10.370	10.370
II	10	.112	RG	− 0.2	+ 1.4	+ 0.7	746.6	III	—	10.198	10.198

DATE		τ	OBS.	T_z	T_i	T_r	B_0	GR.	φ_a	φ_b	φ_d
1971									"	"	"
II	11	.114	MD	+0.0	+ 0.5	+ 0.0	747.7	II	10.399	10.210	
		.115	MD	− 1.3	− 1.8	− 1.7	747.9	III	10.415	10.270	10.324
	12	.117	VM	+ 1.5	+ 0.5	+ 0.3	743.6	II	10.169	10.288	
		.118	VM	+ 2.1	− 0.2	− 0.2	742.7	III	10.194	10.161	10.203
	13	.120	RG	+ 7.0	+ 4.0	+ 5.2	737.7	II	10.239	10.176	
		.120	RG	+ 6.3	+ 4.1	+ 5.0	736.8	III	10.271	10.193	10.220
	16	.128	LD	+ 4.1	+ 4.4	+ 4.2	727.1	II	10.366	—	10.366
III	10	.189	RG	− 3.2	− 2.8	− 3.0	741.8	IV	10.020	10.161	10.090
	12	.194	LD	− 7.0	− 6.3	− 7.0	748.9	IV	10.278	—	10.278
	13	.197	RG	+ 1.6	− 1.0	+ 0.0	743.2	III	10.351	10.072	
		.197	RG	+ 2.4	− 0.8	+ 0.0	742.2	IV	10.097	10.187	10.177
	15	.202	MD	+ 3.6	+ 2.9	+ 3.0	732.0	III	—	10.241	10.241
	18	.210	MD	+ 9.5	+ 7.6	+ 8.0	736.0	III	10.153	10.149	
		.211	MD	+ 8.5	+ 6.8	+ 7.2	735.8	IV	10.141	10.160	10.151
	20	.216	RG	+15.0	+12.0	+12.8	735.8	III	10.060	10.036	
		.216	RG	+11.6	+10.7	+11.0	735.4	IV	9.975	10.147	10.054
	22	.221	MD	+11.6	+11.2	+11.1	724.4	III	10.164	10.132	10.148
	24	.227	LD	+ 1.8	+ 4.2	+ 3.0	743.4	IV	10.351	10.153	10.252
	25	.230	MD	+ 5.0	+ 4.0	+ 4.0	738.2	III	—	10.330	
		.230	MD	+ 3.1	+ 2.6	+ 2.5	737.0	IV	10.234	10.365	10.310
	26	.232	LD	+ 5.8	+ 5.5	+ 5.2	731.1	III	10.250	10.218	
		.233	LD	+ 4.3	+ 3.8	+ 3.7	730.7	IV	10.109	10.174	10.188
	31	.246	RG	+ 5.8	+ 6.0	+ 6.2	739.0	III	10.042	10.051	10.046
IV	7	.265	RG	+12.5	+11.0	+11.2	737.0	III	—	10.107	10.107
	8	.268	MD	+11.0	+11.0	+11.0	738.2	III	10.211	10.254	
		.268	MD	+ 9.8	+ 9.4	+ 9.5	737.9	IV	10.109	10.218	10.198
	9	.270	LD	+10.6	+10.8	+10.6	737.2	III	9.982	10.073	
		.271	LD	+10.0	+ 9.6	+ 9.8	737.4	IV	9.979	10.246	10.070
	14	.284	MD	+ 5.0	+ 6.9	+ 6.0	741.6	III	—	10.115	
		.284	MD	+ 3.3	+ 4.7	+ 4.0	742.2	IV	10.279	10.336	10.243
	15	.287	VM	+ 4.5	+ 3.8	+ 3.4	742.8	IV	10.136	10.068	10.102
	16	.290	LD	+ 6.7	+ 5.7	+ 6.0	738.0	IV	10.125	10.170	10.148
	18	.295	MD	+ 8.6	+ 8.6	+ 8.3	745.1	IV	10.187	10.151	10.169
	20	.301	LD	+ 8.1	+ 8.8	+ 8.1	744.0	III	—	10.185	
		.301	LD	+ 6.8	+ 7.0	+ 6.8	743.8	IV	10.052	10.159	10.132
	21	.304	MD	+12.0	+10.0	+ 9.8	744.4	IV	10.107	10.283	
		.304	MD	+11.4	+ 9.0	+ 9.1	744.5	V	10.234	—	10.208
V	7	.348	LD	+10.7	+12.3	+11.7	739.6	IV	—	10.194	10.194
	9	.353	MD	+12.9	+12.6	+12.4	744.2	IV	10.171	10.171	10.171
	10	.356	VM	+17.2	+16.0	+15.2	743.1	IV	10.118	—	10.118
	11	.358	LD	+17.4	+16.4	+16.6	743.6	IV	10.076	10.070	
		.359	LD	+14.6	+14.2	+14.2	743.2	V	—	10.132	10.093
	12	.361	VM	+17.4	+16.7	+16.8	741.5	IV	10.211	—	
		.362	VM	+14.0	+13.8	+13.6	741.3	V	10.141	10.131	10.161
	13	.364	MD	+16.9	+15.8	+15.7	738.9	IV	10.217	10.132	
		.364	MD	+15.4	+14.2	+14.4	738.6	V	10.145	10.150	10.161
	14	.366	LD	+20.0	+17.8	+17.5	737.4	IV	10.320	10.225	
		.367	LD	+15.3	+15.3	+15.2	737.1	V	—	10.180	10.242
	17	.375	MD	+15.7	+17.6	+17.2	738.1	V	10.216	10.219	10.218
	18	.378	LD	+16.1	+16.8	+16.8	738.4	V	10.267	10.310	10.288
	25	.396	LD	+19.1	+18.6	+17.8	733.9	IV	10.093	—	10.093
VI	3	.422	MD	+15.3	+16.4	+15.9	738.5	V	10.328	10.328	10.328
	11	.443	LD	+20.4	+21.3	+20.8	733.3	IV	—	10.138	
		.444	LD	+18.2	+19.2	+18.8	733.3	V	10.362	10.381	10.294
	14	.452	MD	+15.8	+16.4	+16.2	738.6	V	10.423	10.305	10.364
	15	.454	LD	+21.2	+21.5	+21.2	736.1	V	10.324	—	10.324
	24	.479	MD	+17.4	+17.8	+17.7	737.0	V	10.281	—	10.281
	28	.490	MD	+17.4	+18.0	+17.2	737.1	V	10.324	10.311	10.318
VII	8	.517	MD	+17.2	+18.3	+17.8	742.5	V	10.451	10.396	10.424
	9	.520	LD	+20.8	+20.0	+19.8	740.5	V	10.358	10.308	10.333
	10	.523	MD	+20.0	+19.4	+18.8	742.5	V	10.307	10.426	10.366
	12	.528	MD	+23.6	+22.0	+21.6	741.5	V	10.337	10.405	
		.528	MD	+21.2	+20.3	+20.2	741.2	VI	10.415	10.501	10.414
	16	.539	LD	+21.6	+21.2	+21.1	738.7	V	10.261	—	10.261
	17	.542	VM	+25.4	+23.3	+24.2	736.1	VI	10.324	—	10.324
	22	.556	LD	+13.9	+16.0	+14.7	739.7	VI	10.319	—	10.319
	25	.564	LD	+19.9	+20.0	+19.4	744.0	V	10.325	10.280	10.302
	27	.569	LD	+21.4	+21.4	+20.8	741.0	V	10.488	10.394	
		.570	LD	+18.8	+19.3	+18.8	740.6	VI	10.485	—	10.456
VIII	19	.632	MD	+18.4	+18.6	+18.4	742.8	VI	10.535	10.539	10.537

DATE		τ	OBS.	T_z	T_i	T_v	B_0	GR.	φ_a	φ_b	φ_d
									″	″	″
1971											
	20	1971.634	VM	+20.9	+20.5	+20.6	740.2	V	10.489	10.499	
		.635	VM	+18.6	+18.2	+18.3	740.1	VI	—	10.464	10.484
	21	.638	MD	+19.2	+19.6	+19.3	739.1	VI	10.556	10.529	10.542
	26	.651	MD	+20.8	+20.8	+20.4	739.5	V	—	10.370	
		.651	MD	+21.1	+20.2	+20.3	739.0	VI	10.581	10.527	10.493
	28	.657	VM	+17.6	+18.0	+17.4	742.0	VI	10.416	—	10.416
	29	.659	MD	+17.1	+18.0	+17.6	739.3	V	—	10.563	10.563
	30	.662	VM	+19.9	+20.7	+20.0	736.5	V		10.503	
		.662	VM	+18.1	+18.6	+18.4	735.9	VI	10.538	10.539	10.527
IX	3	.673	LD	+15.4	+16.4	+15.9	745.8	VI	10.582	10.662	
		.674	LD	+12.8	+14.2	+13.6	745.7	I	10.610	10.614	10.617
	4	.676	MD	+17.8	+17.4	+17.4	744.0	VI	10.597	10.638	
		.676	MD	+15.7	+16.1	+16.0	743.4	I	10.678	10.692	10.651
	9	.690	MD	+ 8.6	+10.0	+ 9.3	739.6	VI	—	10.599	
		.690	MD	+ 7.9	+ 9.4	+ 8.9	739.6	I	10.758	—	10.678
	12	.698	VM	+14.6	+15.3	+14.8	739.1	VI	10.654	10.636	10.645
	21	.722	LD	+13.8	+12.9	+12.5	750.0	VI	10.771	10.630	
		.723	LD	+13.4	+11.9	+11.9	750.1	I	10.579	10.790	10.692
	22	.725	VM	+12.7	+13.5	+13.2	748.8	VI	10.622	10.665	
		.726	VM	+11.4	+11.8	+11.6	748.0	I	10.567	10.703	10.639
	23	.728	MD	+12.4	+12.6	+12.4	745.5	VI	10.790	10.753	
		.728	MD	+11.0	+11.4	+11.4	744.6	I	10.653	10.609	10.701
	24	.731	LD	+12.4	+13.2	+13.0	743.4	VI	10.723	10.598	
		.731	LD	+11.5	+11.4	+11.4	743.1	I	10.639	10.698	10.664
	26	.736	MD	+13.2	+13.6	+13.8	742.0	I	10.677	10.645	10.661
	27	.739	VM	+16.0	+15.0	+15.2	741.4	VI	10.664	10.550	
		.739	VM	+15.3	+14.3	+14.4	740.8	I	10.575	10.687	10.619
X	2	.752	MD	+14.0	+13.8	+13.6	747.6	VI	10.770	10.737	10.754
	4	.758	MD	+15.6	+15.4	+15.3	738.0	VI	10.749	—	10.749
	5	.761	LD	+ 6.1	+ 8.3	+ 6.7	748.0	VI	10.664	—	
		.761	LD	+ 2.3	+ 4.4	+ 3.4	750.2	I	10.661	10.749	10.691
	8	.769	LD	+14.2	+10.6	+11.6	746.0	VI	10.598	10.612	
		.769	LD	+13.3	+10.2	+10.8	745.6	I	10.667	10.702	10.645
	10	.774	MD	+13.4	+12.7	+12.4	744.9	VI	10.584	10.670	
		.775	MD	+11.4	+11.0	+11.0	745.0	I	10.664	10.763	10.670
	11	.777	VM	+13.4	+12.5	+12.4	745.3	VI	10.697	10.769	
		.778	VM	+12.9	+11.6	+11.9	744.8	I	10.797	10.760	10.756
	12	.780	LD	+16.6	+14.2	+14.4	742.2	VI	10.735	10.710	
		.780	LD	+14.8	+12.9	+13.0	741.8	I	10.683	10.676	10.701
	13	.782	MD	+16.0	+15.4	+15.1	740.3	VI	10.567	10.654	10.610
	14	.785	MD	+18.0	+17.0	+17.3	735.9	VI	10.736	10.678	
		.786	MD	+16.0	+15.6	+15.7	735.3	I	10.598	10.578	10.648
	19	.799	LD	+ 7.6	+ 7.5	+ 7.4	750.2	VI	10.584	10.611	
		.799	LD	+ 7.3	+ 6.5	+ 6.8	748.8	I	—	10.754	10.650
	20	.802	VM	+11.7	+ 9.7	+ 9.8	746.6	VI	10.647	10.688	
		.802	VM	+11.3	+ 9.0	+ 9.0	746.3	I	10.694	10.585	10.654
	22	.807	LD	+11.2	+10.5	+10.6	745.7	VI	10.698	10.549	
		.808	LD	+11.1	+11.0	+10.5	744.4	I	10.759	10.776	10.696
	23	.810	VM	+15.2	+13.8	+14.3	745.2	VI	10.605	10.681	
		.810	VM	+10.8	+11.2	+10.9	747.0	I	10.637	10.734	10.664
	24	.812	MD	+10.8	+10.4	+10.2	748.6	VI	10.642	10.529	
		.813	MD	+11.4	+ 9.8	+10.0	748.0	I	10.646	10.652	10.617
	26	.818	LD	+ 7.9	+ 9.7	+ 9.0	748.2	VI	10.605	—	10.605
	28	.824	MD	− 0.6	+ 2.6	+ 1.3	751.8	I	10.658	10.722	10.690
	29	.826	LD	+ 0.6	+ 1.0	+ 0.0	751.2	I	10.596	10.647	10.622
XI	5	.846	LD	+14.0	+ 9.8	+11.4	741.2	I	10.532	10.489	
		.846	LD	+12.0	+ 9.5	+10.3	740.0	II	10.581	10.563	10.541
	6	.848	VM	+14.6	+12.1	+13.1	738.9	I	10.592	10.552	
		.849	VM	+11.9	+10.8	+11.0	738.9	II	10.697	10.629	10.618
	8	.854	MD	+13.3	+12.0	+12.6	738.2	I	10.564	10.551	
		.854	MD	+13.4	+11.6	+12.4	737.5	II	—	10.606	10.574
	11	.862	MD	+10.4	+10.6	+10.2	734.5	I	10.781	10.618	
		.862	MD	+11.0	+ 9.5	+10.2	734.6	II	10.569	—	10.656
	15	.874	MD	+ 1.4	+ 3.8	+ 2.9	744.7	III	10.534	—	10.534
	27	.906	VM	+ 1.7	+ 1.4	+ 1.3	742.8	I	10.645	10.500	
		.906	VM	+ 1.6	+ 0.9	+ 1.2	741.0	II	10.458	10.542	10.536
XII	7	.933	LD	+ 1.0	+ 1.9	+ 1.4	747.1	I	—	10.490	
		.934	LD	+ 0.1	+ 0.3	− 0.1	746.6	II	—	10.557	10.524
	10	.941	LD	− 5.9	− 4.2	− 5.4	740.8	I	10.659	10.688	10.674
	15	.955	VM	+ 5.1	+ 3.7	+ 3.8	750.2	I	10.584	10.631	

DATE		τ	OBS.	T_z	T_i	T_v	B_0	GR.	φ_a	φ_b	φ_d
1971									″	″	″
		.955	VM	+4.2	+3.2	+3.4	750.0	II	10.647	10.575	10.609
XII	22	.974	VM	+8.2	+5.8	+7.4	747.2	I	10.498	10.498	
		.975	VM	+10.2	+6.0	+7.2	745.8	II	—	10.556	10.517
	23	.977	MD	+10.2	+7.6	+8.4	740.6	I	10.483	10.469	
		.977	MD	+6.7	+6.7	+6.8	742.1	II	10.338	—	10.430
1972											
II	2	1972.089	RG	−7.6	−5.9	−6.6	746.3	II	—	10.462	10.462
	3	.092	MD	−5.9	−5.4	−6.0	744.4	II	10.537	10.512	10.524
	5	.097	RG	−5.2	−4.4	−4.9	742.1	II	10.292	10.428	10.360
	17	.130	MD	+3.2	+3.0	+3.0	743.4	II	10.469	10.436	
		.130	MD	+1.4	+1.2	+1.2	743.7	III	10.276	10.490	10.418
	18	.133	LD	+2.6	+2.6	+2.4	743.8	II	10.417	10.369	10.393
	20	.138	RG	+1.6	+2.6	+2.4	743.1	II	10.341	—	10.341
	26	.155	RG	+4.8	+4.7	+4.7	737.8	II	10.297	10.277	
		.155	RG	+3.0	+3.2	+3.2	738.0	III	10.276	—	10.283
III	1	.166	RG	+4.1	+5.2	+4.6	740.2	II	—	10.270	
		.166	RG	+2.8	+3.2	+2.8	740.2	III	10.275	10.294	10.280
	4	.174	RG	+1.4	+2.5	+1.9	736.8	III	10.162	10.197	10.180
	13	.199	LD	−3.4	−2.8	−3.4	753.2	III	10.147	10.263	
		.199	MD	−4.0	−3.4	−3.8	752.7	IV	10.264	10.510	10.296
	14	.202	RG	+3.3	+1.4	+1.8	749.0	III	10.156	10.359	
		.202	RG	+1.6	+0.5	+0.6	748.2	IV	10.447	10.257	10.305
	15	.204	MD	+7.2	+5.8	+6.2	746.5	III	10.183	10.443	
		.205	MD	+5.4	+4.4	+4.6	746.2	IV	10.392	10.345	10.341
	17	.210	MD	+10.3	+8.8	+9.5	746.2	III	10.219	10.340	10.280
	19	.215	RG	+3.4	+4.7	+4.0	744.2	III	10.168	10.362	10.265
	20	.218	LD	+6.8	+6.6	+6.0	742.2	III	10.292	—	
		.218	LD	+5.0	+4.2	+4.4	741.8	IV	10.128	10.304	10.241
	21	.221	MD	+9.9	+7.8	+8.0	740.2	IV	—	10.355	10.355
	25	.232	RG	+6.5	+5.3	+5.1	742.1	III	10.135	10.225	10.180
	30	.245	LD	+12.6	+10.6	+10.6	740.8	III	10.132	10.170	10.151
	31	.248	MD	+15.8	+15.1	+14.9	740.0	III	10.142	—	10.142
IV	2	.254	RG	+6.2	+7.4	+6.8	744.0	IV	10.221	—	10.221
	3	.256	LD	+15.6	+13.1	+14.4	737.3	III	10.013	10.097	10.055
	4	.259	MD	+14.8	+14.0	+14.0	734.8	IV	—	10.218	10.218
	5	.262	RG	+18.6	+17.4	+17.4	732.2	III	10.212	10.130	10.171
	7	.268	MD	+10.9	+11.3	+11.7	739.0	IV	10.173	—	10.173
	8	.270	RG	+17.1	+15.2	+15.6	735.0	III	10.144	—	
		.270	RG	+15.4	+14.0	+14.4	734.6	IV	10.206	10.207	10.186
	10	.275	LD	+13.7	+13.0	+12.6	731.4	III	10.184	10.053	10.118
	22	.308	RG	+9.5	+10.8	+9.8	737.0	IV	10.282	10.182	10.232
	29	.328	RG	+6.3	+7.7	+6.7	737.0	IV	10.139	—	10.139
V	6	.347	RG	+11.4	+11.8	+11.6	736.7	IV	10.200	10.123	
		.347	RG	+11.2	+10.7	+10.7	736.6	V	10.119	10.182	10.156
	7	.350	MD	+11.8	+13.2	+12.9	737.6	IV	—	10.186	10.186
	8	.352	LD	+14.2	+13.4	+13.4	739.0	IV	10.100	10.139	
		.353	LD	+12.3	+12.2	+12.3	739.0	V	10.112	10.124	10.119
	17	.374	RG	+15.2	+16.8	+15.6	739.9	IV	10.235	—	10.235
	22	.390	LD	+15.6	+15.8	+15.1	742.1	IV	10.245	10.234	
		.391	LD	+13.8	+14.0	+13.6	742.1	V	10.217	10.293	10.247
	23	.393	MD	+16.2	+16.2	+15.7	743.0	IV	10.167	10.368	
		.394	MD	+16.2	+14.7	+14.6	743.1	V	10.193	10.211	10.235
	24	.396	RG	+19.5	+18.2	+17.4	743.1	IV	10.309	10.206	
		.396	RG	+18.4	+16.4	+16.6	742.9	V	10.104	10.094	10.178
	25	.398	LD	+21.4	+20.4	+19.7	743.0	IV	10.121	—	10.121
	26	.401	MD	+22.2	+22.2	+21.5	739.5	IV	10.105	—	10.105
	29	.410	LD	+13.7	+13.4	+13.4	741.6	IV	—	10.042	
		.410	LD	+11·6	+11.8	+11.1	741.7	V	—	10.072	10.057
	30	.412	MD	+17.8	+17.0	+16.4	740.0	IV	10.247	10.195	
		.413	MD	+16.2	+14.8	+14.6	739.6	V	10.255	10.265	10.240
	31	.415	RG	+18.6	+18.0	+17.9	738.1	IV	—	10.166	
		.416	RG	+18.2	+17.0	+17.1	737.7	V	10.250	10.157	10.191
VI	5	.429	LD	+16.0	+17.2	+16.8	741.8	V	10.189	10.224	10.206
	6	.432	MD	+19.8	+20.0	+20·0	741.6	IV	10.128	10.134	
		.432	MD	+17.0	+18.2	+17.8	742.0	V	10.235	—	10.166
	7	.434	RG	+18.6	+19.1	+18.3	741.0	IV	10.190	10.184	
		.434	RG	+16.8	+16.6	+16.4	740.4	V	10.157	10.079	10.152
	8	.437	LD	+21.4	+19.9	+19.1	738.2	IV	—	10.131	
		.437	LD	+18.9	+18.1	+17.8	737.2	V	—	10.123	10.127
	9	.440	MD	+22.3	+22.0	+21.6	736.9	IV	—	10.147	

DATE		τ	OBS.	T_z	T_i	T_r	B_0	GR.	φ_a	φ_b	φ_d
									″	″	″
1972		.440	MD	+19.8	+19.7	+19.2	736.4	V	10.263	10.258	10.223
	15	.456	LD	+22.8	+23.3	+23.0	735.7	V	—	10.132	10.132
	17	.462	RG	+18.2	+20.9	+19.4	736.8	V	10.106	10.192	10.149
	21	.473	RG	+17.2	+18.4	+17.4	742.8	V	10.184	10.166	10.175
	25	.484	RG	+13.0	+15.2	+14.0	741.2	V	10.173	10.178	10.176
	26	.486	LD	+14.3	+15.7	+14.7	739.0	V	10.206	10.235	10.220
	28	.492	RG	+16.0	+17.2	+16.6	736.0	V	—	10.227	
		.492	RG	+15.9	+16.4	+16.1	735.5	VI	10.336	—	10.282
	29	.495	LD	+21.2	+20.7	+20.4	734.3	V	10.165	10.052	10.108
VII	2	.503	RG	+16.4	+18.1	+17.0	738.0	V	10.309	10.269	10.289
	5	.511	RG	+18.2	+17.8	+17.3	737.8	V	10.232	10.196	10.214
	8	.519	RG	+21.2	+21.3	+21.0	742.1	V	10.225	—	10.225
	10	.525	RG	+21.2	+22.2	+21.6	736.5	V	10.248	10.333	10.290
	16	.541	RG	+22.8	+21.8	+21.3	737.2	V	10.391	—	10.391
	18	.547	MD	+19.1	+20.6	+19.8	735.0	V	—	10.285	
		.547	MD	+18.1	+19.4	+19.0	736.2	VI	10.151	—	10.218
	19	.549	RG	+20.0	+21.1	+20.3	736.6	V	10.193	—	10.193
	20	.552	MD	+17.3	+20.4	+18.8	737.1	VI	10.164	—	10.164
	30	.579	MD	+19.8	+20.0	+19.4	738.5	V	—	10.171	10.171
VIII	9	.606	MD	+23.8	+23.0	+22.3	742.1	V	10.175	10.267	
		.607	MD	+21.8	+21.1	+20.6	742.4	VI	10.313	—	10.252
	11	.612	MD	+25.1	+24.8	+24.3	741.3	V	10.198	10.187	
		.612	MD	+22.2	+22.2	+21.6	741.7	VI	10.333	—	10.239
	14	.621	MD	+22.0	+22.4	+21.6	740.5	VI	—	10.271	10.271
	27	.656	MD	+15.4	+16.0	+15.3	741.4	V	—	10.301	
		.656	MD	+15.3	+14.7	+14.3	741.2	VI	10.390	—	10.346
IX	1	.670	MD	+13.4	+14.2	+13.7	743.0	VI	10.379	10.338	10.358
	6	.684	RG	+15.6	+16.6	+16.0	742.4	VI	10.471	10.462	10.466
	7	.686	LD	+18.6	+18.3	+18.3	741.6	VI	10.549	10.584	10.566
	14	.705	RG	+11.0	+10.8	+10.2	738.8	VI	10.513	10.447	
		.706	RG	+10.6	+10.0	+10.0	737.9	I	10.563	—	10.508
	18	.716	RG	+12.8	+13.2	+12.8	742.3	VI	10.485	—	10.485
	22	.727	LD	+12.6	+13.2	+12.8	744.2	VI	10.510	10.563	
		.728	LD	+10.2	+11.4	+11.1	740.9	I	—	10.524	10.532
	25	.736	RG	+ 7.3	+ 8.4	+ 7.9	739.9	VI	10.573	10.440	10.506
	28	.744	RG	+ 7.9	+ 9.0	+ 8.2	741.0	VI	10.529	10.524	10.526
X	15	.790	MD	+ 6.2	+ 7.3	+ 6.6	744.8	I	10.388	10.362	10.375
	17	.796	MD	+ 6.8	+ 7.6	+ 6.6	745.9	VI	—	10.519	10.519
	24	.815	MD	+ 8.8	+ 7.0	+ 7.9	744.9	I	—	10.442	10.442
	25	.817	RG	+ 9.4	+ 7.7	+ 7.6	745.2	VI	10.498	10.507	
		.818	RG	+ 8.7	+ 6.9	+ 7.2	745.2	I	10.535	10.516	10.514
	26	.820	LD	+12.0	+ 9.1	+10.0	746.6	VI	10.715	10.730	
		.820	LD	+ 9.0	+ 8.0	+ 8.1	746.4	I	10.654	10.601	10.675
	27	.823	MD	+ 9.1	+ 8.6	+ 8.7	743.4	VI	10.435	10.551	
		.823	MD	+ 7.6	+ 7.1	+ 7.1	742.6	I	10.628	10.369	10.496
	31	.834	MD	+ 9.1	+ 9.3	+ 9.0	745.0	VI	10.500	10.428	
		.834	MD	+ 7.3	+ 7.3	+ 7.0	745.5	I	10.611	10.361	10.475
XI	1	.836	RG	+ 8.6	+ 8.7	+ 8.2	746.0	VI	10.567	10.708	
		.837	RG	+ 8.2	+ 7.4	+ 7.2	746.4	I	10.570	10.474	10.580
	4	.845	RG	+ 9.2	+ 8.2	+ 8.1	746.2	I	10.668	10.518	10.593
	7	.853	MD	+11.0	+10.0	+10.1	746.4	I	10.557	—	10.557
	8	.856	RG	+12.0	+10.6	+10.2	744.9	I	10.731	10.658	10.694
	9	.859	LD	+ 9.9	+ 8.2	+ 8.4	745.9	I	—	10.714	10.714
	12	.867	RG	+ 2.8	+ 4.8	+ 3.8	737.8	I	10.647	10.535	10.591
	28	.911	MD	+ 1.4	+ 1.0	+ 1.2	745.7	I	—	10.485	
		.911	MD	+ 1.4	+ 0.4	+ 0.7	745.4	II	10.503	—	10.494
XII	3	.924	RG	+ 5.4	+ 6.0	+ 6.0	743.0	I	10.606	10.615	10.610
	4	.927	LD	+11.8	+ 8.2	+ 9.4	744.6	I	10.558	10.491	10.524
	20	.971	RG	− 4.0	− 3.1	− 3.4	757.2	I	10.503	10.536	
		.971	RG	− 4.8	− 3.9	− 4.2	757.0	II	10.535	10.614	10.547
	21	.974	LD	− 4.6	− 5.0	− 5.3	757.0	I	10.561	10.503	10.532
	23	.979	RG	− 1.8	− 2.2	− 2.1	751.9	I	10.500	—	10.500
	28	.992	RG	− 6.2	− 5.3	− 5.6	752.2	I	10.601	10.524	10.562
	29	.995	MD	− 6.4	− 5.5	− 6.2	753.5	I	—	10.521	10.521

OBSERVATIONS A LA LUNETTE ZENITHALE (DE 110 mm) DU SERVICE DE LATITUDE DE L'OBSERVATOIRE DE BELGRADE 1973

par *R. GRUJIĆ, M. DJOKIĆ, L. DJUROVIĆ*

DATE		τ	OBS.	T_z	T_i	T_v	B_0	GR.	φ_a	φ_b	φ_d
1973										44°48′+	
I	13	1973.036	RG	− 2.0	− 2.1	− 2.2	750.2	I	—	10″442	10″442
	14	.039	MD	− 2.6	− 3.8	− 3.9	744.8	II	10.482	10.425	10.454
	20	.056	RG	1.2	0.8	1.0	738.5	II	10.521	—	10.521
	25	.070	LD	− 5.6	− 5.2	− 5.3	751.7	II	—	10.528	10.528
	26	.072	MD	− 7.4	− 6.0	− 7.2	744.9	II	10.277	10.526	10.402
II	6	.102	RG	0.4	0.7	0.5	743.6	III	10.376	10.433	10.404
	8	.108	LD	7.3	5.4	5.5	739.9	III	10.291	—	10.291
	12	.118	LD	0.0	− 0.7	− 1.2	736.4	II	10.511	10.576	
		.119	RG	− 0.8	− 1.4	− 1.8	735.0	III	10.255	10.331	10.418
	19	.138	LD	1.1	0.9	0.3	741.0	II	10.445	—	
		.138	RG	0.2	− 1.0	− 1.0	742.0	III	10.375	10.295	10.372
III	17	.209	RG	2.3	1.8	1.8	741.6	III	10.250	10.345	
		.210	RG	1.6	0.9	1.0	739.2	IV	10.255	10.351	10.300
	22	.223	LD	6.6	5.4	5.9	747.8	III	10.304	10.271	
		.223	LD	6.5	4.2	4.7	747.4	IV	10.336	10.315	10.306
	23	.226	MD	9.8	7.1	7.0	744.8	III	10.302	10.191	
		.226	MD	9.0	5.6	5.9	744.3	IV	10.215	10.233	10.235
	31	.247	RG	10.6	9.7	9.4	737.8	III	10.142	10.301	
		.248	RG	9.6	8.0	8.0	738.1	IV	10.323	10.306	10.268
IV	2	.253	LD	14.0	12.6	13.3	733.6	III	10.311	10.272	
		.253	LD	11.8	11.2	11.4	732.4	IV	10.296	10.288	10.292
	7	.266	RG	12.0	10.8	11.1	733.6	III	10.223	10.371	
		.267	RG	10.3	9.4	9.7	733.3	IV	10.172	—	10.255
	17	.294	MD	7.3	7.0	7.1	739.5	IV	10.239	—	10.239
	18	.296	RG	6.1	7.0	6.3	737.6	III	10.209	10.261	10.235
	22	.308	RG	7.1	6.1	5.9	739.7	IV	10.169	10.166	10.168
	27	.322	MD	10.2	8.9	8.4	739.8	IV	10.192	10.287	10.240
V	13	.365	RG	8.6	10.0	9.6	745.4	IV	—	10.167	
		.366	RG	8.0	9.2	9.0	745.0	V	10.191	—	10.179
	14	.368	MD	17.2	12.1	12.0	743.3	IV	10.095	10.113	10.104
	15	.371	RG	11.4	13.6	13.2	740.8	IV	—	10.232	10.232
	17	.376	RG	7.4	8.0	7.6	743.0	IV	10.104	10.190	10.147
	21	.387	MD	21.4	19.4	19.0	737.6	IV	10.076	10.138	10.107
	22	.390	RG	20.2	20.0	19.3	740.0	IV	10.200	10.111	10.156
	24	.395	RG	18.9	19.4	18.7	741.2	IV	10.122	—	10.122
	29	.409	RG	16.5	15.9	15.8	736.7	IV	10.091	10.263	
		.409	RG	13.2	13.0	12.5	736.6	V	10.237	10.168	10.190
	30	.412	MD	17.4	17.2	16.7	736.8	IV	—	10.142	10.142
VI	1	.417	MD	20.0	19.2	18.4	739.4	IV	9.989	10.003	
		.418	MD	18.9	17.6	18.0	739.6	V	10.236	10.124	10.088
	12	.448	RG	15.5	16.0	15.4	742.9	V	10.132	10.293	10.212
	13	.450	MD	18.6	19.8	19.2	741.4	IV	—	10.171	
		.450	MD	17.4	18.0	17.4	741.0	V	10.092	10.181	10.148
	16	.458	RG	10.8	12.7	11.7	741.7	V	10.156	—	10.156
	22	.475	MD	18.8	19.0	19.2	737.2	V	10.235	10.080	10.158
VII	5	.510	RG	17.6	19.2	18.4	737.0	V	10.095	10.184	10.140
	6	.513	MD	22.4	21.4	21.1	737.7	V	10.023	10.164	10.094
	10	.524	RG	18.5	20.2	19.2	738.4	V	10.187	10.212	10.200
	12	.530	RG	19.4	19.9	19.1	736.0	V	10.214	10.114	10.164
	16	.540	RG	25.8	24.4	24.2	736.6	V	10.204	10.193	10.198
	19	.548	RG	20.3	22.6	21.2	735.2	V	10.243	—	10.243
	21	.554	RG	24.5	23.5	23.7	737.3	V	10.111	10.195	10.153
	31	.581	RG	19.1	19.4	18.7	741.2	V	10.277	10.346	10.312
VIII	1	.584	RG	18.8	18.4	18.1	741.6	VI	10.301	—	10.301
	21	.639	MD	22.8	22.2	21.8	741.6	VI	10.339	10.222	10.280
IX	2	.672	RG	17.0	17.7	17.4	743.0	VI	10.383	10.309	10.346
	4	.678	RG	20.8	20.4	20.0	743.4	VI	10.416	10.427	10.422
	7	.686	MD	22.4	21.4	21.0	743.3	VI	10.221	—	10.221
	9	.691	MD	23.6	22.5	22.7	738.8	VI	10.314	10.308	10.311
	11	.697	RG	12.4	16.0	13.9	743.8	VI	10.513	10.493	10.503
	12	.699	MD	12.0	13.9	12.8	742.3	VI	10.375	—	10.375
	15	.707	RG	15.4	16.0	15.2	744.3	VI	10.430	—	10.430
	16	.710	MD	17.7	16.2	16.1	741.2	VI	10.261	10.354	10.308

DATE		τ	OBS.	T_z	T_i	T_v	B_0	GR.	φ_a	φ_b	φ_d
1973											
	20	1973.721	RG	13.1	13.7	13.8	740.4	VI	10″398	10″425	
		.722	RG	11.4	12.8	12.4	738.7	I	—	10.340	10″388
	25	.735	RG	14.7	16.8	15.9	741.7	VI	—	10.270	10.270
	29	.746	RG	12.5	13.3	13.0	737.2	VI	10.358	10.337	
		.746	RG	12.3	12.6	12.8	736.6	I	10.426	10.217	10.334
X	5	.762	MD	10.3	11.2	10.6	747.0	VI	10.318	10.344	
		762	MD	8.6	9.3	8.8	746.8	I	10.358	10.292	10.328
	10	.776	MD	11.3	12.3	12.0	740.5	VI	—	10.437	10.437
	11	.778	RG	15.3	13.5	13.8	736.6	VI	10.202	10.309	
		.779	RG	12.6	12.3	12.3	736.8	I	10.273	10.460	10.311
	19	.801	MD	6.4	7.0	7.0	740.8	I	—	10.298	10.298
	23	.811	RG	4.9	5.4	4.6	744.5	VI	10.406	—	10.406
	26	.820	MD	2.1	3.6	2.7	751.6	VI	10.491	10.506	10.498
	27	.822	RG	3.1	3.9	3.4	749.6	VI	10.367	10.432	
		.823	RG	1.1	2.4	2.0	749.4	I	10.465	10.550	10.454
XI	1	.836	RG	− 2.8	− 0.5	1.6	750.2	I	10.444	10.535	10.490
	10	.861	RG	4.0	3.4	3.4	743.4	I	10.488	10.338	10.413
	18	.883	RG	1.9	1.5	1.1	750.4	I	10.521	10.402	10.462
	19	.886	MD	8.4	5.3	7.0	742.1	I	10.363	10.444	
		.886	MD	8.4	6.2	7.5	739.6	II	—	10.290	10.366
	20	.888	RG	3.2	3.4	3.1	746.4	I	10.429	10.357	10.393
	23	.896	MD	6.8	4.8	5.5	744.3	I	10.547	—	10.547
XII	6	.932	RG	4.0	2.0	2.4	738.7	I	10.323	—	10.323
	10	.943	MD	− 7.4	− 5.6	− 6.8	752.4	I	10.517	10.436	
		.943	RG	− 7.9	− 6.7	− 7.4	752.5	II	10.421	10.354	10.432
	16	.959	RG	− 1.3	− 1.5	− 1.2	738.3	I	10.585	—	10.585
	20	.970	RG	7.1	5.4	6.4	740.0	I	10.485	—	
		.970	MD	6.8	5.3	6.0	739.5	II	10.444	10.500	10.476
	23	.979	RG	9.8	7.8	8.6	741.2	II	10.418	10.322	10.370

LA LÉGENDE:

Date : Année, mois et date d'observation.
τ : Partie d'année tropique.
Obs : Observateurs R. Grujić (RG), M. Djokić (MD), L. Djurović (LD).
T_z : Température à l'abri météorologique éloigné 50 m de l'instrument.
T_i : Témpérrature de l'instrument.
T_v : Température de l'air dans la salle d'observation (valeur moy. des états des thermométres sud et nord).
B_0 : L'états du baromètre en mm Hg (la température du baromètre est réduite).
GR : Nombre de la groupe.
$\varphi a, \varphi b$: La latitude de la sous-groupe a, resp. le.
φ_d : La valeur moy. de la latitude pour une nuit.

Les valeurs observées de φ sont reduites à la manière déjâ signalée (voir de Bulletin, Vol. XXIV, N°s 3—4, p. 19, 1954), mais sans tenir compte des erreurs progréssives et périodiques (voir de Bulletin, Vol. XXVII, N° 2, p. 159, 1970). Les réductions ont été faites dans le système FK4 et on a appliqués les corrections convenables des déclinaisons (voir ce Bulletin, Vol. XXIX, N° 2).

La valeur du tour de la vis micrométrique adoptée était: $R = 40''.0481$.

OCCULTATIONS OF STARS BY THE MOON, OBSERVED AT THE BELGRADE ASTRONOMICAL OBSERVATORY, 1972—1973

M. B. PROTITCH and V. PROTIĆ-BENIŠEK

Next table presents the occultations of stars by the Moon, observed at the Belgrade Astronomical Observatory during 1972. and 1973. with Askania refractor 135/1600 (standard magnification 128 *x*).

The observations were carried out on the basis of the preliminary data, that H. M. Nautical Almanac Office — England prepared (published in Bulletin de l'Observatoire Astronomique de Beograd, Vol. XXIV, N° 125, 1972/73).

Time was registrated by chronograph, using the clock R 507 which has been compared twice per day (station FTK 77).

Personal equation has been applied to the timing data which H. M. Nautical Almanac Office used for obtaining (O—C).

1972

Date	Star ZC	Phen.	UTC	O−C	Remarks
Jan. 25	647	DD	$22^h04^m58^s.80$	−1″.35	(3)
Mar. 19	537	DD	19 26 53 .40	+0 .93	(4−5)
Mar. 19	536	DD	19 37 15 .10	+0 .47	(4−5)
Mar. 19	Anonyme+	DD	19 51 00 .10	+0 .48	(2)
Mar. 19	545	DD	20 05 44 .20	+0 .85	(3−4)
Mar. 19	546	DD	20 11 03 .20	+3 .85	(4)
Mar. 19	552	DD	20 29 19 .30	+0 .86	(4)
Mar. 19	551	DD	20 34 55 .30	+0 .61	(3)
Mar. 19	553	DD	20 37 01 .30	+0 .85	(3−4)
Mar. 19	557	DD	21 04 49 .10	+1 .29	(3)
Mar. 19	561	DD	21 07 55 .30	+0 .31	(3)
Mar. 19	560	DD	21 08 03 .60	+0 .50	(4)
Mar. 19	552	RB	21 22 46 .00	+0 .76	(3)
Mar. 20	717	DD	18 40 00 .60	+0 .63	(3−4)
Mar. 22	1041	DD	18 28 14 .20	+2 .82	(2)
May 17	1227	DD	19 30 51 .60	+0 .69	(5)
June 21	2027	DD	21 05 30 .30	+0 .02	(3−4)
Dec. 24	1409	RD	00 05 45 .50	−0 .54	(3)

1973

Date	Star ZC	Phen.	UTC	O−C	Remarks
Jan. 14	550	DD	$21^h30^m50^s.24$	+0.″70	(2)
Jan. 14	556	DD	21 47 16 .25	−0 .14	(3)
Jan. 14	559	DD	22 22 27 .05	+0. 33	(4)
Jan. 14	564	DD	22 24 00 .46	+0 .49	(3)
Jan. 14	567	DD	22 44 45 .93	+0 .38	(3)
Apr. 06	584	DD	19 42 05 .55	−0 .26	(4)
Apr. 07	740	DD	17 49 30 .76	+0 .46	(4)
Apr. 08	923	DD	20 47 35 .91	+0 .47	(4)
Apr. 14	1670	DD	22 18 50 .88	−0 .10	(3)
June 07	1605	DD	20 58 44 .16	+0 .85	(3)
June 13	2269	DD	20 04 23 .65	−0 .10	(2)
Jul. 10	2237	DD	20 14 00 .09	−0 .96	(3)
Jul. 11	2371	DD	18 45 01 .76	−0 .88	(3)
Aug. 20	472	DB	22 32 12 .70	−0 .06	(4)
Oct. 05	2908	DD	18 27 44 .86	+0 .00	(3)
Nov. 12	664	RD	00 12 17 .54	+0 .74	(2)
Dec. 11	1077	RD	19 18 30 .90	−3 .05	(1)

Notes:

UTC — Coordinated Universal Time
ZC — Robertson Zodiacal Catalog number
Phenomenon — DD — disappearance at dark limb
— DB — disappearance at bright limb
— RD — reappearance at dark limb
— RB — reappearance at bright limb
+) Anonyme — Star, identified as BD +23°517

Remarks: (5) — very good
(4) — good
(3) — fair
(2) — poor
(1) — very poor

In 1973 two observers took part in observations of occultations *M. B. Protitch* and *V. Protić-Benišek.*

OCCULTATIONS OF MAJOR PLANETS BY MOON AT BELGRADE ASTRONOMICAL OBSERVATORY DURING 1974

V. PROTIĆ-BENIŠEK and *M. PROTITCH*

On the basis of ephemeris that British H. M. Nautical Almanac Office regulary sends to Observatory in Belgrade, during 1974 there were opportunities to observe lunar occultations of two major planets: Saturn, around midnight on March 3^{rd}, and Venus, in the daytime on July 17^{th}.

Both of these occultations were observed using Askania refractor 135/1600 with standard magnification 128*x*. Timings were registered by chronograph and standard clock Riffler 507 was used.

Saturn (V. Protić-Benišek). — Since the ring system of Saturn was highly tilted to our line of sight, the outer edge remained visible as a complete ellipse surrounding the disk of the planet. This more favourable case made it possible to record satisfactorily contact times of the planet with the limb of the Moon.

The phenomenon of dissapearance was observed only. Timings were registered in the following order.

1. West inner edge of inner ring (t_2)
2. West edge of planet's disk (t_3)
3. East edge of planet's disk (t_4)
4. East inner edge if inner ring (t_5)
5. East outer edge of outer ring (t_6)

Contact of west outer edge of outer ring (t_2) was'nt registered timely, since the Moon's limb was invisible. List of observed contact times is:

$t_2 \cdots 0^h00^m05^s.59$ UT
$t_3 \cdots$ 0 00 12. 81 UT
$t_4 \cdots$ 0 00 43 85 UT
$t_5 \cdots$ 0 00 50 .60 UT
$t_6 \cdots$ 0 01 07 .47 UT

General estimation of these registrations of contacts is: good.

With respect to the contacts indicated above, the average value of deviation $\Delta\sigma$ is obtained:

$$\Delta\sigma = +1''.58 \pm 0''.32$$

In this case, no limb corrections and personal equation have been applied.

Atmospheric conditions were good, but dark limb of the Moon was invisible because the sky was covered with thin clouds.

Venus (M. B. Protitch). — The reappearance of east edge of planet disk was recorded. The phenomenon of disappearance was not registered because of the cloudy sky, so that the general estimation of observation is: satisfactory.

Observed contact time is:

$$t = 12^h01^m39^s.62 \text{ UT}$$

With respect to this contact time, it was obtained:

$$\Delta\sigma = +1''.63.$$

Here too, limb correction and personal equation have not been applied.

PARTIAL LUNAR ECLIPSE ON JUNE 4/5 1974

V. PROTIĆ-BENIŠEK

Partial eclipse of the Moon on June 4/5, 1974 was observed at Belgrade Astronomical Observatory visually, with the refractor Askania 135/1600 (V. P. Benišek), and photographically, with Zeiss astrograph 160/800 (M. B. Protić). It was carried out according to the programme, prepared in advance.

The weather conditions were rather convenient; the sky was generally very clear, but it was windly and the image was unstable sometimes.

During the visual observation, contact times of the Earth's shadow with formations on the Moon's surface were registrated by the marine chronometer which had been compared with a standard quartz clock of Belgrade Time service.

Table 1

Lunar immersion

	UT	phase
Craters:		
1. Plato	$20^h54^m.0$	partially eclipsed
2. Kepler	20 55 .0	contact of E crater rim
3. Grimaldi	20 58 .7	contact of NE crater rim
4. Archimedes	21 01 .0	central contact
5. Copernicus	21 01 .8	contact of NE crater rim
6. Grimaldi	21 02 .6	contact of SW crater rim
7. Copernicus	21 03 .8	contact of SW crater rim
8. Newcomb	21 13 .1	partially eclipsed
9. Le Monnier	21 17 .1	partially eclipsed
10. Gassendi	21 32 .3	contact of N crater rim
11. Bullialdus	21 32 .8	contact of N crater rim
12. Pitatus	21 39 .4	contact of N crater rim
13. Pitatus	21 43 .1	contact of S crater rim
14. Teophilus	21 44 .2	partially eclipsed
Seas:		
1. Mare Imbrium	21 05 .3	contact of W rim
2. Mare Crisium	21 27 .3	contact of NE rim
3. Mare Tranquilitatis	21 31 .7	contact of SW rim
4. Mare Crisium	21 36 .4	contact of SW rim
5. Mare Humorum	22 09 .2	contact of SE rim (Clausius eclipsed)

In the follwoing tables 1 and 2 the observed times of different phenomena are given.

Table 2

Lunar emmersion

	UT	phase
Craters:		
1. Grimaldi	$22^h31^m.6$	partially eclipsed
2. Pitatus	22 36 .1	eclipsed
3. Bullialdus	22 42 .1	central contact
4. Kepler	22 54 .2	eclipsed
5. Herodotus	22 56 .7	partially eclipsed
6. Copernicus	23 02 .2	contact of SE crater rim
7. Plato	23 24 .0	contact of SE crater rim
8. Le Monnier	23 30 .8	eclipsed
Seas:		
1. Mare Imbrium	23 04 .6	contact of E rim
2. Mare Crisium	23 44 .3	contact of SE rim
3. Mare Crisium	23 49 .8	contact of NW rim

Visual moment of the lunar eclipse begining was registered at $20^h40^m.0$ UT, middle of the eclipse at $22^h17^m.0$ UT and the end of the eclipse at $23^h52^m.5$ UT.

During photographic observation, series of photographs were taken in the equidistant intervals from the moment of the middle of the eclipse. These photos will be treated for determination of eclipse phases and for calculating the correction: $\Delta\ T = ET - UT$.

Earth's shadow was sharp and dense; in the basis of shadow cone it was ruddy-copper colour, but on the shadow rim it became prominently gray. A good contrast of the lunar features permitted the contacts of Earth's shadow with Moon's craters to be perceptible very well. Some of those formations (Aristarh, etc) were also visible clearly in the shadow, so that the crater, by which the instrument was guided during the exposures, was a good mark all the time.

LUNAR OCCULTATIONS 1975 VISIBLE AT BELGRADE

by *H. M. NAUTICAL OFFICE, LONDON*

DATE M	D	U. T. h	m	Z. C.	MAG.	ELG. MOON	PH.	P.A	AZ. MOON	ALT.	A min/deg	B	BD/CD		DOUBLE AITKEN	NAME
1	1	4	3.5	1397	5.5	221°	R	313°	237°	41°	−0.8	−1.9	+09°	02188	7390	OMEGA LEONIS
1	16	16	3.8	3340	7.5	46	D	72	224	33	−1.4	−0.5	−03	05505		
1	21	17	16.0	402	6.5	103	D	74	178	63	−2.8	+0.7	+17	00426		36 ARIETIS
1	21	20	41.6	415	6.0	104	D	355	254	41	...		+17	00442		40 ARIETIS
1	21	20	47.8	415	6.0	104	R	345	255	40	...		+17	00442		40 ARIETIS
1	23	23	30.8	725	6.9	130	D	144	268	33	0.0	−3.1	+21	00707		
1	24	17	52.1	851	6.3	141	D	35	120	55	−0.9	+3.7	+21	00918		
1	30	0	50.2	1582	6.3	215	R	287	179	46	−1.6	−0.5	+01	02495		237 B. LEONIS
1	30	2	42.6	1587	6.0	215	R	328	216	40	−0.9	−2.0	+01	02501	7982	55 LEONIS
2	4	2	9.2	2212	6.1	281	R	322	137	12	−0.5	−0.2	−20	04246		147 B. LIBRAE
2	17	17	14.6	363	7.3	72	D	61	231	52	−1.6	+0.3	+16	00293		
2	18	17	6.7	480	7.3	84	D	114	212	61	−2.0	−1.8	+18	00459		
2	19	19	44.6	633	5.4	97	D	52	249	49	−1.6	+0.5	+20	00733		53 TAURI
2	19	20	45.4	642	6.9	97	D	77	262	38	−1.0	−0.9	+20	00740		219 B. TAURI
2	19	21	16.6	646	6.1	97	D	125	267	33	−0.3	−2.5	+20	00744	3158	224 B. TAURI
2	19	21	44.3	651	5.9	98	D	86	272	28	−0.5	−1.3	+20	00751		227 B. TAURI
2	22	1	15.7	995	4.1	125	D	33	287	11	...		+20	01441	5103	NU GEMINORUM
3	1	23	21.8	2029	5.1	236	R	327	137	18	−0.5	−0.5	−15	03817		40 H. VIRGINIS
3	3	1	51.1	2172	4.7	250	R	327	160	23	−1.0	−0.8	−19	04047	9532	IOTA LIBRAE
3	18	18	0.5	595	6.8	66	D	112	253	45	−1.0	−2.1	+19	00643		164 B. TAURI
3	20	22	55.3	915	4.7	92	D	164	286	13	+0.9	−3.2	+20	01233		CHI 2 ORIONIS
3	22	19	15.4	1190	7.1	117	D	132	201	60	−1.3	−1.8	+16	01580	6440	
3	22	20	56.9	1197	6.0	118	D	123	238	48	−1.0	−1.8	+16	01590		1 CANCRI
3	23	21	26.4	1332	5.7	132	D	123	226	49	−1.1	−1.7	+12	01941		60 CANCRI
4	3	1	59.2	2697	6.5	267	R	310	144	16	−1.2	+0.1	−20	05189		108 B. SAGITTARII
4	19	19	12.4	1281	6.4	99	D	102	226	51	−1.4	−1.2	+13	01940		84 B. CANCRI
4	20	18	30.0	1397	5.5	112	D	80	188	54	−2.1	+0.3	+09	02188	7390	OMEGA LEONIS
4	21	23	14.0	1543	6.6	128	D	97	251	22	−0.7	−1.5	+03	02379		
4	26	21	47.1	2172	4.7	196	R	256	154	21	−1.8	+1.1	−19	04047	9532	IOTA LIBRAE
4	30	1	41.1	2635	5.7	235	R	202	170	23	...		−21	04916		14 SAGITTARII
5	15	18	57.3	1116	7.4	56	D	93	267	28	−0.5	−1.4	+17	01561		
5	16	20	22.0	1256	7.1	70	D	144	269	20	0.0	−2.2	+14	01879		
5	18	21	10.0	1495	5.9	97	D	91	252	24	−0.8	−1.4	+05	02301		19 SEXTANTIS
5	21	18	51.4	1845	6.5	136	D	101	168	34	−1.7	0.0	−09	03569	8684	343 B. VIRGINIS
5	29	0	17.2	2865	5.9	226	R	255	156	24	−1.8	+1.0	−18	05432		267 B. SAGITTARII
6	24	23	49.7	2814	5.0	195	D	357	181	26	...		−19	05379		43 SAGITTARII
6	25	0	10.7	2814	5.0	195	R	329	187	26	...		−19	05379		43 SAGITTARII
6	27	23	57.2	3185	5.3	229	R	209	145	29	−1.1	+2.3	−09	05829		46 CAPRICORNI
7	7	14	22.2	4001	0.4	338	D	52	277	23	−0.8	−0.3				MERCURY
7	7	15	3.3	4001	0.4	338	R	329	284	16	+0.6	−2.7				MERCURY
7	17	20	44.1	2172	4.7	115	D	141	218	17	−1.5	−2.1	−19	04047	9532	IOTA LIBRAE
7	17	21	7.7	2175	6.0	115	D	98	223	14	−1.2	−1.3	−19	04055		25 LIBRAE
7	20	23	40.3	2614	6.2	153	D	74	220	13	−1.1	−0.8	−21	04855		30 G. SAGITTARII
7	26	22	0.6	3370	6.2	220	R	191	123	25	−0.5	+3.1	−03	05539		6 G. PISCIUM
8	18	22	19.4	2865	5.9	146	D	113	209	22	−2.2	−1.7	−18	05432		267 B. SAGITTARII
9	10	17	55.0	2217	5.5	66	D	16	224	13	...		−19	04135		11 H. LIBRAE
9	10	18	8.1	2217	5.5	66	R	355	227	12	...		−19	04135		11 H. LIBRAE
9	11	18	11.1	2376	4.6	79	D	101	215	16	−1.5	−1.2	−21	04381		OMEGA OPHIUCHI
9	13	19	1.7	2666	5.0	103	D	30	202	22	−1.0	+1.0	−20	05134	11325	21 SAGITTARII
9	14	18	9.2	2814	5.0	114	D	84	177	26	−2.0	+0.2	−19	05379		43 SAGITTARII
9	14	18	34.0	2816	6.8	115	D	73	183	26	−1.9	+0.3	−19	05387		
9	14	21	42.8	2828	6.0	115	D	356	228	13	...		−18	05325		45 SAGITTARII
9	17	19	15.7	3185	5.3	148	D	94	156	33	−2.1	+0.6	−09	05829		46 CAPRICORNI
9	23	0	55.8	240	5.6	205	R	266	201	56	−2.1	−0.2	+11	00205		PI PISCIUM
9	26	1	45.8	614	5.7	239	R	266	157	63	−1.9	+0.5	+19	00672		43 TAURI
9	27	22	26.9	888	6.0	261	R	265	79	18	−0.1	+1.4	+19	01110		
9	27	23	31.3	895	5.9	262	R	230	90	29	−0.1	+2.6	+19	01126		57 ORIONIS
10	1	1	3.5	1318	5.7	301	R	256	84	11	0.0	+1.7	+12	01904		50 CANCRI (A 2 CANCRI)
10	8	16	22.5	2307	4.1	46	D	74	220	15	−1.1	−0.8	−20	04405		OMEGA 1 SCOR (KOW KIN)
10	8	16	43.0	2310	4.6	46	D	116	224	12	−1.3	−1.7	−20	04408		OMEGA 2 SCOR (KOW KIN)

DATE M	DATE D	U. T. h	U. T. m	Z. C.	MAG.	ELG. MOON	PH.	P. A.	AZ. MOON	ALT. MOON	A min/deg	B min/deg	BD/CD		DOUBLE AITKEN	NAME
10	11	16	57.9	2763	6.7	84	D	35	191	25	−1.3	+1.0	−19°	05255		
10	11	19	1.2	2773	6.1	84	D	86	219	16	−1.3	−1.0	−19	05273	11972	171 B. SAGITTARII
10	11	19	9.7	2774	6.3	84	D	56	221	15	−0.9	−0.3	−19	05275		173 B. SAGITTARII
10	14	19	19.0	3154	7.4	119	D	43	193	35	−1.3	+1.0	−10	05696		
10	28	3	25.1	1281	6.4	271	R	333	144	54	−1.2	−2.2	+13	01940		84 B. CANCRI
10	29	3	25.6	1397	5.5	284	R	323	131	44	−1.1	−1.1	+09	02188	7390	OMEGA LEONIS
11	12	19	7.6	3340	7.5	110	D	10	203	40	−0.4	+2.7	−03	05505		
11	13	17	24.1	3462	7.5	121	D	105	154	43	−2.5	+0.1	+00	05009		
11	13	22	41.2	3482	5.6	122	D	357	249	23	...		+01	04744		
11	21	19	30.8	947	5.2	212	R	220	83	20	+0.3	+2.9	+19	01270	4842	71 ORIONIS
11	23	22	23.6	1234	6.1	239	R	302	98	29	−0.8	+0.3	+15	01775		30 B. CANCRI
11	24	23	47.6	1359	5.1	252	R	305	107	32	−0.9	+0.1	+11	01984		KAPPA CANCRI
11	26	3	5.6	1482	6.3	266	R	309	150	47	−1.3	−0.7	+06	02259		14 SEXTANTIS
12	5	15	33.6	2787	6.4	31	D	6	221	16	...		−18	05206		187 B. SAGITTARII
12	5	15	54.5	2794	6.7	32	D	91	225	14	−1.2	−1.2	−19	05317		
12	13	21	30.5	240	5.6	124	D	59	240	42	−1.3	0.0	+11	00205		PI PISCIUM
12	13	21	48.5	241	6.9	124	D	83	244	39	−1.3	−1.0	+11	00207		281 B. PISCIUM
12	21	20	4.7	1318	5.7	220	R	263	88	16	−0.2	+1.6	+12	01904		50 CANCRI (A 2 CANCRI)
12	22	0	57.4	1332	5.7	222	R	312	164	56	−1.4	−1.3	+12	01941		60 CANCRI

THE MICROMETER MEASURES OF DOUBLE STARS IN BELGRADE (Series 22)

G. M. POPOVIĆ

SUMMARY:

208 measures of 100 double stars are presented. Among them there are 9 pairs with the parabolic or hyperbolic orbit.

This series is the continuation of Belgrade double stars series of measures with Zeiss refractor 65/1055 cm. All measures are carried out in Belgrade and, concluding with Series 21 and Supp. III (new pairs), are published in „The first general catalogue of double-star observations made in Belgrade, 1951−1971“, (Popović, 1974).

The method of computing the mean weighted values has here been kept as in previous series.

The data of 2, 3, 4, 5, and 7th column are given in usual form. The first column is identical with the first column of the mentioned Belgrade catalogue. The sixth column shows the weight of each individual measure: W=the quality of the seeing+the quality of the measure. These values are used for computing the mean weighted values of the position angle, separation and magnitudes. In this column the number of mesures of the pair is also given.

ADS α, β m	Disc. 1900−2000 Mult.	Epoch 1900+	θ	ρ	*m*	*W*	Notes
55	A 110	72.938	123°.5	2″.04	dm=0.0	1+2	
00006−057N4206−39		73.601	122.4	1.94	dm=0.0	2+2	
9.9−10.0		73.606	120.4	1.97	dm=0.0	1+2	
		73.404	**122.1**	**1.98**	**dm=0.0**	**3 n**	
−	GP 35	72.736	299.8	0.61	9.0−11.0	2+2	Motion in angle evident: 1970.20:293°.0, 0″.78,2 n
00143−195N3511−44							
9.5−11.5							
−	GP 36	72.736	102.2	0.52	dm=0.5	3+3	
00145−196N3428−61		73.601	103.4	0.75	−	1+1	
9.7−10.2		**72.952**	**102.5**	**0.58**	**dm=0.5**	**2 n**	
285	AC 1	72.938	286.6	1.62	−	1+2	Angle slowly increasing with change in distance.
00157−210N3226−59		72.979	286.4	1.39	dm=1.5	1+2	
		72.958	**286.5**	**1.50**	**dm=1.5**	**2**	

ADS α, β m	Disc. 1900−2000 Mult.	Epoch 1900+	θ	ρ	m	W	Notes
			°	″			
—	GP 38	73.760	95.0	2.38	9.0−13.0	1+2	First measure of the pair:
00267−320N3504−38							1969.83:99°.8, 2″.43, 1 n
9.0−13.0							
497	Σ 42	72.861	23.8	5.94	dm=1.0	2+1	Hopmann J., 1967 (hiperbolic
00307−360N2927−60		72.938	24.6	6.10	8.0−9.0	2+2	orbit):
9.0−9.8	AB	73.700	24.8	5.93	—	1+1	
		73.741	24.8	5.65	8.0−8.8	1+2	
		73.246	**24.5**	**5.92**	**dm=1.0**	**4 n**	0°.0, −0″.20
497	Σ 42	72.861	259.6	27.2	—	1+1	IDS: Optical pair.
00307−360N2927−60							
8.7−11.4	AC						
883	A 1515	72.736	247.6	<0.2	—	3+1	The angle has increased by 131°
00594−650N3617−49							since 1907.
9.7−10.0							
1079	Da 8	73.700	142.9	2.26	8.5−10.0	1+2	
01143−201N4326−58							
8.3−9.6							
—	GP 53	73.683	75.2	2.05	dm=4.0	2+1	First measure of the pair:
01143−199N3448−80							1970.97:70°.2, 2″.19, 1 n
9.3−13.3							GP 53=BD+34°229 (9^m.3)
—	GP 54	73.683	49.6	1.21	9.5−11.5	3+2	First measure of the pair:
01158−214N3409−40							1971.37:45°.5, 1″.21, 2 n.
9.0−11.0							GP 54=BD+33°214 (9^m.5)
—	Cou 148	72.736	246.0	1.21	dm=0.4	2+2	
01221−276N2033−64							
9.5−9.8							
1248	Hld 6	73.700	112.6	2.06	dm=−0.3	1+1	
01302−359N3233−64							
9.9−9.9							
1254	Σ 138	71.974	51.8	1.63	7.7−7.8	1+2	IDS: An orbital pair.
01308−360N0708−39		72.736	51.9	1.61	dm=0.2	2+2	The angle has increasred by 32°
7.7−7.7	AB	72.938	52.6	1.43	dm=0.0	1+2	since 1830.
		72.568	**52.1**	**1.56**	**dm=0.1**	**3 n**	
1529	Hu 1033	73.776	224.1	1.16	dm=0.3	3+2	The angle has decreased by 15°
01498−557N3551−80							since 1904.
9.3−9.6							
1860	Σ 262	74.041	236.0	2.10	5.0−8.7	1+1	1974.071: dm$_{BC}$<1^m.
02208−290N6657−84		74.071	237.9	2.20	4.5−8.0	1+2	1974.088: dm$_{BC}$: 0^m.1−0^m.2
4.7−7.6	AB	74.079	235.5	2.24	4.5−8.0	1+2	Heintz, 1961:
		74.088	238.5	2.22	4.5−8.5	1+2	+0°.6, −0″.11.
		74.072	**237.1**	**2.20**	**4.6−8.3**	**4 n**	
1860	Σ 262	74.041	114.9	6.79	5.0−9.5	1+1	Hopmann J., 1960: hyperbolic
02208−290N6657−84		74.071	114.3	7.07	4.5−8.2	1+2	orbit.
4.6−8.5	AC	74.079	114.8	7.28	4.5−8.5	1+2	
		74.088	114.8	7.06	4.5−8.7	1+2	
		74.072	**114.7**	**7.07**	**4.6−8.6**	**4 n**	
2218	Σ 326	72.736	220.7	5.74	dm=2.5	2+2	Hopmann J., 1967 (parabolic
02497−556N2628−52		72.938	220.1	5.66	8.0−11.0	1+2	orbit):
7.5−9.7		72.941	220.6	5.78	8.0−11.0	1+2	+1°.6, −0″.52
		73.107	220.1	5.73	dm=1.7	2+2	
		74.041	220.7	5.44	8.0−10.0	1+1	
		73.068	**220.4**	**5.69**	**dm=2.3**	**5 n**	
2261	Σ 334	73.760	312.4	1.23	8.0−8.5	1+1	The angle has decreased by 11°
02541−594N0615−39		74.112	312.1	1.22	8.0−9.7	2+2	since 1830 and the distance has
7.9−8.4		**73.995**	**312.2**	**1.22**	**8.0−8.6**	**2 n**	decreased 0″.4.

ADS α, β m	Disc. 1900–2000 Mult.	Epoch 1900+	θ	ρ	m	W	Notes
3053	OΣ 74	72.736	269°.6	0″.39	8.5–9.0	2+2	
04068–123N0924–39							
8.3–8.8							
–	Es 2336	74.112	104.3	1.97	dm = 0.2	1+1	
04134–200N3608–23							
10.9–11.0							
3156	Es 279	74.071	238.6	2.25	9.0–12.0	1+1	No change in angle but distance
04159–225N3501–15		74.074	238.0	2.92	9.3–12.0	1+1	decreasing.
10.9–12.9		74.112	243.3	2.59	9.5–14.0	1+1	
		74.086	**240.0**	**2.59**	**9.3–12.7**	**3 n**	
3167	Ho 508	74.074	223.8	3.18	8.5–14.0	1+1	1974.074: ρ uncertain.
04165–231N3515–29		74.112	225.9	3.34	8.5–14.0	1+1	1974.074: The A component
8.5–12.5		**74.093**	**224.8**	**3.26**	**8.5–14.0**	**2 n**	seemed double.
3187	Ho 15	74.074	143.7	0.82	dm = 0.5	2+2	
04182–245N2954–68		74.088	147.4	0.73	dm = −0.3	1+2	
9.8–9.8		**74.080**	**145.3**	**0.78**	**dm = 0.4**	**2 n**	
3596	OΣ 93	73.108	248.3	0.99	8.5–9.5	1+2	Janova V., 1966: hyperbolic orbit.
04552–605N0457–65		74.088	247.1	0.93	8.0–8.7	2+2	Costa J. M., 1966 (eliptic orbit):
8.2–9.7		**73.668**	**247.6**	**0.96**	**8.2–9.0**	**2 n**	+5°.8, +0″.06.
3897	Weisse 8	72.133	332.2	2.42	9.5–10.2	1+2	
05130–187N3608–15							
9.7–9.8	AB						
	GP 70	74.088	8.5	1.22	9.8–10.0	1+2	GP 70 = BD+35°1056
05136–202N3555–63							
10.1–10.4							
–	GP 69	72.133	299.4	3.68	11.0–12.5	1+1	
05148–215N3509–15		72.166	304.0	3.56	9.5–11.0	1+1	
11.2–12.2		74.030	299.5	3.53	11.0–12.5	1+1	
		72.776	**301.0**	**3.59**	**10.5–12.0**	**3 n**	
4202	Da 3	74.115	173.9	0.83	8.0–8.7	1+1	
05310–359S0542–38							
8.4–9.9							
4243	OΣ 112	72.938	55.6	1.04	7.8–8.5	1+1	The angle has decreased by 29°
05330–398N3754–58							since 1848.
7.8–8.5							
4823	Ho 22	72.938	203.6	0.85		1+1	
06079–134N1016–14		74.099	202.4	0.84	dm = 0.1	1+2	
8.6–8.6		**73.635**	**202.9**	**0.84**	**dm = 0.1**	**2 n**	
–	Mlb 1045	73.072	152.4	5.76	9.5–11.0	1+2	
06166–232N3421–18							
11.2–11.7							
5014	Hu 702	73.072	328.3	0.82	dm = 1.0	1+1	
06180–246N3427–24		74.099	321.7	0.92	8.5–9.0	1+1	
9.2–9.7		**73.586**	**325.0**	**0.87**	**dm = 0.8**	**2 n**	
–	Cou 86	72.166	211.3	1.21	9.8–10.0	2+1	Cou 86 = BD+23°1454 ($9^m.2$)
06345–405N2319–13							
9.6–9.8							
							Observations of J 39:
5341	J 39	73.108	276.1	1.81	9.5–11.0	2+2	1910.06: 272°.2 0″.93 J2
06364–418N0918–12		74.115	279.1	1.66	9.5–11.0	1+1	1913.12: 274.7 1.01 Doo 3
10.6–11.0		**73.444**	**277.1**	**1.76**	**9.5–11.0**	**2 n**	1915.15: 275.4 1.69 J 1
							1933.26: 272.6 0.94 Gia 1
							1957.14: 278.6 1.35 C 1
							1958.18: 275.4 1.08 C 1

ADS α, β m	Disc. 1900−2000 Mult.	Epoch 1900+	θ	ρ	m	W	Notes
6067	A 2045	72.938	16.7	0.96	8.7−9.9	1+1	
07195−268N4623−11		74.115	16.6	0.94	dm=2.0	1+2	
8.7−9.2		74.257	16.3	0.94	8.8−10.0	1+2	
		73.874	**16.5**	**0.94**	**dm=1.5**	**3 n**	
6175	Σ 1110	74.166	115.9	1.84	dm=0.7	1+2	Muller, 1955: −0°.3, −0″.16
07282−346N3166−53							Rabe, 1957: +0.5, −0.09
2.0−2.9	AB						
6569	Σ 1177	72.174	350.6	3.37	6.5−8.0	1+2	
07595−656N2749−32		73.103	351.7	3.29	7.5−8.5	1+2	
6.6−7.5		73.119	352.0	3.34	7.5−8.0	2+2	
		72.831	**351.5**	**3.33**	**7.2−8.1**	**3 n**	
—	Cou 46	72.166	136.3	1.62	9.0−9.7	2+1	At -45^s and +3′ from Cou 46
08091−148N2035−17		72.242	133.6	1.47	8.8−9.6	2+2	faint pair exists:
9.4−10.0		72.259	139.0	1.37	9.2−10.0	1+2	1972.242, 167°3, 10″.05, 1 n,
		72.224	**136.3**	**1.48**	**9.0−9.7**	**3 n**	13.0−13.3
7081	AG —	73.108	190.8	1.48	dm=0.3	1+1	The angle has decreased by 45°
08491−546N1659−36		73.119	192.4	1.44	8.7−9.0	2+3	since 1912.
9.3−9.4		73.294	192.0	1.42	dm=0.3	1+2	
		73.169	**192.0**	**1.44**	**dm=0.3**	**3 n**	
—	Cou 166	72.174	158.1	2.26	dm=0.1	1+1	
10017−073N2245−15		72.242	159.6	2.15	10.3−10.5	1+2	
10.5−10.5		72.259	160.6	2.40	10.5−10.7	1+1	
		72.227	**159.4**	**2.25**	**dm=0.2**	**3 n**	
7788	A 2152	73.119	31.1	0.57	dm=0.1	3+3	The angle has increased by 30°
10232−290N3483−53		73.226	30.5	0.60	—	2+1	since 1910.
9.6−9.7		**73.155**	**30.9**	**0.58**	**dm=0.1**	**2 n**	
7888	OΣ 227	74.116	0.1	0.86	8.3−9.0	1+2	The angle has increased by 24°
10364−416N1076−45							since 1845.
8.0−9.0							
8083	OΣ 231 rej	73.294	262.7	34.67	9.0−10.5	1+2	1973.386: The A component
11056−110N3060−27		73.386	263.3	34.44	8.5−11.0	1+2	seemed double. 1974.261: The A
9.2−10.2		74.261	262.6	34.97	dm=1.0	1+2	component seemed elongate in
		73.647	**262.9**	**34.69**	**dm=1.7**	**3 n**	θ∼263°.
							Hopmann J., 1960: hyperbolic
							orbit.
8085	A 2156	73.119	221.8	0.47	—	3+2	The angle has decreased by 35°
11066−121N3533−00							since 1910.
8.3−9.1							
8128	Σ 1527	73.294	30.7	1.47	dm=1.7	1+1	The change is mostly in distance.
11138−191N1449−16		73.370	31.7	1.41	dm=1.5	1+1	Since 1829 the angle has increased
6.9−8.1		73.395	28.4	1.48	7.5−9.0	1+1	by 20°.
		73.353	**30.3**	**1.45**	**dm=1.6**	**3 n**	
8267	A 1356	73.294	275.9	1.19	9.0−11.5	1+1	
11358−409S0214−47							
8.9−11.0							
8841	β 800	72.456	104.0	6.10	7.0−10.0	1+2	Hopmann J., 1960:
13118−167N1733−01		72.472	104.5	6.13	7.0−10.0	1+2	hyperbolic orbit.
6.7−9.8		73.294	106.4	6.49	7.5−11.0	1+2	
		73.371	106.0	6.20	7.0−11.0	1+2	
		72.898	**105.2**	**6.23**	**7.1−10.5**	**4 n**	
8887	Ho 260	74.356	63.6	1.00	dm=0.2	3+2	Baize, 1967: −3°.6+0″.06
13189−236N2945−14		74.359	63.0	1.06	dm=0.5	2+2	Popović, 67: −4.1 −0.16
9.6−9.8		74.403	65.1	1.01	8.5−8.8	3+2	
		74.374	**64.0**	**1.02**	**dm=0.3**	**3 n**	
8946	A 1792	74.356	308.2	0.55	dm=1.0	3+2	The angle has decreased by 39°
13290−340N0878−47		74.403	306.1	0.51	9.0−10.0	3+2	since 1908 and some increase in
8.8−9.3		**74.380**	**307.2**	**0.53**	**dm=1.0**	**2 n**	distance.

ADS α, β m	Disc. 1900–2000 Mult.	Epoch 1900+	θ	ρ	m	W	Notes
9067	β 937	74.356	124°.4	1″.04	8.5–8.7	2+2	The angle has increased by 20° since 1880.
13527–571N3455–26		74.359	125.9	0.98	8.9–9.1	2+2	
9.2–9.4		74.403	127.7	0.93	8.6–8.8	2+2	
		74.428	125.9	1.09	8.7–9.0	1+2	
		74.384	**126.0**	**1.00**	**8.7–8.9**	**4 n**	
9084	A 569	74.356	126.2	0.53	dm=0.2	2+2	The angle has increased by 23° since 1903.
13566–602N2551–22							
9.9–10.2							
9126	Hu 742	73.477	118.4	0.51	8.5–12.0	3+2	The angle has decreased by 58° since 1904.
14044–088N3369–40							
8.8–12.3							
9269	Ho 542	74.359	224.2	0.71	11.0–11.3	2+2	The angle has decreased by 50° since 1896. Slow increase in distance.
14230–277N2064–37							
10.7–10.7							
9379	Σ 1876	73.371	97.9	1.09	dm=0.0	1+1	1973.390: ρ uncertain. Since 1832 the angle has increased by 45°.
14411–464S0658–83		73.390	95.6	1.33	–	1+1	
8.4–8.9	AB	73.447	97.1	1.26	dm=0.0	1+2	
		73.409	**96.9**	**1.23**	**dm=0.0**	**3 n**	
9630	Σ 1941	73.365	216.8	1.42	dm=0.0	1+2	Since 1832 the angle decreased by 15°.
15215–257N2659–38		73.387	217.9	1.35	dm=0.0	1+2	
9.1–9.1		73.447	218.8	1.34	9.0–8.9	2+2	
		73.543	216.6	1.47	dm=0.0	1+2	
		73.436	**217.6**	**1.39**	**dm=0.0**	**4 n**	
9641	A 82	73.447	338.8	0.62	9.7–11.0	2+1	Since 1900 the angle increased by 17°.
15228–271N2376–55							
10.0–11.0							
9647	Σ 1944	74.359	317.8	0.85	dm=0.2	1+2	Since 1832 the angle decreased 28°. Decrease in distance 0″.4.
15228–277N0627–05		74.428	311.2	0.86	8.5–8.7	2+1	
8.4–9.0		**74.394**	**314.5**	**0.86**	**dm=0.2**	**2 n**	
9639	OΣ 296	73.365	284.1	1.71	8.0–10.0	1+2	Since 1845 the angle decreased by 44°.
15230–265N4421–00		73.387	284.2	1.77	8.0–10.0	1+2	
7.6–9.2	AB	73.431	284.8	1.68	8.5–10.0	1+2	
		73.394	**284.4**	**1.72**	**8.2–10.0**	**3 n**	
9737	Σ 1965	72.456	304.4	6.16	6.5–8.0	1+2	„Distance fondamentale“, Muller, 1949: +0″.04.
15356–394N3658–38		72.472	305.0	6.23	6.5–8.0	1+2	
5.1–6.0		**72.464**	**304.7**	**6.20**	**6.5–8.0**	**2 n**	
9880	OΣ 303	72.546	165.2	1.29	dm=–0.2	1+2	Since 1846 the angle increased by 67°. Increase in distance 0″.7.
15562–609N1333–15		73.365	168.5	1.33	dm=0.3	1+2	
7.5–8.0		73.387	167.0	1.35	dm=0.2	1+2	
		73.099	**166.9**	**1.32**	**dm=0.1**	**3 n**	
9979	Σ 2032	72.415	231.5	6.17	6.0–8.0	1+2	Rabe, 1954: –0°.1, –0″.28; Zagar F., parabolic orbit, 1935: –0°.9, –0″.27.
16109–147N3367–52		72.456	231.7	6.19	7.0–8.0	2+2	
5.8–6.7	AB	72.484	231.6	6.31	7.0–8.5	1+2	
		72.489	231.2	6.25	dm=1.0	3+3	
		73.431	232.1	6.12	6.3–7.8	1+2	
		73.639	231.9	6.39	dm=0.7	1+2	
		72.758	**231.6**	**6.24**	**dm=1.2**	**6 n**	
–	GP 5	73.477	140.1	0.68	9.6–10.0	3+2	GP 5=BD+34° 2834 (9^m.3)
16413–450N3366–53		74.357	135.1	0.54	dm=0.1	1+1	
9.8–9.9		**73.728**	**138.7**	**0.64**	**dm=0.3**	**2 n**	
10312	Σ 2114	72.473	184.5	1.30	8.0–8.7	1+2	Since 1830 the angle increased by 48°.
16572–619N0836–27		72.489	182.8	1.17	dm=1.2	1+3	
6.5–7.7		72.492	183.6	1.22	8.0–8.5	1+2	
		72.485	**183.6**	**1.22**	**dm=0.8**	**3 n**	

ADS α, δ m	Disc. 1900–2000 Mult.	Epoch 1900+	θ	ρ	m	W	Notes
10640	Fur –	73.639	48.9	2.08	dm=0.5	1+2	
17310–343N3908–04							
10.2–10.5							
10699	Σ 2199	72.500	64.7	1.83	dm=0.7	1+2	The angle has decreased by 51°
17368–386N5549–46		72.547	64.3	1.73	8.5–9.3	1+2	since 1830.
7.8–8.4		73.365	64.8	1.79	7.5–8.5	1+2	
		72.804	**64.6**	**1.78**	**dm=0.8**	**3 n**	
10722	Σ 2203	72.500	302.6	0.76	dm=0.3	1+2	The angle has decreased by 33°
17381–412N4142–40		72.547	300.6	0.74	8.0–8.5	2+2	since 1830.
7.6–7.9		73.390	299.9	0.80	dm=0.4	1+2	
		72.786	**301.0**	**0.76**	**dm=0.4**	**3 n**	
10742	Ho 560	73.584	82.9	1.08	dm=–0.5	2+2	dm≠0.0
17398–434N3359–57		73.639	82.2	1.16	dm=–0.2	2+2	Little change in angle and the
8.7–8.7		**73.611**	**82.6**	**1.12**	**dm=–0.4**	**2 n**	distance has increased by 0″7, since
							1894.
10850	OΣ 338	73.390	354.5	0.81	dm=0.3	1+2	The angle has decreased by 49°
17475–520N1521–20		73.639	355.2	0.84	dm=0.0	1+2	since 1845.
6.8–7.1	AB	**73.514**	**354.8**	**0.82**	**dm=0.2**	**2 n**	
–	GP 10	72.547	216.0	2.09	dm=0.3	1+1	
17537–573N3542–41		73.387	214.9	1.93	dm=0.5	1+1	
10.2–10.4		73.390	215.8	1.76	11.5–11.6	2+2	
		73.178	**215.6**	**1.88**	**dm=0.2**	**3 n**	
11186	Σ 2294	73.513	92.1	1.02	dm=0.3	1+1	Wilson Jnr., 1935: –2°.1, +0″.05
18094–145N0009–10		73.639	91.9	1.07	dm=0.3	1+2	
8.5–8.8		**73.589**	**92.0**	**1.05**	**dm=0.3**	**2 n**	
11432	OΣ 354	73.390	195.2	0.78	7.5–9.0	1+1	The angle has increased by 41°
18272–321N0643–47							since 1846.
7.7–8.5							
11632	Σ 2398	72.552	164.9	14.63	9.0–9.3	1+3	Heintz, 1967: –0°.1, –0″.07
18418–433N5927–33		72.716	165.6	14.45	9.0–9.3	2+2	Wieth-Knudsen, 1953,
9.3–9.8	AB	72.732	165.3	14.74	dm=0.8	1+1	a. parabolic orbit,
		73.623	164.9	14.44	dm=0.5	1+2	b. hyperbolic orbit:
		72.877	**165.2**	**14.55**	**dm=0.4**	**4 n**	a. –0°.2, –0″.17
							b. –0.2, –0.19.
–	GP 30	73.633	316.4	2.33	11.0–11.5	1+2	
19051–087N3412–21							
9.2–9.7							
12345	J 116	72.484	128.7	4.15	10.5–11.5	1+2	The angle has increased by 37°
19166–218S0133–22		72.547	127.2	4.59	dm=1.0	1+1	since 1895.
10.5–10.7		72.552	126.2	4.50	9.5–11.0	1+1	
		72.521	**127.6**	**4.38**	**dm=1.2**	**3 n**	
–	GP 33	72.716	233.4	0.84	9.5–9.7	2+2	GP 33=BD+34°3549 (9^m.4)
19231–268N3445–56							
8.8–9.0							
–	GP 34	73.513	66.9	2.69	dm=4.0	1+1	The retrograde motion evident:
19252–289N3503–25		73.612	72.0	2.64	dm=3.0	1+2	1969.78 79°.0,2″.88,2 n
9.6–12.6		73.639	71.6	3.38	dm=4.0	1+1	GP 34=+34°3568 (9^m.5)
		73.680	69.1	2.42	dm=4.0	1+2	
		73.748	69.6	2.41	dm=3.5	1+2	
		73.648	**69.9**	**2.66**	**dm=3.7**	**5 n**	
–	GP 42	73.606	286.5	3.82	12.5–13.5	1+1	
19285–322N3402–14		73.612	284.4	4.57	12.0–13.5	1+2	
11.0–12.0		73.672	286.6	4.57	10.5–12.0	1+1	
		73.627	**285.6**	**4.36**	**11.7–13.0**	**3 n**	

ADS α, δ m	Disc. 1900–2000 Mult.	Epoch 1900+	θ	ρ	m	W	Notes
			°	″			
12581	Hu 946	73.606	221.4	6.94	8.0 10.0	1+2	The angular decrease by 19°
19286	323N3404−17	73.672	222.0	7.06	8.5 10.5	1+1	and the increase in distance by
8.6−10.6		73.688	222.8	7.00	8.7 11.0	1+1	1″.8 since 1904.
		73.648	**222.0**	**6.99**	**8.4 10.5**	**3 n**	
12638	OΣ 376	73.688	232.8	2.39	8.5 12.0	1+1	
19314−351N3359−72							
8.1−10.8							
12667	OΣ 377	73.748	38.9	1.07	dm 0.0	1+1	The angle has decreased by 12°
19326−362N3526−39							since 1842.
9.3−9.4	AB						
12746	Hu 953	73.628	216.6	0.55	dm 0.7	2+1	The angle has increased by 40°
19352−389N3501−15							since 1904.
8.8−9.2							
—	Es 2303	72.547	21.7	4.23	9.5−14.0	1+1	Component C existis.
20204−243N3457−77		72.552	23.5	4.60	9.5−14.0	1+1	AC: 1972.552, 149°, 47″.6
10.8−12.2	AB	72.716	23.4	4.74	9.0−14.0	1+2	
		72.621	**22.9**	**4.55**	**9.3 14.0**	**3 n**	
14194	ARG 39	72.484	163.5	10.82	8.7−9.5	2+2	The angular increase by 54° and
20393−424N4854−76							the increase in distance by 1″.2
8.7−9.3	AB						since 1903.
14233	Σ 2723	72.484	120.8	0.99	dm 1.5	1+2	The angular increase by 36° and
20402	450N1157−79	72.716	123.3	1.01	7.0−8.5	2+1	the decrease in distance by 0″.5.
6.9−8.7	AB	72.732	121.7	1.01	dm=2.0	1+1	
		72.633	**122.0**	**1.00**	**dm 1.6**	**3 n**	
14260	A 173	72.716	132.8	0.71	9.0 11.0	2+2	Since 1900 the angle has decreased
20414−458N2354−76							by 16°.
9.0 11.0							
14286	β 364	73.688	240.5	1.23	9.0−9.0	1+2	Since 1876 the angle has increased
20427−470N2503−25							by 21°.
8.9−9.1							
14421	OΣ 418	73.688	282.4	1.06	8.0−8.2	1+2	Since 1842 the angle decreased
20507−548N3219−42		73.691	285.1	1.11	dm=0.0	2+2	by 18°.
8.1−8.2		**73.690**	**283.9**	**1.09**	**dm=0.1**		
14499	Σ 2737	72.732	286.5	1.07	dm=0.3	1+2	Van den Bos., 1933:
20541−591N0355−78		72.861	285.9	1.09	dm=0.1	1+2	+0°.7, −0″.01
5.8−6.3	AB	72.877	287.5	0.98	dm=0.7	1+2	
		72.823	**286.6**	**1.05**	**dm 0.4**	**3 n**	
14499	Σ 2737	72.732	69.4	10.81	m_C=8.5	1+2	Zeller G., 1965 (hyperbolic orbit):
20541−591N0355−78		72.861	69.5	10.36	m_C=9.5	1+2	0°.0, 0″.16
7.1	AB×C	72.877	67.6	10.68	6.0−9.5	1+2	
		72.823	**68.8**	**10.62**	**m_C 9.2**	**3 n**	
	GP 24	72.492	241.6	7.54	dm 3.0	1+2	GP 24 = BD+34°4278 (9m.5)
21019−059N3435−59							
9.6−12.4							
15645	OΣ 462	73.612	319.7	1.11	—	1+2	The angular decrease by 14° and
22027−070N3536−65		73.863	319.5	1.03	8.0 9.0	1+1	the decrease in distance by 0″.3
7.9−9.7	AB	**73.712**	**319.6**	**1.08**	**8.0−9.0**	**2 n**	since 1848.
16037	Ho 475	72.736	310.9	1.15	—	3+3	The angular decrease by 15° and
22280−327N2554−84		72.861	307.6	0.88	—	1+1	the increase in distance by 0″.4.
9.3−9.5	AB	**72.767**	**309.6**	**1.08**	—	**2 n**	
16037	Ho 475	72.736	223.6	8.20	m_C=11.5	3+2	No change since 1893.
22280−327N2554−84		72.861	223.7	8.10	7.5−10.0	1+1	
8.9−10.9	AB×C	**72.772**	**223.6**	**8.17**	**m_C=11.1**	**2 n**	

ADS α, β m	Disc. 1900−2000 Mult.	Epoch 1900+	θ	ρ	m	W	Notes
			°	″			
16435 22551−597N4117−49 9.3−9.4	Hld 56	73.691	99.3	1.14	dm=−0.2	2+2	The angle has decreased by 26° since 1881.
16467 22580−626N4213−45 5.1−8.8	β 1147 AB	73.691	36.4	0.44	—	1+1	The angle has increase by 78° since 1889.
— 23158−205N3548−80 9.5−9.5	GP 68	73.628 73.776 **73.694**	318.7 317.4 **318.1**	0.98 1.23 **1.09**	dm=−0.1 dm=0.0 **dm=−0.1**	3+2 2+2 **2 n**	GP 68=BD+35°5010 ($9^m.4$). Firs measure of the pair: 1971.86:323°.4, 1″.10, 2 n
— 23169−217N3550−83 9.0−11.7	GP 67	73.776	308.1	2.94	9.5−13.0	2+2	
— 23224−272N2941−74 13.0−13.0	GP 3	73.759	115.8	4.20	12.5−12.5	1+2	
17167 23564−615N3011−44 8.2−10.2	Ho 208	73.749	201.7	0.96	$m_{tot.}$=8.5	1+1	The angular decrease by 34° and the increase in distance by 0″3 since 1884.

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MICROMETRIC MEASUREMENTS OF 176 PAIRS OF DOUBLE STARS (Series 23)

D. OLEVIĆ

SUMMARY:

Information on 192 micrometric measurements of 176 double stars, made with the refractor „Zeiss“ 65/1055 cm.

This list contains 192 micrometric measurements of 176 pairs of double stars and multiple stars made with „Zeiss“ refractor of the Beograd Observatory (D=65 cm, F=1055 cm).

The structure of pairs by distance ρ is as follows: $\rho<1''$: N=85; $1''\leqslant\rho<2''$: N=68; $\rho\geqslant2''$: N=23

In column Δm are shown the differences of apparent magnitudes of components for most of measured pairs according to author's estimation

In „Notes“ the following remarks are given:

1=a change is observed in position angle θ,
2=a change is observed in distance ρ,
1, 2=a change is observed in θ and ρ,
0=no changes are observed in θ and ρ,

For pairs with orbit, besides the author's name and the year of publication also deviations of the measured magnitude from that computed by this orbit are given.

For pairs with components of the same apparent magnitudes the quadrant is coordinated with that from IDS catalogue.

ADS	IDS	Nom		Comp.	1900+	θ	ρ	Δ m	n	Notes
24	23588N2725	A	429	AB	73.779	153°.0	0″.56	0.8	1	1
24	23588N2725	HJ	1929	AB×C	73.779	289.2	5.20	—	1	1
39	23597N4325	A	203		72.815	341.0	1.60	0.3	1	
142	00063N2903	HO	1		72.612	341.9	1.09	0.1	1	1
293	00158N6627	STT	6	AB	73.863	158.0	0.59	—	1	Muller, 1954: +5°.8, +0″.02
304	00172N5344	A	907		73.705	39.6	0.90	0.2	1	0
367	00226N2301	BU	779		72.859	252.2	0.72	1.0	1	
416	00254N4659	BU	394		73.680	289.8	0.84	—	1	2
475	00294S0466	STF	39	AB×C	72.815	44.0	19.20	—	1	0
955	01042N2316	BU	303		72.621	288.5	0.76	—	1	0
1040	01119N4829	STF	102	AB	73.779	278.9	0.53	1.5	1	1
1081	01147S0061	STF	113	A×BC	72.612	190.7	1.47	—	1	
					72.615	189.7	1.55		1	
					72.614	**189.0**	**1.25**		2 n	
1105	01170N5737	STF	115	AB	73.705	147.6	0.64	—	1	
1133	01200N2801	HO	310		72.815	356.9	1.63	0.2	1	
1161	01225N4216	AC	14		72.859	92.4	0.76	1.0	1	0
1294	01336N2626	BU	508	AB	73.749	60.6	0.75	9.3−10.2	1	0
1449	01440N3234	BU	1016		72 815	226.0	0.94	0.2	1	2
1502	01473N4408	STF	3113		73.681	274.8	0.83	0.1	1	2
1503	01478N1456	BU	260		72.859	253.3	0.98	0.2	1	1
1522	01494N2818	STF	183	AB×C	73.779	157.3	5.35	—	1	1
1786	02148N4219	STF	248		73.749	100.6	0.76	—	1	1,2
1933	02258N4603	BRT	330		73.705	217.3	1.95	0.0	1	1,2
1956	02290N1122	HLD	63		72.859	292.5	0.98	—	1	0
1962	02292N4345	A	1528		73.681	13.3	1.45	0.0	1	
2004	02327N3259	STF	285		72.815	163.4	1.79	0.8	1	
2366	03034S0358	BU	528	AB	73.749	191.1	0.72	—	1	0
2581	03257S0437	STF	408		73.681	324.3	1.25	0.3	1	
	03291N3508	GP	83		72.938	267.7	0.76	0.8	1	
2815	03454N4030	STT	66		73.749	140.2	1.08	0.3	1	0
3038	04046N4136	BU	546		73.705	40.2	1.02	—	1	0
3187	04182N2954	HO	15		73.749	144.6	0.88	0.1	1	0
3537	04498N3908	HU	1091		73.749	36.2	0.87	—	1	0
3856	05113S0336	BU	318		73.749	252.7	0.81	0.3	1	
4243	05330N3754	STT	112		72.938	55.0	0.88	0.3	1	
4388	05425N0756	STT	119		73.137	340.0	0.67	1.0	1	1
4823	06079N1016	HO	22		72.938	204.4	1.02	—	1	0
4984	06162N2517	HO	25	AB	73.137	248.9	0.77	0.2	1	0
5491	06443N1449	HO	239	AB	73.138	144.3	0.52	0.4	1	0
5983	07142N2170	STF	1066		73.932	220.5	6.20	—	1	Hopma, n:1959; +0°.2 +0″.08
6067	07195N4623	A	2045		72.938	14.7	0.93	1.1	1	2
6175	07282N3166	STF	1110	AB	73.932	116.3	2.04	1.0	1	Muller, 1955; −0°.9, +0″.05
6623	08032N3231	STF	1187		72.210	29.1	2.30	1.5	1	1,2
6650	08065N1757	STF	1196	AB	73.138	315.9	0.96	0.4	1	
					73.932	311.8	0.79	0.8	1	
					73.535	**313.8**	**0.88**	**0.6**	**2 n**	
				A×C	73.932	78.7	5.96	0.2	1	
				AB×C	73.138	79.8	5.42	0.3	1	1,2
6946	08367N3870	BU	209		72.224	4.6	1.19	0.1	1	
7071	08482N3057	STF	1291	AB	73.223	310.5	1.32	0.3	1	
7153	08564N4764	HU	720		72.224	141.1	0.68	0.2	1	0,0
7229	09044N6983	STF	1313		72.232	271.7	1.04	0.0	1	1,2
7236	09071N1656	STF	1322		73.138	54.3	1.44	0.1	1	
7286	09123N3547	STF	1333		73.932	49.7	1.97	—	1	
7307	09147N3837	STF	1338	AB	73.932	244.3	0.99	0.2	1	Gu-li, 1953: +2°.5, −0″.04
7390	09231N0930	STF	1356		72.248	352.2	0.51	—	1	Muller, 1957: −0°.2, 0″.00

ADS	IDS	Nom.	Comp.	1900+	θ	ρ	m	n	Notes
7398	09236N4242	A 1985		73.223	30.4	1.10	0.0	1	1,2
7456	09316N1641	STF 1372		72.224	69.5	0.44	0.0	1	1,2
7536	09440N6065	STF 1381		72.232	198.8	1.07	0.1	1	1,2
7566	09468N6882	STF 1386	AB	72.256	109.0	1.86	0.0	1	1,2
7632	09599N3134	STF 1406		73.223	225.5	1.01	0.8	1	0.0
7632	09599N3134	STF 1406		73.266	223.3	1.16	0.7	1	
7692	10091N1783	L 10		72.224	359.1	1.03	0.5	1	1,0
7704	10108N1774	STT 215		72.248	182.9	1.20	0.2	1	
				72.218	184.5	1.16	0.2	1	1
				72.223	**183.4**	**1.19**	**0.2**	**2 n**	Zaera, 1957: 0°.0 −0″.17
7758	10195N4468	STF 1429		72.232	191.8	0.55	0.0	1	1
7864	10335N0575	STF 1457		72.256	329.7	1.82	0.8	1	1
7898	10374N4469	STF 1465		73.266	9.3	2.04	0.2	1	0
7929	10423N4138	STT 229		72.224	287.0	0.82	0.5	1	1
7943	10456N2459	STF 1478		73.223	345.0	8.48	0.1	1	0
8043	10588N0371	STF 1504		72.256	296.0	1.33	0.0	1	1
8067	11028N1044	J 81		73.308	135.4	1.88	0.2	1	1
8169	11222N4443	A 1848		73.266	206.1	0.69	0.1	1	1,2
8222	11296N0163	AG 175		72.232	189.9	2.09	0.4	1	0
8355	11511N3560	STT 241	AB	73.308	139.0	1.85	2.5	1	1
8446	12058N3987	STF 1606		73.266	275.9	0.57	—	1	1
8460	12075N3579	STF 1613		73.308	8.0	1.29	0.0	1	0
8549	12214S0120	HLD 13	AB	73.226	138.7	1.44	0.3	1	1
8611	12322N2145	STF 1663		72.235	85.0	0.62	0.3	1	1
8625	12358N0883	STF 1668		72.377	188.8	1.10	—	1	1
8651	12393N3579	HO 256		73.308	118.2	0.65	2.5	1	1
8791	13032N2689	STT 260		73.226	156.1	0.68	—	1	
8814	13073N3237	STT 261		72.235	340.0	2.17	0.5	1	1,2
8897	13207N4443	ES 1548		73.308	7.1	1.39	0.2	1	1,2
8968	13318N0681	A 1611		73.226	126.8	0.79	0.0	1	1,2
8974	13330N3648	STF 1768	AB	72.235	105.7	1.62	3.1	1	Jackson, 1921: +2°.2, −0″.09
9031	13445N2689	STF 1785		72.401	151.0	3.23	—	1	
				73.294	151.4	3.17	0.5	1	
				72.847	**151.2**	**3.19**	**0.5**	**2 n**	
9116	14033N2472	A 346		73.226	313.8	1.13	1.3	1	1,2
9182	14103N0336	STF 1819		72.235	260.7	0.84	0.2	1	Baize, 1973: −1°.5, −0″.02
9269	14230N2064	HO 542		73.226	224.6	1.00	0.0	1	1,2
8340	14365N3143	STF 1867		73.294	3.1	0.92	0.6	1	
				73.453	1.7	0.95	—	1	
				73.374	**2.4**	**0.94**	**0.6**	**2 n**	1,2
9350	14381M5150	STF 1871		73.410	304.3	1.68	0.0	1	1
9498	15008N1161	STF 1907		73.235	355.5	1.19	0.1	1	1
9599	15169N3521	HO 62		73.294	278.8	1.47	—	1	0
9630	15215N2659	STF 1941		73.226	218.4	1.33	0.0	1	1
9641	15228N2376	A 82		73.447	340.4	0.86	1.2	1	1
9647	15228N0627	STF 1944		73.226	310.7	1.05	0.5	1	1
9809	15464N1929	A 2078		72.494	157.6	1.05	0.5	1	0
9853	15610N8355	STF 2034		73.396	110.8	1.12	0.6	1	0
9880	15562N1333	STT 303		72.235	165.5	1.34	0.3	1	
				73.395	164.7	1.29	—	1	
				72.815	**165.1**	**1.32**	**0.3**	**2 n**	1
9925	16026N1670	BU 812		73.226	104.2	0.75	0.2	1	1,0
9969	16086N1348	STF 2021	AB	73.294	350.3	4.14	—	1	1,0
10036	16198N3335	BU 951	AB×C	73.226	34.9	1.07	0.6	1	1,0
10070	16238N2572	STF 2049		72.396	196.8	—	—	1	1
10107	16283N2327	BU 817		73.294	329.9	1.05	—	1	0,0

ADS	IDS	Nom.	Comp.	1900+	θ	ρ	Δm	n	Notes
10169	16389N4123	STF 2091		72.412	311.5	0.76	0.7	1	1,0
10217	16433N0255	BU 43		73.226	238.2	1.31	0.1	1	1,2
10235	16479N2850	STF 2107	AB	73.521	84.7	1.06		1	Rabe, 1927: +0°.4, −0″.28
10312	16572N0836	STF 2114		72.235	185.0	1.16	—	1	
				72.473	182.5	1.40	1.3	1	
				72.354	**183.8**	**1.28**	**1.3**	**2 n**	1
10345	17033N5436	STF 2130	AB	72.538	52.0	1.95	—	1	Heintz, 1965: −2°.6, −0″.02
10418	17101N1430	STF 2140	AB	73.294	107.3	4.91	—	1	1
10464	17157N4958	HU 669		73.447	77.6	0.79	0.1	1	0
10526	17202N3714	STF 2161	AB	72.456	317.2	4.06	—	1	0
10699	17368N5549	STF 2199		73.294	64.3	1.93	0.5	1	1
10722	17381N4142	STF 2203		73.513	301.2	0.77	—	1	1
10988	17581N5251	STF 2271	AB	72.473	265.9	3.01	1.0	1	1,2
11011	17596N4414	BU 1127		73.447	84.9	0.78	7.9−9.0	1	1, BD+44°2814 prob. BU 1127
11155	18082N2737	STF 2292		72.412	267.3	0.95	0.2	1	0
11186	18094N0009	STF 2294		73.513	95.1	0.99	—	1	Wilson J. N. R, 1935: +0°.9, −0″.01
11291	18176N1410	AG 222		72.456	146.0	1.39	0.3	1	2
11562	18372N5554	A 1380	AB	72.473	21.4	0.92	0.2	1	0
11610	18386N0438	A 357		73.447	72.2	0.63	0.1	1	0
11617	18389N0231	STF 2369		72.413	75.9	0.52	0.5	1	1,2
11640	18406N0524	STF 2375	AB×CD	72.457	120.1	2.38	0.1	1	1
11722	18450N1034	STF 2402		72.620	269.2	2.03	1.0	1	1,2
11956	18575N1902	STF 2437		72.413	34.0	0.66	—	1	
				72.620	32.2	0.71	—	1	
				72.517	**33.3**	**0.69**	—	**2 n**	1,2
12137	19074N4128	A 590		73.447	152.1	0.65	0.1	1	1,2
12239	19119N2717	STT 371	AB	72.612	158.1	0.88	0.2	1	1
12447	19225N2707	STF 2525		73.710	291.4	1.71	0.2	1	Finsen, 1937: −0°.9, +0″.08
12623	19302N1755	STT 375		72.626	169.2	0.66	0.8	1	1
12624	19324N6548	HU 1304		73.685	266.0	0.86	0.2	1	0
12746	19352N3501	HU 953		72.473	213.9	0.58	0.6	1	1,2
12880	19418N4453	STF 2579	AB	73.710	235.4	2.39	—	1	Rabe, 1961: −0°.4, + 0″.21
12930	19432N3307	HU 758		72.457	146.8	0.95		1	0
12965	19446N3655	STT 386		72.615	73.5	1.02	—	1	0
				72.620	73.6	0.95	0.0	1	
				72.618	**73.6**	**0.98**	**0.0**	**2 n**	0
13384	20020N1239	BU 428		72.626	353.2	0.71	1.5	1	1
13542	20092N1551	STF 2651		72.620	276.3	1.22	0.0	1	
				72.705	278.0	1.02	0.0	1	
				73.745	277.1	1.20		1	
				73.025	**277.1**	**1.13**	**0.0**	**3 n**	0
13649	20134N2604	BU 984		73.677	244.3	0.65		1	1,2
14083	20339N2937	A 743		72.620	309.5	1.01	0.5	1	0
14088	20340N2932	A 744		72.62[illegible]	274.1	0.86	0.0	1	2
14126	20359N4014	STT 410	AB	73.745	2.4	0.70		1	1
14397	20488N2846	STT 417	AB	72.626	29.2	0.78	0.0	1	1
14558	20580N3852	STF 2746		72.473	309.0	—		1	
				72.705	311.1	0.97	1.2	1	
				72.589	**310.1**	**0.97**	**1.2**	**2 n**	1
14562	20582N3850	LV 9		72.705	191.6	2.06	1.0	1	0
14573	20580N0108	STF 2744	AB	73.685	127.9	1.22	0.3	1	Popović, 1964: −1°.1, −0″.06

ADS	IDS	Nom.	Comp.	1900+	θ	ρ	Δ*m*	*n*	Notes
14626	21025N5316	BU 680	AB	73.710	291.3	0.70	0.5	1	1
14778	21105N4044	STT 432		73.746	121.5	1.40	—	1	
				73.754	116.8	1.36	0.4	1	
				73.750	**118.0**	**1.37**	**0.4**	**2 n**	1
14879	21162N2718	A 295		72.626	243.4	0.50	0.2	1	1
15002	21237N0717	HU 276		72.621	31.8	0.91	0.2	1	0
15007	21240N1039	STF 2799	AB	73.685	266.7	1.72	—	1	1
15039	21262N3437	HLD 45		73.677	16.9	1.25	—	1	0
15155	21340N4126	A 402		73.754	48.0	0.84	—	1	0
15177	21347N2016	STT 445		73.779	118.4	0.93	0.2	1	0
15245	21377S0253	A 180		72.626	52.0	0.85	—	1	0
15270	21397N2817	STF 2822	AB	72.612	290.0	1.81	—	1	Heintz, 1965: −2°.5, −0″.05
15769	22100N2905	STF 2881		72.582	83.3	1.23	—	1	1,2
15843	22156N2901	BU 1216		72.621	285.7	0.85	0.3	1	1,2
15899	22199N1843	HU 493		73.754	168.0	0.99	0.3	1	0
15971	22237S0032	STF 2909	AB	72.705	240.5	1.81	—	1	Rabe, 1954: −2°.1, −0″.02
16037	22280N2554	HO 475	AB	72.626	311.0	0.99	0.4	1	
				73.863	307.0	0.86	0.4	1	
				73.244	**309.7**	**0.95**	**0.4**	**2 n**	1,2
			AC	72.626	226.6	8.12	2.8	1	0
16046	22287N4852	HU 1320		72.621	296.3	0.42	—	1	Muller, 1954: +1°.5 +0″.15
16139	22341N1819	HU 392		73.710	348.6	0.76	0.3	1	2
16185	22370N2054	STF 2934	AB	73.779	79.9	0.99	1.0	1	Heintz, 1960: +1°.7, +0″.12
16428	22542N1112	STT 483		72.621	295.9	0.87	2.0	1	Gu-li, 1956: +5°.4, +0″.18
16435	22551N4117	HLD 56		72.582	99.5	1.12	—	1	
				73.680	100.2	1.08	8.0−8.3	1	
				73.131	**99.8**	**1.10**	**8.0−8.3**	**2 n**	1.2
16537	23037N1500	HU 995		73.754	190.3	1.06	—	1	0
16561	23055N3156	BU 385	AB	73.779	96.6	0.64	0.5	1	1
16602	23084N2132	STF 2990		73.762	58.7	2.19	—	1	1,2
16748	23210N2709	HO 489	AB	72.621	230.9	0.58	—	1	1
16783	23242N4251	A 109		73.754	314.8	0.98	0.3	1	2
16807	23258N0856	STT 497		72.858	213.4	1.12	—	1	0
16873	23323N0704	Fox 102	AB	73.779	271.4	0.39	—	1	Popović, 1972: −2°.6, +0″.09
16957	23390N2849	AGC 14		73.680	243.7	1.15	4.0	1	1
16995	23419N0442	BAR 19		72.858	356.2	0.84	0.0	1	1
17006	23426N4617	BU 995		73.754	248.0	0.90	2.5	1	1
17076	23476N2225	BU 859		72.615	199.4	0.79	—	1	
				73.705	197.6	0.94	0.0	1	
				73.182	**198.5**	**0.86**	**0.0**	**2 n**	1
17143	23542N7417	BU 1154		73.863	323.6	1.09	—	1	1
17156	23551N0113	WEI 45		72.621	86.0	1.87	0.0	1	0
17167	23564N3011	HO 208		73.749	199.5	1.14	—	1	1,2

THE NEW DOUBLE STARS DISCOVERED IN BELGRADE WITH THE ZEISS REFRACTOR 65/1055 cm, SUPPLEMENT IV

G. M. POPOVIĆ

SUMMARY:

The positions of 23 new double or multiple systems discovered in Belgrade with Zeiss refractor 65/1055 cm are presented together with 58 of their measurements.

This supplement of new pairs is the continuation of the results of previous checking (Popović G., 1972/1973) of BD stars in zones +34° and +35° (epoch 1855).

The structure of pairs by ρ, in this and previous supplements, is as follows:

Suppl.	ρ<1″	1″⩽ρ<3″	ρ⩾3″	Σ
I	1	—	13	14
II	5	11	12	28
III	—	7	23	30
IV	3	9	11	23
Σ	9 (9%)	27 (28%)	59 (62%)	95

The symbol ⋆ shows that for this pair Notes, at the end, are presented.

Double star	1900 α 1950 δ 2000	t	θ	ρ	m	Mgf.	W	BD Δα Δδ	C. I. UAI Comm. 26
GP 71	03078N3456	71.974	102°.5	4″.14	11.0−12.5	590	1 2 3	+34°604 ($7^m.7$)	
	03109N3507	71.977	102.8	4.22	11.5−13.0	420	1 1 2	$-8^s-4'$	
	03140N3519	72.094	100.8	4.17	*dm*=1.5	500	1 1 2		
		72.009	**102.1**	**4.17**	**dm=1.5**		**3 n**		
GP 83⋆	03291N3508	72.938	267.3	0.75	8.0−9.0	590	2 2 4	+34°685 ($8^m.0$)	62
	03322N3518	72.941	266.5	0.67	—	590	1 2 3		
	03354N3528	74.071	264.9	0.72	8.0−8.7	500	3 2 5		
		73.411	**266.1**	**0.72**	**8.0−8.8**		**3 n**		
GP 84	07060N3522	73.108	188.3	1.89	dm=0.5	590	1 1 2	+35°1573 ($9^m.5$)	62
	07094N3517	74.074	188.2	1.94	dm=0.1	590	1 2 3		
	07127N3513	**73.688**	**188.2**	**1.92**	**dm=0.3**		**2 n**		
GP 74⋆	07174N3439	72.234	147.7	9.00	9.5−11.0	590	1 2 3	+34°1592 ($9^m.2$)	
	07207N3434	72.242	146.7	9.24	9.5−12.0	590	1 2 3	$+63^s+2'$	
	07240N3428	**72.238**	**147.2**	**9.12**	**9.5−11.5**		**2 n**		
GP 75⋆	07250N3407	72.234	210.2	5.89	9.5−13.0	590	1 2 2	+34°1624 ($9^m.4$)	
	07283N3401	72.242	210.1	6.30	9.3−12.5	590	1 2 3		
	07315N3346	72.245	210.1	6.25	9.5−12.5	590	1 2 3		
		72.259	211.3	6.63	9.4−12.5	590	1 2 3		
		72.261	210.1	5.84	9.3−12.5	590	1 1 2		
		72.248	**210.4**	**6.23**	**9.4−12.6**		**5 n**		
GP 87	07389N3402	73.226	261.9	3.26		500	1 1 2	+34°1667 ($8^m.7$)	62
	07422N3356							$-8^s-2'$	
	07454N3349								
GP 97	08372N3403	74.261	279.2	0.79	dm=+0.1	500	1 2 3	+34°1888 ($9^m.5$)	63
	08403N3352	74.271	279.1	0.75	dm=−0.7	590	2 1 3		
	08435N3341	74.274	281.3	0.74	dm=+0.1	590	1 1 2		
		74.268	**279.7**	**0.76**	**dm=−0.3**		**3 n**		
GP 85	10054N3416	73.226	41.4	4.52	11.0−12.5	500	2 1 3	+34°2095 ($9^m.5$)	
	10084N3402	73.370	41.1	4.61	10.5−12.0	590	1 1 2	$-7^s+2'$	
	10113N3347	73.386	41.6	4.61	11.0−12.5	500	1 2 3		
		73.322	**41.4**	**4.58**	**10.9−12.4**		**3 n**		
GP 73	10511N3351	72.234	200.1	0.75	9.8−9.8	590	1 2 3	+34°2186 ($9^m.4$)	57
	10538N3335	72.259	203.2	0.80	9.5−9.5	590	1 2 3		
	10560N3318	72.311	205.3	0.90	9.7−9.7	590	1 1 2		
		72.263	**202.6**	**0.81**	**9.7−9.7**		**3 n**		

Double star	1900 α 1950 δ 2000	t	θ	ρ	m	Mgf.	W	BD Δα Δδ	C. I. UAI Comm 26
GP 72	13119N3504	72.221	314.1	1.44	9.5 – 10.5	590	1 2 3	+35°2430 ($9^m.5$)	57
	13142N3448	72.391	320.1	1.47	10.0 – 11.5	590	1 1 2	$+4^s+8'$	
	13166N3432	72.412	318.6	1.45	9.5 – 10.5	590	1 2 3		
		72.335	**317.3**	**1.45**	**9.7 – 10.8**		**3 n**		
GP 89	16296N3548	73.543	171.0	2.94	12.0 – 12.3	590	1 1 2	+35°2833 ($9^m.5$)	62
	16315N3542	73.584	171.4	2.56	12.7 – 13.0	590	1 2 3	$+4^s-3'$	
	16332N3535	**73.568**	**171.2**	**2.71**	**12.4 – 12.6**		**2 n**		
GP 76	17111N3455	72.391	117.1	2.25	10.5 – 11.7	590	1 1 2	+34°2928 ($7^m.0$)	57
	17130N3452	72.473	112.9	1.55	12.5 – 13.0	590	1 1 2	$-53^s+6'$	
	17148N3448	72.492	113.4	1.83	12.5 – 13.0	590	1 1 2		
		72.452	**114.5**	**1.88**	**11.8 – 12.6**		**3 n**		
GP 77*	17129N3455	72.415	322.2	4.11	10.0 – 13.0	590	1 1 2	+34°2930 ($9^m.2$)	
	17147N3451	72.456	321.2	4.35	10.0 – 13.0	590	1 1 2	$+9^s+1'$	
	17165N3448	72.492	320.3	4.58	10.0 – 14.0	590	1 1 2		
		72.454	**321.2**	**4.35**	**10.0 – 13.3**		**3 n**		
GP 78*	18078N3505	70.600	249.8	13.68	10.0 – 10.5	590	1 1 2	+35°3173 ($9^m.5$)	
	18096N3506	72.484	249.5	13.62	9.5 – 10.0	590	1 1 2		
	18113N3506	72.732	250.1	14.18	9.0 – 10.0	590	1 2 3		
		72.052	**249.8**	**13.88**	**9.5 – 10.2**		**3 n**		
GP 79	19274N3509	73.513	325.6	4.32	12.0 – 12.2	590	1 1 2	+35°3661 ($8^m.9$)	
	19293N3515	73.606	325.0	4.11	12.0 – 12.3	590	1 1 2	$-3^s-3'$	
	19311N3521	**73.560**	**325.3**	**4.22**	**12.0 – 12.2**		**2 n**		
GP 95*	19280N3457	73.612	298	27.71	$m_A=9.0$	590	1 2 3	+34°3589 ($9^m.5$)	62
A – B	19298N3503								
	19327N3509								
BC		73.606	24.5	2.20	10.0 – 11.0	590	1 1 2	+34°3489 ($9^m.5$)	62
		73.612	20.0	2.45	11.0 – 12.0	590	1 2 3		
		73.623	23.3	2.48	10.0 – 10.5	590	1 1 2		
		73.613	**22.2**	**2.39**	**10.3 – 11.2**		**2 n**		
GP 96*	19327N3419	73.612	108.7	1.17	11.0 – 11.5	420	2 2 4	+34°3628 ($9^m.2$)	62
	19344N3426	73.628	113.1	1.15	11.0 – 11.2	500	1 1 2	$-6^s+5'$	
	19363N3433	**73.617**	**110.1**	**1.16**	**11.0 – 11.4**		**2 n**		
GP 94	20203N3437	73.601	150.5	2.33	12.3 – 12.5	590	1 1 2	+34°4000 ($9^m.5$)	62
	20223N3446	73.680	152.9	2.80	12.5 – 12.9	420	1 2 3	$+6^3-4'$	
	20242N3456	**73.648**	**152.0**	**2.62**	**12.4 – 12.7**		**2 n**		
GP 80	20204N3448	72.716	328.5	2.17	12.0 – 12.5	590	1 1 2	+34°3998 ($9^m.3$)	62
	20224N3456	73.601	329.5	2.21	12.7 – 13.0	700	1 1 2	$+34^s\ 0'$	
	20243N3506	73.680	331.9	2.45	12.5 – 13.2	590	1 1 2		
		73.333	**330.0**	**2.28**	**12.4 – 12.9**		**3 n**		
GP 82	20544N3549	72.733	22.4	4.22	10.5 – 12.0	590	1 2 3	+35°4342 ($9^m.0$)	
	20563N3600							$+15^3-4'$	
	20583N3611								
GP 81	20562N3524	72.733	203.8	5.57	13.0 – 13.5	590	1 2 3	+35°4349 ($9^m.5$)	
	20581N3533							$-2^s+2'$	
	21001N3544								
GP 88	21510N3410	73.639	246.4	3.07	11.0 – 12.5	500	1 1 2	+33°4383 ($9^m.3$)	62
	21531N3424								
	21553N3438								
GP 91	21546N3427	73.585	302.1	2.07	10.0 – 13.0	700	1 1 2	+33°4395 ($8^m.7$)	62
AB	21567N3440	73.601	297.0	2.09	11.0 – 14.0	700	1 1 2	$+24^s+16'$	
	21589N3454	**73.593**	**299.6**	**2.08**	**10.5 – 13.5**		**2 n**		
AC		73.601	317.7	20.0	$m_C=12.5$	590	1 1 2	+33°4395 ($8^m.7$)	—

NOTES:

GP 83 — The identification of this pair is correct as I published in Circ. Inform. No 62 UAI March 1974. So: GP 83 = BD + 34°685 ($8^m.0$).

GP 74 — On March 26th, 1972., I did not find BD +34°1596 ($9^m.4$) at the position which correspond to BD map. Maybe GP 74 is just that BD star.

GP 75 — The possibility that componente A is double exists. Uncertain informations of possible duplicity I obtained twice:

1972.259	52°	~ 0″.4
1972.261	58	~ 0.6

GP 77 — On June 28th, 1972., I got the impression that BD +34°2930 ($9^m.2$), (reference star for GP 77 pair) is close pair.

GP 78 — A component looks elongate in direction $\theta \sim 187°$.

GP 95 — Also D component exists ($\theta \sim 348°$).

GP 96 — Also C component exists ($\theta \sim 222°$, $\rho \sim 5''$).

REFERENCE:

Popović, G., 1972/73: Bull. Obser. Astron. Belgrade, No **125**, pp. 44.

ORBIT OF THE DOUBLE STAR ADS 11311=STT 353 AB

D. OLEVIĆ

SUMMARY:

Information is given on the elements of the orbit and ephemerides of the pair ADS 11311= STT 353 as well as on astrophysic quantities resulting from these elements.

We have data on the double star ADS 1131 (*Sp.* : *AO*; Mag.: $4^m.4-6^m.1$) (Table 1) that make it possible to derive the elements of its orbit.

The data 24 and 25 have been obtained trough courtesy of Dr. P. Muller from the Observatory in Meudon.

The analysis of the graph $\theta=\theta\ (t)$ and $\rho=\rho\ (t)$ led to the conclusion that for the determination of orbit elements of this pair it is most appropriate to form normal places (Table 2).

The measurements 11, 16 and 17 of Table 1. have not been taken into account because of great accidental errors.

Using the data from Table 2, the following orbit elements of this pair were calculated by Thiel-Innes--Van den Boss method:

$P=271^h.7$	$a=0''.3925$	$A=-0''.178$
$n=1°.32495$	$i=118°.96$	$B=-0.326$
$T=1720.75$	$\Omega=72°.25$	$F=-0.124$
$e=0.44$	$\omega=201°.25$	$G=+0.192$

πdyn$=0''.00357$ πtr.$=0''.008\pm5$ (Yale, L. F. Jenkins, 1952)

From the obtained orbit elements the following quantities were computed:

	Components: A	B	*Ephemerides:*		
M	− 2.82	−1.4	1974.0	274°.5	0″.22
$\mathfrak{M}$	12.28⊙	5.70⊙	1977.0	269.0	0.22
R	5.62⊙	3.29⊙	1980.0	263.0	0.23
ρ	0.07⊙	0.16⊙			
Te	4.01⊙	2.52⊙			
	22903° K	14385°K			

Table 1.

N.	t	θ_{2000}	ρ	n	Obs.	Ref.
1.	1856.13	63°.6	0″.56	6	0Σ	ADS
2.	1868.77	63.6	0.5...	6	Δ	BDS
3.	1878.59	52.2	0.39	8	H1	BDS
4.	1881.12	57.7	0.44	9	β	BDS
5.	1898.86	50.8	0.38	6	Hu	BDS
6.	1900.94	49.0	0.42	4	Com	ADS
7.	1903.92	55.4	0.40	3	VBs	BDS
8.	1905.80	47.7	0.45	9	VBs	ADS
9.	1906.47	43.6	0.27	3	Lau	ADS
10.	1909.55	49.8	0.43	4	Dob	ADS
11.	1909.68	61.7	0.67	2	Sto	ADS
12.	1915.52	31.6	0.30	1	A	ADS
13.	1921.30	32.3	0.23	3	A	ADS
14.	1923.69	33.6	0.25	5	Mag	ADS
15.	1940.59	350.7	0.179	1	F	Bull. Lick. Obs. N° 518
16.	1940.68	8.2	0.23	1	VBs	Publ. Yerkes Obs. Vol. VIII, part VI

17.	1941.52	323.9	0.125	1	G	Bull. Lick. Obs N° 518.
18.	1943.67	343.4	0.19	4	VBs	Publ. Yerkes Obs. Vol. VIII, part VI
19.	1945.72	330.0	0.155	1	F	Bull. Lick. N° 518
20.	1946.54	331.2	0.18	3	VBs	Publ. Yerkes Obs. Vol. VIII, part VI
21.	1948.64	326.9	0.17	4	VBs	„ „ „
22.	1951.79	321.2	0.15	2	VBs	Publ. Yerkes Obs. Vol. IX, part II
23.	1953.66	318.1	0.17	4	M	Bull. Lick. Obs. N° 530
24.	1958.58	310.8	0.13	1	B	(priv. coresp. P. Muller)
25.	1960.45	303.3	0.19	5	Wor	Bull. Lick. Obs N° 576
26.	1960.75	304.3	0.29	6	VBs	Kitt. Peak. N. O. Contr. N° 180
27.	1961.57	300.0	0.26	2	Cou	J. O. 45, N° 9, 1962
28.	1962.67	299.4	0.18	4	B	A. J. N° 1313, 1963
29.	1968.75	289.6	0.25	6	Bz	(priv. coresp. P. Muller)

Table 2.

Normal points:

N.	*t.*	θ 2000.0	ρ	*n*	N. P. (T. 1.)	(0−C)	
1.	1856.13	61°.13	0″.56	6	1.	−0°.4	+0″.02
2.	1868.77	61.3	0.5±	6	2.	+3.9	0.
3.	1879.86	53.0	0.42	17	3., 4.	−0.4	−0.06
4.	1904.26	46.1	0.42	29	5., 6., 7., 8., 9., 10.,	+4.5	+0.04
5.	1920.17	31.6	0.25	9	12., 13., 14.,	+2.6	−0.05
6.	1940.59	349.7	0.18	1	15.	−6.9	+0.07
7.	1946.14	332.6	0.18	13	18., 19., 20., 21.	−12.3	+0.06
8.	1952.72	318.3	0.16	6	22., 23.	−8.6	−0.02
9.	1960.80	302.1	0.23	18	24., 25., 26., 27., 28.	−2.3	+0.05
10.	1968.75	289.6	0.25	6	29.	+4.5	+0.04

LES ORBITES NOUVELLES DE TROIS ETOILES DOUBLES VISUELES A162=ADS 12631, Hu 1268=ADS 9285, A 1840 AB=ADS 3326

V. ERCEG

RÉSUMÉ:

On a donné les éléments des orbites, les masses, les magnitudes absolues et les parallaxes dynamiques de trois étoiles doubles, les éléments étant determinés en utilisant la méthode de Thiele-Innes-Van den Bos.

ORBITE de A 162=*ADS* 12631
Pos. (1950): $19^h32^m.9$
+23°22′
Magn. 8.2−8.2; Sp. AO

Elements:

P = 182.58 ans
n = 1°.972
T = 2062.56
e = 0.41
a = 0″.241=60.2 U. A.
i = 51°.13
Ω = 128°.97
ω = 290°.60
$T_{\Omega\mho}$ = 1895.56, 2030.78

Les constantes de Thiele--Innes:

A = +0″.0567
B = +0.1550
F = −0.1833
G = +0.1420

Le système des éléments conduit aux valeurs suivantes de la parallaxe dynamique, des masses et des magnitudes absolues des composantes:

π = 0″.004
$\mathfrak{M}_A$ = 2.38⊙
$\mathfrak{M}_B$ = 2.38⊙
M_A = 1.44
M_B = 1.44,

Les constantes C et H étant:

$C = a \sin i \sin \omega = \pm 0''.1756$
$H = a \sin i \cos \omega = \pm 0.0660$

Observations:

	t	θ	ρ	n	Obs.	Source	0−C	
1.	1900.66	144°.6	0″.21	3	A	ADS	+5°.6	+0″.02
2.	1914.57	166.5	19	3	A	ADS	+4.2	−1
3.	1917.64	172.9	22	2	A	ADS	+5.7	+2
4.	1921.30	178.1	21	3	A	ADS	+4.9	+1
5.	1924.27	178.1	20	2	A	ADS	+0.1	0
6.	1930.53	188.1	20	2	A	La corr. pers. (P. Muller)	−0.3	0
7.	1931.27	182.7	19	4	VBs	Publ. Y. O. Vol. VIII, Part II.	−6.9	−1
8.	1933.56	202.6	21	2	GrO	La corr. pers. (P. Muller)	+9.2	+1
9.	1934.81	197.3	20	1	A	Lick O. Bull. N. 491.	+1.8	0
10.	1935.48	199.5	20	2	A	La corr. pers. (P. Muller)	+2.7	0
11.	1937.07	191.6	20	4	Voûte	„	−7.7	0
12.	1944.36	208.6	20	4	Voûte	J. O. Vol. XXXVIII, N. 6.	−2.7	0
13.	1944.84	219.0	21	2	VBs	Publ. Y. O. Vol. VIII, Part VI.	+6.9	+1
14.	1946.57	217.7	16	3	Jeff.	La corr. pers. (P. Muller)	+2.8	−4
15.	1950.60	207.2	24	1	MRz	Publ. Naval O. Vol. XVII, Part V.	−14.0	+3
16.	1951.73	222.4	18	2	MRz	„	−0.6	−3
17.	1952.80	229.7	22	2	MRz	„	+5.1	+1
18.	1953.55	226.3	16	2	VBs	Publ. Y. O. Vol. IX, Part II.	+0.5	−5
19.	1955.83	216.	22	1	Mull	J. O. Vol. XXXIX, N. 11.	−13.0	+1
20.	1957.95	227.3	17	3	VBs	Publ. Y. O. Vol. IX, Part II.	−5.0	−4
21.	1958.65	229.7	23	4	B	Publ. Y. O. Vol. IX, Part I.	−3.6	+2
22.	1958.65	229.9	22	4	B	„	−3.4	+1
23.	1960.65	246.1	23	4	Cou	J. O. Vol. 44. N. 3	+10.0	+1
24.	1962.48	235.5	22	4	B	Lick O. Bull. N. 583	−3.1	0
25	1962.60	245.2	24	2	Holden	J. O. Vol. 46, N. 5.	+6.4	+2
26.	1962.68	238.4	22	3	Cou	La corr. pers. (P. Muller)	−0.5	0
27.	1964.70	238.0	20	5	Wor	„	−3.6	−2
28.	1964.75	242.5	25	4	Hz	„	+0.9	+3
29.	1965.72	244.3	26	4	Hz	La corr. pers. (P. Muller)	+1.4	+4
30.	1965.73	236.9	23	2	Mull.	J. O. Vol. 49, N. 9.	−6.0	+1
31.	1969.72	239°.8	25	3	Cou	La corr. pers. (P. Muller)	−8.3	+2

Ephémérides:

t	θ	ρ	t	θ	ρ
1973.00	251°.6	0″.23	1977.00	256°.3	24
1974.00	252.8	23	1978.00	257.4	24
1975.00	254.0	23	1979.00	258.6	24
1976.00	255.2	24	1980.00	259.7	0″.24

ORBITE de Hu 1268=*ADS* 9285

Pos. (1950): $14^m29.5$
+36°12′
Sp. F 5

Le nombre des mesures disponibles du système Hu1268=ADS9285 est assez limité. Mais, le changement de l'angle de position, qui était sensible (à peu près 62° pendant 55 ans), permetait une intérpolation suffisament bonne des mesures de la distance et de l'angle de position pour satisfaire à la loi des aires. En sorte qu'on a pu entreprendre une détermination des éléments provisoirs de cette étoile double. Il faut remarquer d'ailleurs, que les données des mesures de deux derniers ans (1956.47 et 1960.57) vu la séparation étroite ($\rho<0''.15$), peuvent produire une discordance notable entre les éléments vrais et ceux calculés, à cause des différences très prononcées dans ces données.

Eléments:

e =0.89
a =0″.355=35.5 U. A.
i =123°.46
Ω =14°.76
ω =261°.22
T =1963.39
P =135.67 ans
n =2°.653
$T_{\Omega\mho}$ =1829.54,1962.21

Les constantes de Thiele-Innes:

$A=-0''.1017$
$B=+0.1733$
$F=+0.3317$
$G=+0.1183$

Les observations:

	t	θ	ρ	n	obs.	Source	0−C	
1.	1905.38	294°.5	0″.30	1	Hu	ADS	0°.0	−0″.07
2.	1906.27	292.7	37	1	A	ADS	−1.3	0
3.	1920.72	284.4	33	2	VBs	ADS	+0.2	− 1
4.	1930.31	276.2	32	3	VBs	Publ. Y. O. Vol. VIII, Part II.	−0.2	+ 1
5.	1946.52	251.6	24	2	VBs	Publ. Y. O. Vol. VIII, Part VI.	−5.8	+ 1
6.	1956.47	223.7	12	5	VBs	Publ. Y. O. Vol. IX, Part. II.	−11.2	− 4
7.	1960.57	232.0	0.13	4	VBs	Kitt Peak N. O. N. 180.	+17.6	+0.03

En utilisant la relation de Parenago pour la série principale de HR diagramme, on a calculés la parallaxe, les masses et les magnitudes absolues des composantes suivantes:

$\pi = 0''.010$
$\mathfrak{M}_A = 1.27 \odot$ $\qquad C = a \sin i \sin \omega = \pm 0''.2927$
$\mathfrak{M}_B = 1.25 \odot$ $\qquad H = a \sin i \cos \omega = \pm 0.0452$
$M_A = 4.00$
$M_B = 4.50$

Ephémérides:

	t	θ	ρ
1.	1973.0	344°.7	0″.22
2.	1975.0	341.5	24
3.	1977.0	338.7	25
4.	1979.0	336.2	27
5.	1981.0	334.0	0.28

ORBITE de A 1840 = *ADS* 3326

Pos. (1950) $4^h33^m.4$ $+8°08'$
Magn. 8.8 Sp. —

Eléments:

$P =$ 140.4 ans
$T =$ 1990.4
$n =$ 2°.5647
$a =$ 0″.237
$e =$ 0.67
$i =$ 129°.74
$\Omega =$ 89°.11
$\omega =$ 70°.33
$T_{\Omega\mho} =$ 1985.34; 2002.01

π dyn. $= 0''.006$
$M_A = M_B = 2.61$
$\mathfrak{M}_A = \mathfrak{M}_B = 1.77 \odot$

Thiele-Innes constantes:

A +0″.1438
B +0.0775
F +0.0475
G −0.2238

$a =$ 41.0 UA
$C = +0''.1716$
$H = +0''.0613$

Ephémérides:

t	θ	ρ
1973.0	132°.6	0″.17
1974.0	130.1	16
1975.0	127.5	16
1976.0	124.8	16
1977.0	122.0	15
1978.0	119.0	15
1979.0	115.9	15
1980.0	112.6	0″.14

Observations:

t	θ	ρ	n	Obs.	Source	0−C	
1908.76	221°.0	0″.28	2	A	ADS	+2°.6	0″.00
1918.89	213.8	28	3	A	ADS	+4.3	+ 1
1932.04	219.3	29	1	Gro	(P. Muller)	+22.6	+ 3
1933.12	195.9	24	2	B	,,	+0.3	− 1
1934.03	192.3	30	2	A	Lick O. Bull. N. 491.	−2.3	+ 5
1935.06	188.4	22	2	B	(P. Muller)	−5.1	− 3
1937.71	185.5	25	4	Voû	,,	−5.0	+ 1
1944.75	182.1	24	3	Voû	J. O. Vol. XXXVIII, N. 6	+0.1	+ 1
1945.75	179.0	28	5	VBs	Publ. Y. O. Vol. VIII, Part VI.	−1.7	+ 5
1948.74	168.2	19	2	VBs	,,	−8.4	− 3
1951.03	167.8	17	2	VBs	,,	−5.6	− 5
1951.80	167.3	20	3	VBs	Publ. Y. O. Vol. IX, Part II.	−5.0	− 2
1956.16	173.1	27	3	Mull	J. O. Vol. XXXIX, N. 7.	+7.4	+ 6
1958.03	157.7	19	3	VBs	Publ. Y. O. Vol. IX, Part II.	−4.9	+ 1
1960.73	161.8	21	3	Cou	J. O. Vol. 45, N. 3.	+3.9	+ 1
1960.809	158.8	0.22	1	Wor	Lick O. Bull. N. 576.	+1.0	+ 2

Observations (suite):

t	θ	ρ	n	Obs.	Source	0–C	
1962.599	151.8	18	3	Wor	Publ. N. O. Vol. XXIII, Part VI.	−2°.8	−0″01
1962.788	154.4	20	4	B	A. J. Vol. 68, N. 8, 1963. N. 1313.	+0.2	+ 1
1964.116	150.0	20	1	Cou	J. O. Vol. 47, N. 10,	−2.3	+ 1
1965.66	153.1	27	4	Bz	J. O. Vol. 50, 1967, Fasc. 1.	+4.4	+ 8
1968.84	143°.8	0″.22	3	Morel	Astr. and Astrph., Supp. Vol. 3, N. 1.	+1.7	+0.04

Literature:

1. *W. H. Van den Bos*, 1926 Orbital elements of Binary stars. Union Observatory Circular N. **68**,
2. *P. P. Parenago*, 1954: Kurs zvezdnoj astronomiji, Moskva,

TRAJECTOIRE APPARENTE RECTILIGNE DE ADS 1322=A2321

V. ERCEG

RÉSUME:

Pour la détermination de la trajéctoire apparente rectiligne on a utilisée la méthode de Arend.(1).

A 2321=ADS 1322

Pos. (1950):

$1^h\,38^m.4\ +18°\,01'$

Ephémérides:

t	θ	ρ
1973.0	229°.8	3″.46
1974.0	230.1	3.55
1975.0	230.4	3.64
1976.0	230.7	3.72
1977.0	230.9	3.81
1978.0	231.2	3.90
1979.0	231.4	3.99
1980.0	231.7	4.07

LES FORMULES LINÉAIRES DE LA TRAJÉCTOIRE

$$\rho \cos(\theta - 152°.0) = 0''.731$$

$$\rho \sin(\theta - 152.0) = +0''.0894\,(t - 1935.16)$$

Observations:

t	θ	ρ	n	Obs.	Source	0–C	
1911.60	81°.2	2″.17	3	A	ADS	+0°.1	−0″.05
1916.84	82.0	2.04	5	FBn2, Doo 3.	ADS	−4.0	+ 25
1919.69	88.2	1.40	2	A	ADS	−1.7	− 16
1921.61	87.8	1.26	2	A	ADS	−5.3	− 16
1930.80	124.7	0.82	2	A	Lick O. Bull. N. 491	+0.7	− 1
1940.762	197.1	1.08	-	Jef	Lick O. Bull. N. 518.	+10.7	+ 19
1947.68	211.8	1.56	1	Jef	(P. Muller)	+3.0	+ 22
1947.70	211.6	1.50	1	Jef	(P. Muller)	+2.8	+ 16
1950.07	209.8	1.61	5	VBs	Publ. Y. O. Vol. VIII, Part VI.	−3.4	+ 9
1950.911	215.4	1.38	3	MRz	Publ. N. O. Vol. XVIII, Part V.	+0.7	− 21
1951.806	213.2	1.52	2	MRz	„	−2.6	− 14
1952.828	216.8	1.58	2	MRz	„	−0.4	− 16
1953.03	214.4	1.80	2	VBs	Publ. Y. O. Vol. IX, Part II.	−3.0	+ 4
1954.97	218.2	1.85	3	Cou	J. O. Vol. XXXVIII, N. 9.	−1.4	− 7
1961.832	225.5	2.62	4	B	Lick O. Bull. N. 579.	+0.5	+ 12
1962.85	226°.0	2″.26	3	Cou	(P. Muller)	+0.5	−0″.31

1) *S. Arend*, Ann. de L'Obs. Roy. de Belgique, Troisieme série, Tom VIII — Fasc. 2.

Jun 1973.

PHOTOELECTRIC OBSERVATIONS OF SOME FLARE STARS DURING 1972

J. ARSENIJEVIĆ, A. KUBIČELA, I. VINCE

Seven flare stars were observed during 1972 at Belgrade Astronomical Observatory. The observations were carried out with Zeiss 65 cm. refractor equipped with EMI 9502 photomultiplier and BG−12 + +GG−13 and GG−11 filter for B and V photometric regions respectively.

The monitoring time intervals for the observed stars are given in Table I. In addition Table I contains data concerning the spectral region of observations in the column F, the error of observations in the column σ^m and the limiting magnitude difference in the column Δm_{lim}.

The total monitoring time is given in Table II.

One flare event on March 14-th was observed in the case of AD Leo. The light curve in quiet star intensity units is shown in Figure 1. The other data of the flare are: the time of maximum $UT_{max}=$ $=22^h21^m.0$, the duration of the intensity rise $\Delta t_1=$ $=0^m.3$, the duration of flare after maximum $\Delta t_2=$ $=11^m.1$, the maximum brightness difference $\Delta m_f=$ $=0^m.34$ magnitudes, the integrated intensity $P=$ $=0^m.583$ and the air mass $X=1.128$.

The expressions for all symbols can be found elsewhere (Arsenijević J., Kubičela A. and Angelov T., Bull. Astr. Obs. Beograd, 1973, Vol. XXIX, 53)

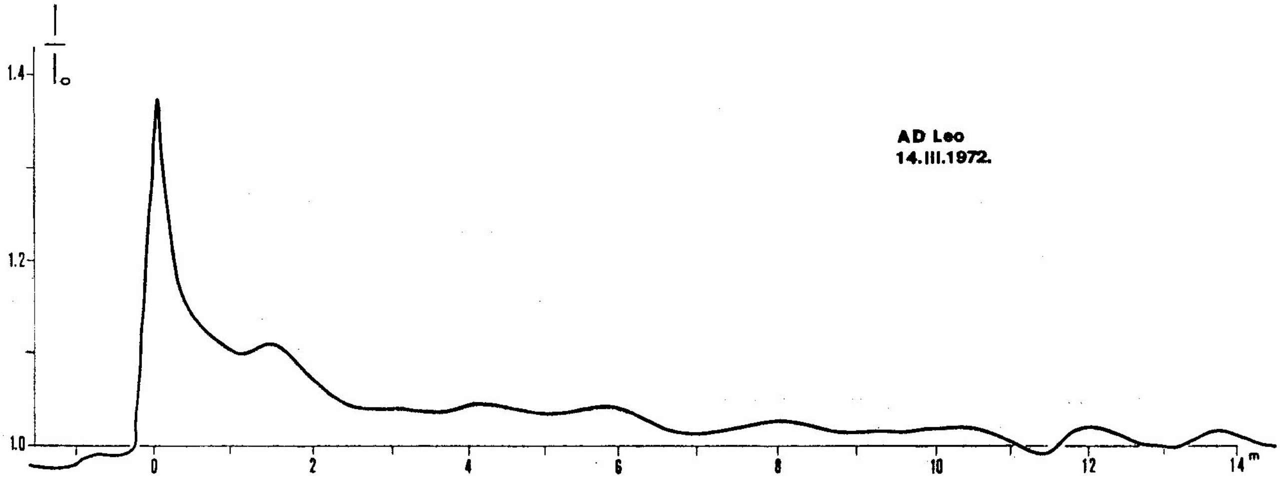

Fig. 1

Table I

Date		Observation Begin.	End	Duration	F	σ^m	Δm_{lim}
AD Leo		U. T.					
1972 Febr.	17	20^h36^m	20^h40^m	4	V	0.016	3.3
		20 42	21 42	60	V	0.016	3.3
		21 55	22 15	20	V	0.016	3.3
		22 26	22 51	25	V	0.016	3.3
		23 04	23 56	52	V	0.016	3.3
		24 18	24 23	5	V	0.016	3.3
		24 34	24 49	15	V	0.016	3.3
1972 March	8	21 28	22 51	83	V	0.040	2.4
	13	20 27	20 41	14	V	0.016	3.3
		20 47	21 10	23	V	0.016	3.3
		21 10	21 35	25	B	0.016	3.3
		21 42	23 45	123	B		
		23 45	24 05	20	V	0.016	3.3
	14	19 46	20 25	39	V	0.017	3.3
		21 05	21 31	26	V	0.017	3.3
		21 35	21 42	7	V	0.017	3.3
		22 01	22 51	50	V	0.017	3.3
		23 01	23 16	15	V	0.017	3.3
		23 22	23 33	11	V	0.017	3.3
		24 13	25 03	50	V	0.017	3.3
	15	19 18	19 34	16	V	0.030	2.7
		23 30	23 43	13	V	0.030	2.7
		24 52	25 19	27	V	0.030	2.7
Apr.	8	19 33	20 26	53	V	0.025	2.9
		20 32	20 52	20	V	0.025	2.9
		20 59	21 24	25	V	0.025	2.9
		21 40	21 50	10	V	0.025	2.9
		21 55	22 00	5	V	0.025	2.9
		22 07	23 00	53	V	0.025	2.9
May	8	19 42	20 42	60	V	—	—
Nov.	28	24 43	25 30	47	V	—	—
Dec.	4	24 48	25 19	31	V	0.054	2.0
		25 29	25 38	9	V	0.054	2.0
		25 43	25 47	4	V	0.054	2.0
BD+13°2618							
Apr.	7	23 22	24 05	43	V	0.048	2.2
		24 17	24 40	23	V	0.048	2.2

Date		Observation Begin.	End	Duration	F	σm	Δm_{lim}
BD+16°2708							
Apr.	8	24 12	25 12	60	V	0.026	2.8
May	7	23 36	24 36	60	V	0.026	2.9
		24 40	25 00	20	V	0.026	2.9
	8	21 37	22 17	40	V	0.030	2.7
June	5	21 29	21 55	26	V	—	—
		22 16	22 25	9	V	—	—
		22 44	23 24	40	V	—	—
	7	20 53	21 35	42	V	—	—
		22 46	23 26	40	V	—	—
	8	21 23	21 56	33	V	—	—
		22 15	22 20	5	V	—	—
		22 35	22 49	14	V	—	—
BD+55°1823							
1972 May	7	25 50	26 00	10	V	—	—
June	6	23 58	24 08	10	V	—	—
	8	23 34	23 50	16	V	—	—
		23 54	24 05	11	V	—	—
		24 27	24 44	17	V	—	—
		24 46	24 58	12	V	—	—
		25 01	25 20	19	V	—	—
SZ UMa							
June	6	20 38	20 46	8	V	—	—
		21 16	21 46	30	V	—	—
		22 11	22 21	10	V	—	—
		22 27	22 37	10	V	—	—
EV Lac							
Sept.	1	21 46	22 02	16	V	—	—
Oct.	1	20 54	21 48	54	V	0.014	3.5
Nov.	4	22 48	23 47	59	V	0.025	2.9
	7	19 21	19 44	23	V	0.025	2.9
		19 57	20 28	31	V	0.025	2.9
		20 41	20 50	9	V	0.025	2.9
	8	19 44	22 44	180	V	0.018	3.2
	29	19 16	19 25	9	V	0.032	2.6
		19 35	20 34	59	V	0.032	2.6
		20 36	20 44	8	V	0.032	2.6
Dec.	3	19 43	20 47	44	V	0.042	2.3
	7	20 36	21 03	27	V	0.042	2.3
PZ Mon							
Nov.	4	25 03	25 12	8	V	0.055	2.0
		25 38	26 15	37	B	—	—
	5	23 51	24 25	34	V	0.023	3.0
	7	24 25	24 58	33	V	0.022	3.1
	28	22 42	23 18	36	V	0.021	3.1
		23 35	23 39	4	V	0.021	3.1
		23 46	23 53	7	V	0.021	3.1
Dec.	3	22 12	23 14	58	V	0.022	3.0
	4	22 27	22 59	32	V	0.024	3.0
		23 16	23 39	23	V	0.024	3.0
		23 44	23 49	5	V	0.024	3.0

Table II

Star	Total duration
AD Leo	1040 minutes
BD+13°2618	66
BD+16°2708	389
BD+55°1823	95
SZ UMa	58
EV Lac	519
PZ Mon	278

PHOTOELECTRIC OBSERVATIONS OF UV CETI STARS DURING 1973

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In 1973 the regular patrol observations of UV Ceti stars were continued at Belgrade Astronomical Observatory with the 65 cm refractor.

The observations started with the instrument described by Arsenijević, et la. (1972/73). It is denoted as instrument I in Table I. During the summer 1973 a new polarimeter, also capable to work as a D. C. photometer has been introduced (instrument II in Table I). Here too an E. M. I. 902 S photomultiplier and 2 mm GG—11 filter have been used.

Three UV Ceti stars have been observed: AD Leo, BD—8°4352 and EV Lac. The observations of these stars covered the intervals of 637, 156 and 103 minutes respectively. The detailed time coverage is shown in Table I. The error of the observation, σ_m, and the limiting magnitude difference, $\Delta\, m$lim, have been explained in a previous paper (Arsenijević et al. 1972/73).

Part of the observations (EV Lac) has been published elsewhere (Arsenijević et al., 1974).

An uncertain flare event of BD—8°4352 was noticed on May, 31 at $22^h\ 12^m.3$ U. T. The maximum magnitude difference introduced by the flare was 0.05. The duration of pre-maximum and post-maximum phase of the flare was 0.2 and 2.2 minutes respectively.

Table I

Date		Observation Begining	End	Duration	σ_m	Δ_m lim	Instr.
AD Leo		U. T.					
III	5	23^h00^m	23^h44^m	44^m	0.039	2.4	I
	6	22 25	23 12	47	0.034	2.5	I
	31	20 37	22 37	120	0.021	3.1	I
IV	2	20 43	21 13	30	0.029	2.7	I
	27	20 21	21 51	30	0.020	3.2	I
	30	21 19	22 19	60	0.023	3.1	I
XI	18	26 12	26 29	17	0.016	3.4	II
	20	25 10	26 30	80	0.026	2.9	II
	21	25 44	26 36	52	0.008	4.2	II
	22	26 55	27 17	22	0.018	3.3	II
		27 19	28 00	41	0.018	3.3	
XII	22	24 32	24 41	9	0.012	3.8	II
		24 49	25 21	32	0.012	3.8	
		25 29	26 10	41	0.012	3.8	
		26 20	26 32	12	0.012	3.8	
BD−8°4352							
V	29	24 20	24 55	25	0.028	2.8	I
	31	22 04	22 18	14	0.015	3.6	II
		22 19	22 44	25	0.015	3.6	
		22 53	23 25	32	0.015	3.6	
VI	1	22 36	23 36	60	0.015	3.6	II
EV Lac							
VIII	22	24 04	24 45	41	0.010	3.8	II
		24 57	25 19	22	0.010	3.8	
		25 22	26 02	40	0.010	3.8	

Another flare, of EV Lac, was observed on August, 22 at $24^h27^m.9$ U.T., Figure 1. Because of a guiding accident a portion of the light curve was only approximately recorded (dashed line). The flare started 0.5 minutes before and ended 3.0 minutes after the maximum. The maximum brightness difference was 0.154 magnitudes, the integrating intensity 0.172 minutes and the air mass 1.050.

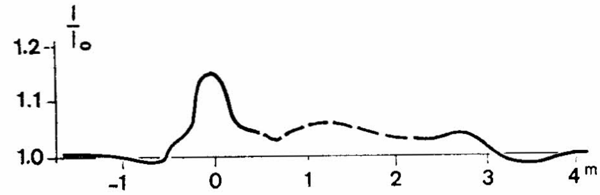

Fig. 1

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THE DETERMINATION OF THE THEORETICAL VALUE OF THE DEGREE OF POLARIZATION OF THE CALIBRATOR OF PHOTOELECTRIC POLARIMETRE OF THE BELGRADE ASTRONOMICAL OBSERVATORY

I. VINCE

SUMMARY:

Using formulas of theoretical physics and the measured geometric and physical parameters of the calibrating glass in the photoelectric polarimetre, the theoretical value of polarization that this glass introduces into the optical column has been found to be 2.87%. The errors of the polarization of the calibrator observed in laboratory ($\Delta p = 0.06\%$) and those observed astronomically ($\sigma \leqslant 0.45\%$) have been estimated. The difference between the theoretical value (P) and the astronimically observed value (P_s, P_π) remains to be explained.

The Astrophysical Group makes observations and analysis of the light polarization of the UV Ceti type stars. The devices for observation have been described by Oskanjan et al. (1969), and the method of treatement of the observations by Vince (1975).

The light polarization is found by a relative method, i. e., comparing the polarization parameters of the observed signal with the parameters of the constant, artificially introduced polarization, the so-called calibrator. The value of the calibrator polarization is found relatively from the observation of generally adopted polarimetric standards (Serkowski, 1965).

For the detecting of possible systematic errors it is useful to rely on the theory which offers accurate polarization values, as when the assumptions on which the theory is based are known, we can greatly reduce the number of possible causes which can bring about such errors.

On the basis of such results we can formulate the following objective:

To measure optical parameters of the calibrator in the photoelectric polarimeter and on this basis to calculate, by laws of physical optics, the value of polarization of the light that passes through the calibrator as an inclined plan-parallel glass using an appropriate method. To compare this polarization with the corresponding observed values.

Polarisation of light

In terms of transmission we can define the degree of polarization in the following way

$$P=\left|\frac{T_n-T_p}{T_n+T_p}\right| \qquad (1)$$

where T_p and T_n are the transmission coefficients of the parallel and the normal component of the light beam.

When the light beam impinges on the plan-parallel glass at oblique angle because of multilateral reflection from the border surfaces a series of images

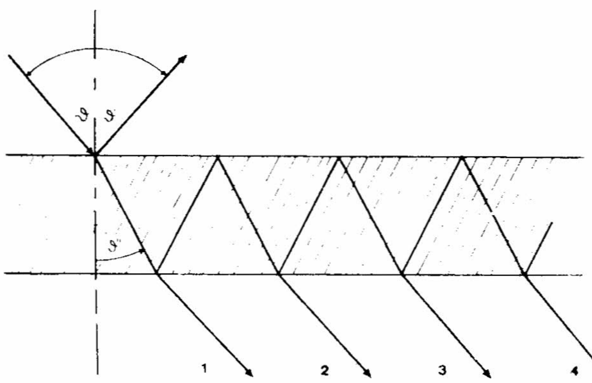

Fig. 1

appears (Fig. 1). The beams 2, 3, . . . are also polarized and they have to be taken into account in the finding out of the polarization.

If we correct the degree of polarization, because of the appearance of these images, taking into account the first N beams, we obtain the following formula

$$P=\left|\frac{T_p^2\dfrac{1-R_p^{2N}}{1-R_p^2}-T_n^2\dfrac{1-R_n^{2N}}{1-R_n^2}}{T_p^2\dfrac{1-R_p^{2N}}{1-R_p^2}+T_n^2\dfrac{1-R_n^{2N}}{1-R_n^2}}\right| \qquad (2)$$

where R_p and R_n are the coefficients of the reflection of the parallel and the normal component of the light beam.

If we wish to find out all corrections we must let N tend to infinity. In this way we obtain

$$P_\infty=\left|\frac{1-\dfrac{T_n}{T_p}\cdot\dfrac{1+R_p}{1+R_n}}{1+\dfrac{T_n}{T_p}\cdot\dfrac{1+S_p}{1+R_n}}\right| \qquad (3)$$

The degree of polarization for $N=1$ makes

$$P_1=\left|\frac{1-\cos^4(\vartheta-\vartheta'')}{1+\cos^2(\vartheta-\vartheta'')}\right| \qquad (4)$$

Optical Parameters of the Calibrator

As T_p, T_n, R_p and R_n are the functions of the angle of incidence (ϑ) and the angle of refraction (ϑ''), then, on the basis of equations (2), (3) or (4), it follows that we can define the corresponding degree of polarization if we know the angles. If we measure the angle of incidence and the index of refraction, then, on the basis of the formula $\sin\vartheta=n\sin\vartheta''$, we can determine the angle of refraction.

For the determination of the refraction index I have used the effect, which is observed when the light beam impinges on the plan-parallel glass at an oblique angle; after the transition the beam does not change its original direction but moves by a certain

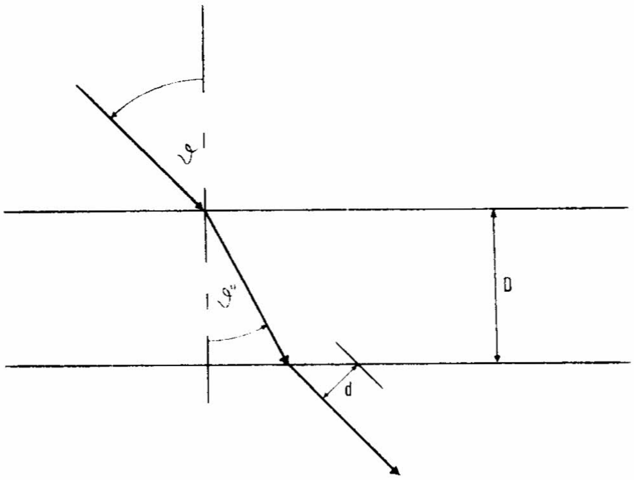

Fig. 2

amount d (Fig. 2) only. Therefrom we obtain for refraction index

$$n^2=\sin^2\vartheta\left|1+\frac{\cos^2\vartheta}{\sin\alpha-\dfrac{d}{D}\cos\vartheta}\right|. \qquad (5)$$

For the measuring of the angle of incidence ϑ, the thickness of the plate D and the shift d I have used the spectrocomparator. On the basis of the results obtained in this way and the formula (5) we have obtained the refraction index value $n=1.502$.

In the instrument for polarimetric observations a planparallel plate is fitted in, standing on a girder at a constant angle in relation to the plane of the girder. If we assume that the plane of the girder stands at the right angle to the optical axis of the telescope, then it is sufficient to measure the angle of inclination of the plate in relation to the girder and to take this angle as the angle of incidence.

I have made the measuring by means of a sextant. Instead of a principal mirror a support was mounted to serve for the fixing of the girder (N), Fig. 3. The light source was at a distance of 3 metres from the sextant. The ray which impinged on the girder reflected from its surface and passed through the tube with the ending (P) wherefrom the observation was performed.

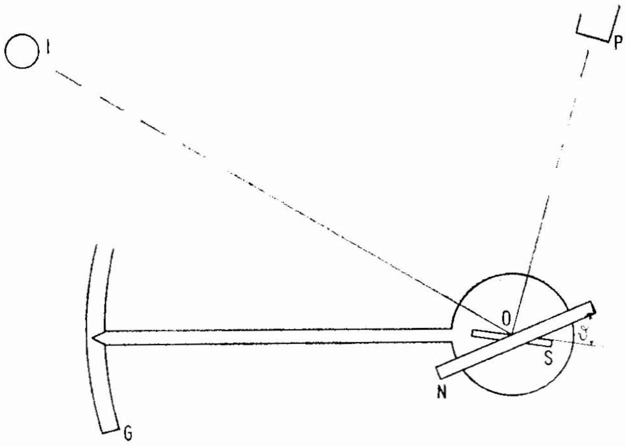

Fig. 3

The tube was also at the distance of about 3 meters from the sextant so that the error due to excentric position of the suporter of the glass on the sextant might be compensated in possibly highest degree. Revolving the platform of the girder around the axis (0) bu angle ϑ, i. e., until the surface of the glass (S) coincides with the frist original position of the girder (N), at the scale (G) of the circle the value of the angle 2ϑ could be read. The angle obtianed in this way makes 28°14′ with the upper limit of error estimated to $\Delta\vartheta = 10'$.

The degree of polarization, without correction, could be computed on the basis of the formula (4). The value of the degree of polarization obtained in this way amounts to

$$P = 2.99\% \pm \Delta P.$$

The degree of polarization with correction is

$$P = 2.87\% \pm \Delta P.$$

$\Delta P = 0.06\%$ is the upper limit of error.

The degree of polarization in multilateral reflection at bordering surfaces and the multiplied image obtained in this way is reduced because the polarization plane in the refracted beam stands at the angle of 90° with respect to the polarization plane of the reflected beams. The beams obtained in this way, beginning already from the second image bring about the reduction of the difference between the normal and the parallel components of intensity.

The Observed Polarization of the Calibrator and the Comparison with the Theoretical Value

By treating the observation of standard stars we obtain two groups of values for the calibrator polarization. One group consists of data that were obtained on the basis of polarimetric standard stars (relative determination), and the other group of data were obtained from stars the light of which is artificially polarized 100% (absolute determination).

These data are shown in Table I, and the final result, as arithmetical mean, is

$$P_s = 4{,}44\%,$$

$$P_\pi = 4.06\%.$$

P_s is the value obtained from table values of light polarization of standard stars, and $P\pi$ is the value obtained from observations with inserted artificial polarization.

Table I

The Calibrator Polarization Values Obtained from the Observation of Standard Stars

Date		Star	P_s	$P\pi$
15. VII	71.	BD+18° 4085	4.34	— — —
19. VIII	71.	55 Cyg	3.62	— — —
20. VIII	71.	BD+18° 4085	5.52	— — —
20. VIII	71.	55 Cyg	4.36	— — —
21. VIII	71.	55 Cyg	3.88	— — —
23. IX	71.	9 Gem	6.51	— — —
23. IX	71.	HD 23512	2.83	— — —
19. X	71.	φ Cas	6.00	— — —
20. X	71.	2 H Cam	2.20	3.82
20. X	71.	φ Cas	4.82	5.18
15. XII	71.	φ Cas	4.31	4.27
16. XII	71.	9 Gem	5.91	3.16
15. III	72.	BD+8° 1332	4.66	3.74
15. III	72.	9 Gem	— — —	3.44
5. VI	72.	96 Her	3.65	— — —
7. VI	72.	96 Her	4.27	5.98
5. VII	72.	BD+18° 4085	3.18	— — —
6. IX	72.	ρ Cas	5.37	— — —
1. X	72.	14 Cep	— — —	2.90
7. XI	72.	φ Cas	— — —	4.08

The mean square errors for P_s and P_π were obtained on the basis of the data in Table I and they are respectively

$$\sigma_s = 0.45\%$$

and $$\sigma_\pi = 0.23\%.$$

A somewhat greater dispersion around the mean value, P_s, and certain disparity of results have been noticed. It has to be remarked that even in the case of a smaller error ($\sigma_\pi = 0.23\%$) these results do not exclude one another, as the difference between them is lower than $2\,\sigma_\pi$.

However, both of these results deviate from the theoretical value. The reasons of this deviation are yet unknown.

With the change of the angle the polarization changes very rapidly. In this way we can notice that the polarization of about 4% to 4.5% correspodns to the angle of about 32° to 35°. The measured angle of incidence is 28° 14′ and it is certain that this angle cannot become larger by 4° to 7° when the girder of glass is mounted onto the instrument for observation. Therefore, we cannot expect that the difference between the theoretical values of polarization and the value obtained from observation comes from a larger angle of light incidence. It should be noticed that some changes in the angle of incidence of the light beam occur in the course of observation in consequence of the flexion of the telescope tube in various positions. However, the bending of the tube does not exceed 1° (we know that from observation). Besides, the changes occuring because of this effect may be considered small and accidental, because we do observations in various positions of the instrument, and consequently, the bendings are in various directions. Accidental errors bring about a greater dispersion of data, but they do not enlarge the observed polarization.

Therefore, the reason of such a great deviation of the theoretical value from the value that is obtained from observations remains to be examined, because therein might be hidden the cause of some systematic error of the polarimeter.

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THE PROCEDURE OF THE TREATMENT OF THE POLARIMETRIC MEASUREMENTS WITH THE PHOTOELECTRIC POLARIMETER OF THE BELGRADE ASTRONOMICAL OBSERVATORY

I. VINCE

General Procedure

The Astrophysical Group at the Astronimical Observatory in Belgrade does the measurement of the linear polarization of the optical radiation of variable stars. The parameters of polarization are measured relatively in relation to the calibrator the characteristic of which is determined from the observations of the stars of known polarization.

In order to obtain the data of the polarization o the light of stars an adapted device described by Oskanjan et al. (1969) is used. By means of this instrument a number of measurements is made in various combinations of optical elements. The groups of measurement are the following:

I. — The measurement of the star polarization. Only a compensative glass plate S_0 is inserted into

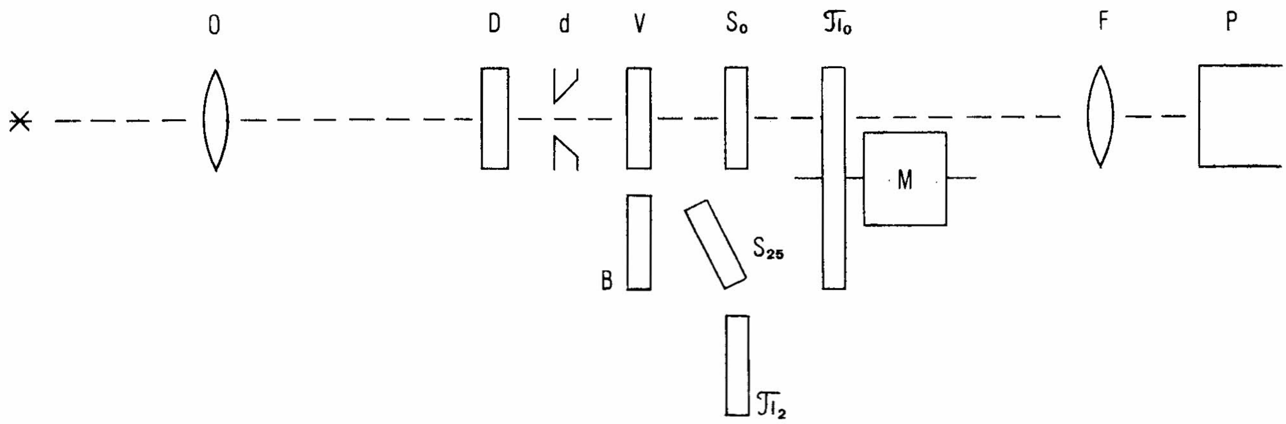

Fig. 1 Optical column of the polarimeter.

O — objective, D — exchangeable depolarizer, d — diaphragm, V — and B — exchangeable filters for the spectral regions V and B, S_0, B_{25} and π_2 — exchangeable glass plates and polariod, π_0 — rotating polaroid, M — motor, F — Fabry lens and P — photomultiplier EMI 9502 S.

the optical column of the polarimeter, Fig. 1. The polarization of the radiation of the star and of the sky is measured together with the instrumental polarization.

II. — The measurement of the instrumental polarization. The instrument itself, mainly a rotating polaroid, generates a signal that is equivalent to an additional polarization of the light beam. Measuring it, a depolarizer D and the glass plate S_0 are inserted into the optical column. Here it should be noticed that the depolarizer depolarizes and partly absorbs the radiation that passes through it.

III — The measurement of the calibrator signal. The radiation of the star and of the sky is let to pass through the depolarizer D and the calibrator glass plate S_{25} which polarizes partly the radiation that has been let to pass through.

The radiation of the sky has also been polarized. The measurements have to get rid of this polarization. Therefore each one of the mentioned groups of measurement is repeated only with the sky signal (I_a, II_a and III_a). These three pairs of measurement, each of them lasting 2 or 4 minutes, yield 6 groups of data at the integrator output. In each group there are 10 data (the numbers of integrator channel: $k=1, 2 \ldots 10$) that determine the sine curve.

The next procedure is the following: On the basis of the two first groups of measurement (I and I_a) we obtain 10+10 data for the construction of the resulting sine curve. For instance, the magnitude g_k is being measured for the following combination: star + sky + plate S_0. From this quantity we subtract the value g'_k, for the combination: sky + plate S_0. In the following two groups (II and II_a) the combinations are the same plus depolarizer D. From each of them we obtain 10 values d_k and d_k'. These values are corrected taking into account the absorption put in by depolarizer. The needed factor v is obtained from simulatneous observations on the D. C. channel of the polarimeter. On the basis of these data we compute for channel k the quantity

$$P_k' = g_k - g_k' - (d_k - d_k'). \qquad (1)$$

By analogy, from groups II and II_a or III and III_a, with the following combinations: star + sky + depolarizer D + plate S_{25} and sky + depolarizer D + plate S_{25}, or star + sky + depolarizer D + plate S_0 and sky + depolarizer D + plate S_0, we obtain h_k and h'_k, or, n_k and n'_k, respectively. As each of these measurements has been carried out by use of depolarizer D, factor v has been taken into account. In this way we obtain for the channel k the quantity

$$s_k' = \vartheta\,(h_k + n_k - h_k' - n_k'). \qquad (2)$$

In the course of measuring the systematic error of the channel is determined. Namely, the integrator yields a value at the output even if at the input there is no signal. For every channel this is a different value. Let us take that for channel k with a zero input signal the obtained output signal is equal to i_k. The arithmetic mean of these signals is

$$i = \frac{1}{10} \sum_{k=1}^{10} i_k \quad .$$

Thereafter, factor f_k is computed on the basis of the formula

$$f_k = \frac{i}{i_k} \, . \qquad (3)$$

On the basis of formula (1), (2) and (3) we obtain

$$P_k = P_k' \cdot f_k \quad \text{and} \quad s_k = s_k' \cdot f_k .$$

For one series of measurement we shall obtain 10 pairs (p_k, s_k). On the basis of these 10 data we have to find out the most probable sine curve from $\{p_k\}$ and $\{s_k\}$. We compute this sine curve by the method of least squares. The procedure is carried out as following: to each value of the angle of the polaroid ($\alpha = 0°$, 18°, 36°, 54°, 72°, 90°, 108°, 126°, 144° and 162° for $k = 1, 2, \ldots\ldots, 10$) corresponds one value $y_k = p_k$, s_k that should satisfy the following equation

$$y_k^\star = a \sin(\alpha_k + \varphi.) \qquad (4)$$

The unknown quantities are a and φ.

In order to be able to use the method of least squares it is most suitable to dissamble the right side of the equation (4) in two addends

$$y_k^\star = a \sin \alpha_k \cdot \cos \varphi + a \cos \alpha_k \cdot \sin \varphi \qquad (5)$$

and to introduce two auxiliary quantities A and B in the following way

$$A = a \cos \varphi ; B = a \sin \varphi .$$

Now, the equation (4) has the form

$$y_k^\star = A \sin \alpha_k + B \cos \alpha_k .$$

To obtain A and B we shall apply to this equation the method of least squares. The result is

$$A = \frac{\sum_{k=1}^{10} y_k \cdot \cos \alpha_k \cdot \sum_{k=1}^{10} \cos \alpha_k \cdot \sin \alpha_k - \sum_{k=1}^{10} y_k \cdot \sin \alpha_k \cdot \sum_{k=1}^{10} \cos^2 \alpha_k}{\left(\sum_{k=1}^{10} \sin \alpha_k \cdot \cos \alpha_k \right)^2 - \sum_{k=1}^{10} \cos^2 \alpha_k \cdot \sum_{k=1}^{10} \sin^2 \alpha_k}$$

$$B = \frac{\sum_{k=1}^{10} y_k \cdot \sin \alpha_k \cdot \sum_{k=1}^{10} \sin \alpha_k \cdot \cos \alpha_k - \sum_{k=1}^{10} y_k \cdot \cos \alpha_k \cdot \sum_{k=1}^{10} \sin^2 \alpha_k}{\sum_{k=1}^{10} \cos^2 \alpha_k \cdot \sum_{k=1}^{10} \sin^2 \alpha_k - \left(\sum_{k=1}^{10} \cos \alpha_k \cdot \sin \alpha_k \right)^2} \, .$$

When we know the values A and B, we can compute the quantities a and φ on the basis of the equation (5). This yields

$$a=\sqrt{A^2+B^2} \qquad \varphi=\operatorname{arctg}\frac{B}{A}$$

This procedure yields the values a_p and φ_p or a_s and φ_s from the data p_k or s_k respectively. By means of these quantities we compute the degree of the polarition and the angle of the plane of polarization,

$$P=\frac{a_p}{a_s}E, \qquad \vartheta=\varphi_p-\varphi_s+\theta$$

where E and θ are still unknown constants. These constants are determined in the course of the year when we carry out polarimetric observations of the so-called standard stars. The degree, P, and the angle of the polarization plane, θ, of the light of standard stars is considered to be known (Serkowski, 1960).

If we know these values, we can determine the above mentioned constants.

The Computation of the Value of the Polarization of the Calibrator for 1970

For every set of observations by means of the data P_i and ϑ_i we shall obtain one value E_i to which corresponds the weight T_i that is determined according to the time of the integration of the signal, and one θ_i with the weight P_i.

If we have now, for instance, n sets of observations ($i=1, 2, \ldots, n$), the final value of the calibrator polarization E_0 will be the weighted mean value

$$E_0=\frac{\sum_{i=1}^{n} E_i T_i}{\sum_{i=1}^{n} T_i}$$

and for the angle

$$\theta_0=\frac{\sum_{i=1}^{n}\theta_i P_i}{\sum_{i=1}^{n} P_i}.$$

The error of the quantity E_0 is found on the basis of the formula

$$\sigma_{\bar{E}}=\frac{\sigma_E}{\sqrt{\sum_{i=1}^{n} T_i}}$$

where

$$\sigma_E=\sqrt{\frac{\sum_{i=1}^{n}\Delta_i^2 T_i}{n-1}}$$

the error of the weight unit ($T=1$), and

$$\Delta_i=E_i-E_0.$$

The error in θ_0 will be found in the following way. We denote

$$\Delta\theta_i=\varphi_p-\varphi_s$$

the weighted mean of which is

$$\overline{\Delta\theta}=\frac{\sum_{i=1}^{n}(\Delta\theta_i)P_i}{\sum_{i=1}^{n}P_i}.$$

The error of the unit weight is

$$\sigma_0=\sqrt{\frac{\sum_{i=1}^{n}[(\Delta\theta_i)-(\overline{\Delta\theta})]^2 P_i}{n-1}}$$

and the final error will be

$$\sigma_{\bar{\theta}}=\frac{\sigma\theta}{\sqrt{\sum_{i=1}^{n}P_i}}.$$

For the computation of these quantities we have used the computer IBM 360 of the Computation Centre at the Institute of Mathematics at the Faculty of Sciences in Beograd with a prepared programme.

We have worked out the cases of 10 stars that were observed in the course of 1970 in V spectral region Table I. Finally adopted values of polarization parameters of the calibrator are

$$E_0=4.35\%\pm0.36\%$$

and

$$\theta_0=175^\circ.7\pm3^\circ.8.$$

Table I

The observed Polarization Standards

Date	Star	E_i	θ_i
30. IX 1970.	14 CEP	6.867%	25.°620
28. IX 1970.	14 CEP	2.545	16.740
6. VI 1970.	96 HER	5.780	−26.072
26. V 1970.	−0°3224	4.741	−10.823
4. IV 1970.	−0°3224	3.605	0.814
7. III 1970.	−0°3224	3.520	2.479
6. X 1970.	φ CAS	5.053	−15.646
30. III 1970.	9 GEM	3.204	−2.223
24. VII 1970.	55 CYG	4.094	−4.673
10. IX 1970.	18°4085	4.732	−13.551

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Oskanjan V., Kubičela A., Arsenijević J., 1969, Bull. Obs. Astr. Belgrade **28**, 1.

Serkowski K., 1960, Lowell Obs. Bull., **105**, 317.

LES TERMES HARMONIQUES DANS LE MOUVEMENT DU PÔLE

D. ĐUROVIĆ

SUMMARY:

Gibbs and Fourier spectral analysis methods have been used for the determination and in the search of harmonic terms in the latitude results. Polar coordinates which constitute the fundamental data for such analysis have previously been calculated from the latitude observations performed at 42 observatories (BIH) during the 1967–1971 period, by a method of two successive approximations.

The following results have bean established:

1. For the range in the period between 10 and 40 days, the polar coordinates do not present periodical fluctuations of significant amplitudes;
2. For the range in the period between 60 and 900 days, polar coordinates spectra show a relatively great number of peaks consisting of sub-harmonics of the annual and of the Chandler terms;
3. The quasi diurnal nutation, theoretically predicted by Poincaré, is not identified. This last result disagrees with other papers on the quasi diurnal nutation. It seems that their interpretations do not take completely into account the mutual influence of the principal and the 204-days terms.

Key words: Rotation of the Earth, Nutations, Latitude, Chandler period.

1. *Le calcul des coordonnées du pôle.*

Les coordonnées du pôle qui représenteront les données de base sont calculées à partir des observations de latitudes de 42 observatoires participant au travail du Bureau International de l'Heure obtenues pendant les cinq années 1967–1971.

La liste de ces observatoires avec les poids et les latitudes initiales est donnée dans la Table A.

La méthode de deux approximations successives ayant donnée de bons résultats dans le calcul du système moyen de TU1–TUC (Đurović D. et Melchior P., 1972) nous l'avons utilisée pour le calcul des coordonnées du pôle.

L'intervalle d'observations est divisé en intervalles de 5 jours et par l'interpolation linéaire des coordonnées du pôle calculées au BIH $-x_0$, y_0 les observations sont réduites aux dates centrales des intervalles correspondants de 5 jours.

Soit RF'_m le résidu moyen d'un observatoire donné par rapport au „système BIH 1968" (RAPPORT ANNUEL POUR 1968 du BIH) pour les premiers 30 jours (janvier 1967).

Pour six intervalles de cinq jours nous avons formé six systèmes des équations:

$$\varphi_i - \varphi_0 - RF'_m = x \cos \lambda + y \sin \lambda \qquad (1)$$

Les inconnues x et y sont calculées par la méthode des moindres carrés.

Les résidus v_i des équations (1) sont utilisés pour le calcul du résidu définitif $-RF^*_m$ de l'observatoire donné pour l'intervalle de 30 jours donnés.

Dans la deuxième approximation x et y sont calculés de la même façon mais en remplaçant RF_m' par RF_m.

Pour les 30 jours suivants le résidu provisoire RF_m' est égal à RF_m de l'intervalle précédent c'est-à-dire que $(RF_m')_{j+1} = (RF_m)_j$.

* $RF_m = RF'_m + \Sigma\, p_i\, v_i / \Sigma\, p_i$.
p_i – le poids de v_i.

Soient x_u et y_u les coordonnées du pôle ainsi calculées (Table *B*, page 69).

Pour obtenir une estimation de l'exactitude des valeurs calculées, x et y sont calculés pour l'ensemble de tous les observatoires et ensuite séparément pour chaque type d'instrument d'observation: astrolabes (*A*), tubes photographiques zénithaux (*PZT*) et lunettes zénithales (*LZ*). Les résultats montrent des différences systématiques relativement grandes. $x(A) - x(LZ)$ présente une période annuelle mais ce n'est pas le cas pour $y(A) - y(LZ)$ (Fig. 1.).

La différence $x(A) - x(PZT)$ varie dans les limites de $\pm 0''.1$, mais cette variation n'a pas un caractère périodique (fig. 2.). $y(A) - y(PZT)$, se présente comme une variable accidentelle.

La dérive des différences n'est évidente que pour $y(A)$ et $y(LZ)$. Elle est de $0''.02$ par an. $y(A) - y(PZT)$ étant une fonction stationnaire, nous considérons que le système de référence défini par les observations avec *LZ* n'est pas conservé.

En raison des grandes différences des coordonnées du pôle nous avons comparé x_u et y_u avec:

a) x_0, y_0 – les coordonnées calculées au BIH (Guinot B., 1968–1972);

b) x_{IPMS}, y_{IPMS}, calculés à l'International Polar Motion Service (IPMS) (Yumi S., 1969–1972) et

c) x_s, y_s, calculés par l' U. S. Naval Weapons Laboratory Dahlgren à partir des mesures Doppler par l'intermédiaire des satellites artificiels (Anderlé R. J. 1970).

Les différences des moyennes aux intervalles de 25 jours sont représentées sur les figures 3, 4 et 5.

x_s et y_s sont obtenus par lissage graphique (fig. 6).

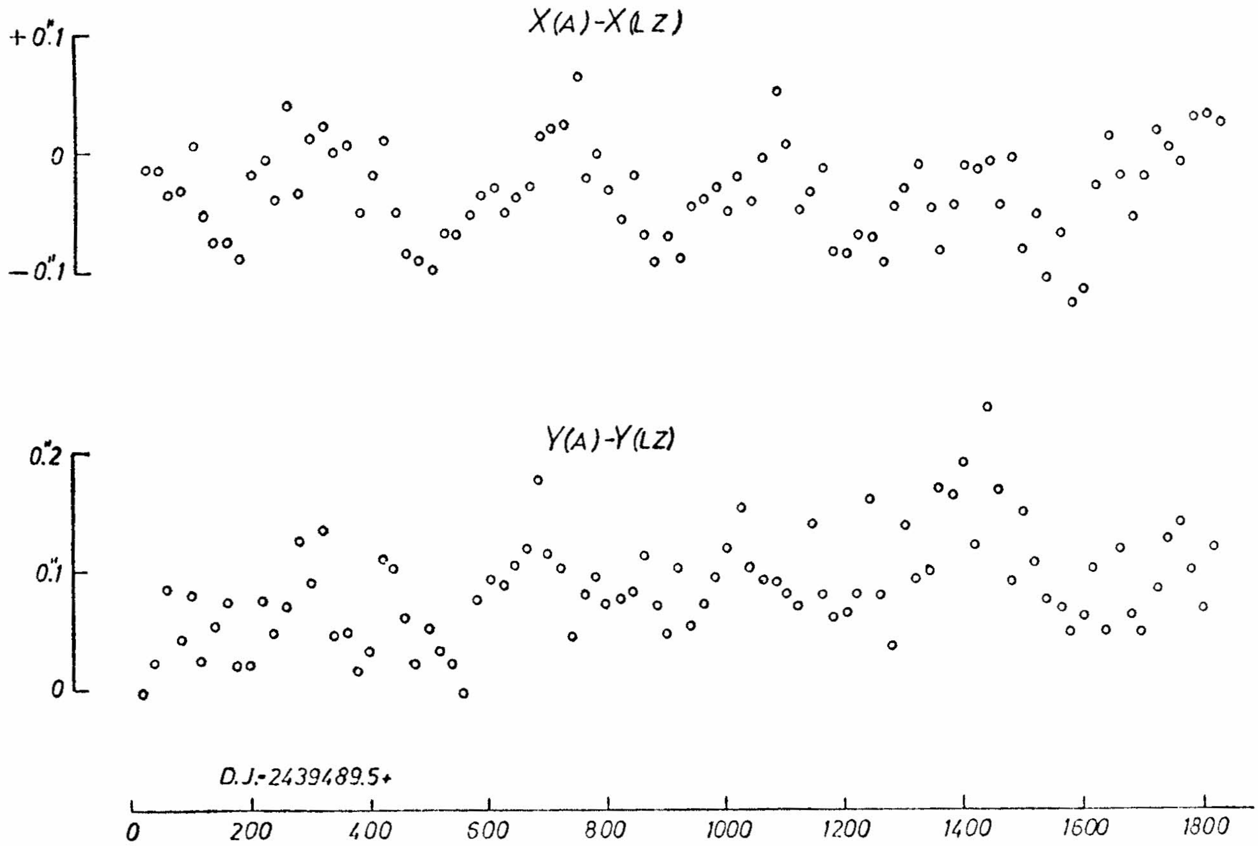

X(A)-X(LZ)
+0".1
0
−0".1
Y(A)-Y(LZ)
0".2
0".1
0
D.J.-2439489.5+
0
200
400
600
800
1000
1200
1400
1600
1800

Fig. 1

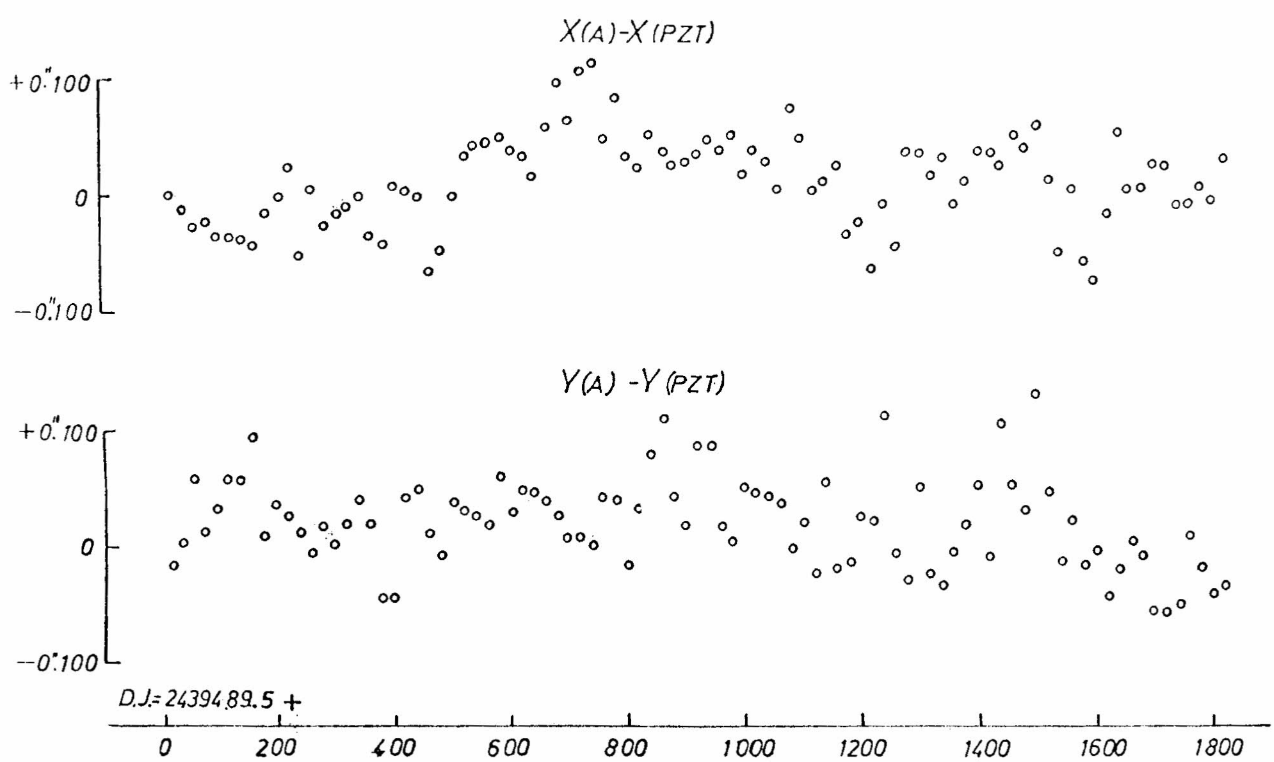
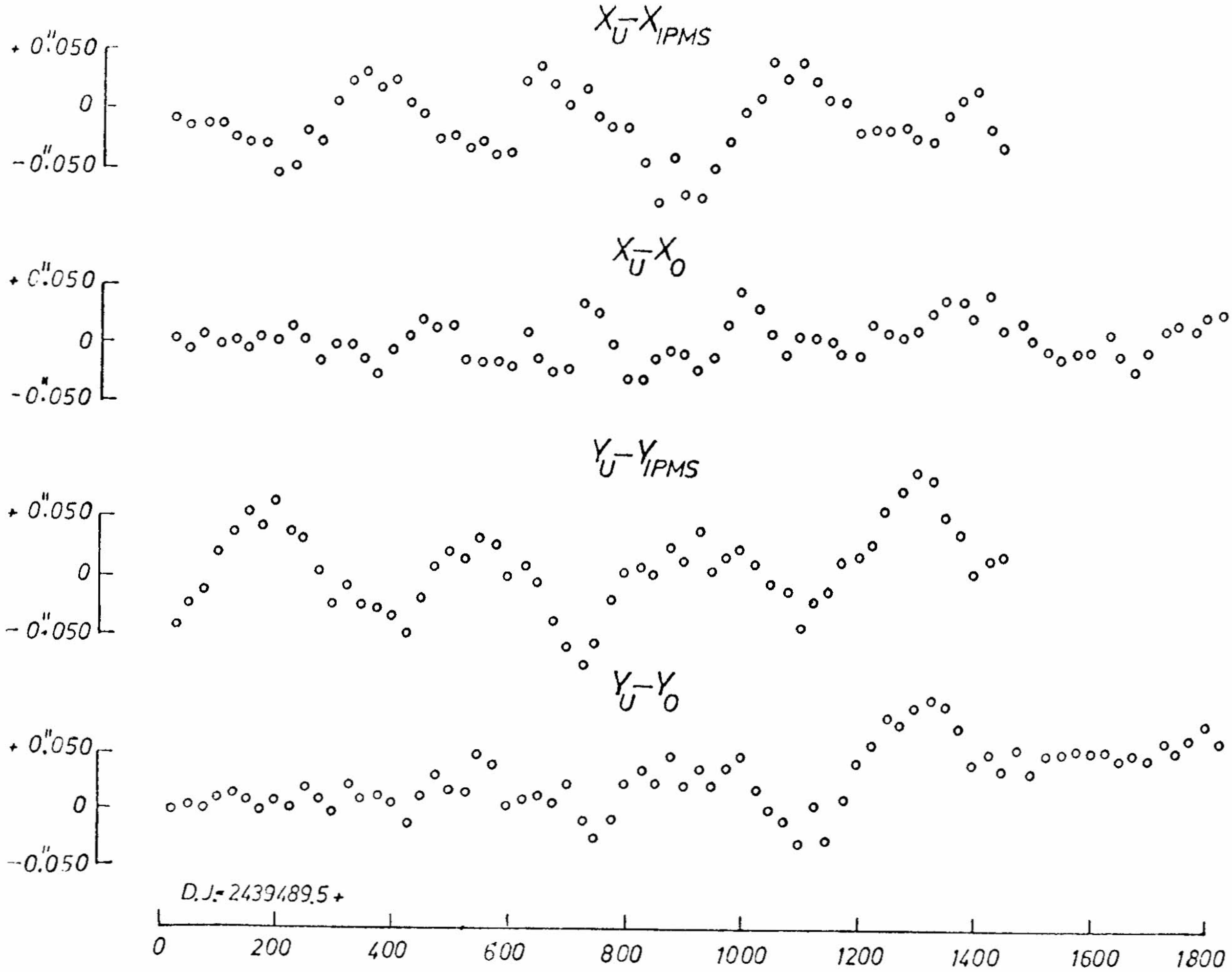
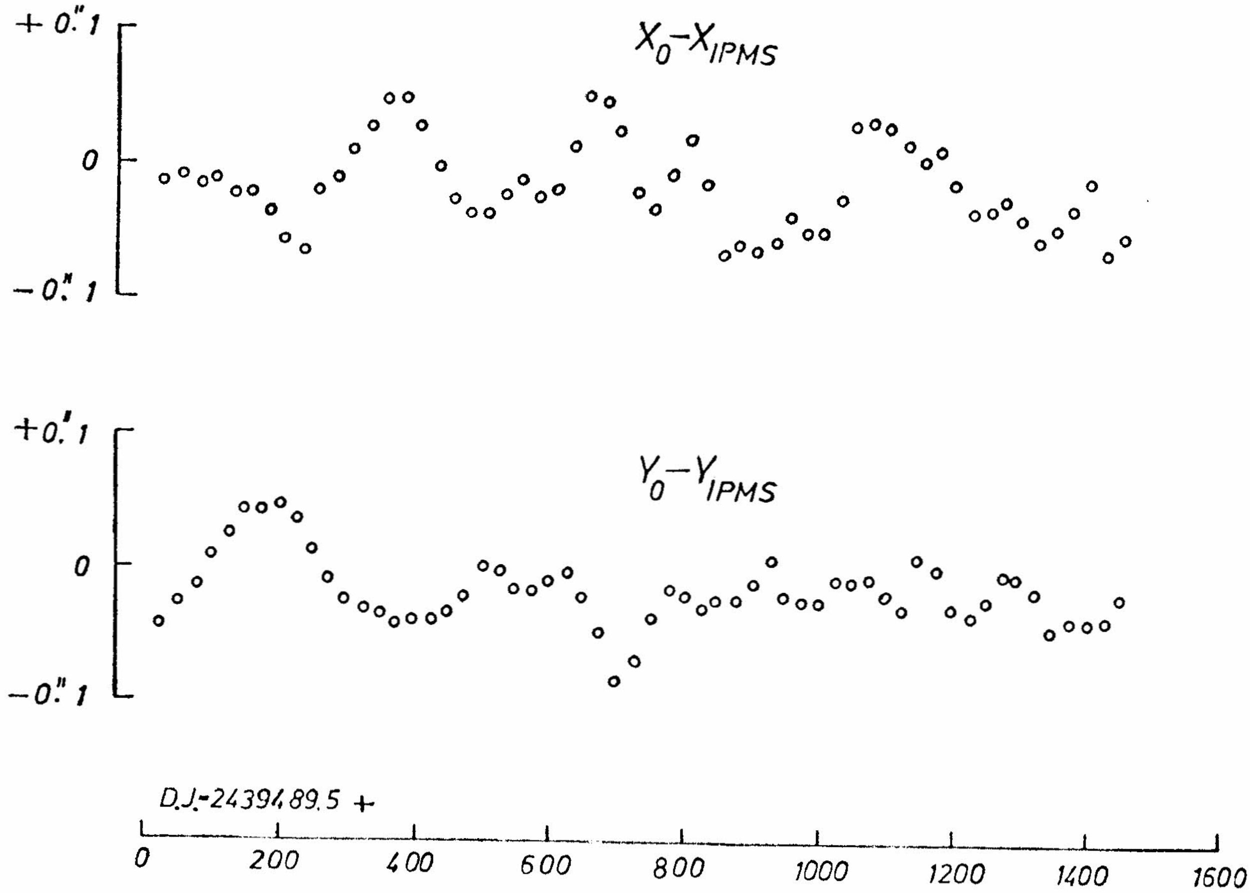

X(A)-X(PZT)
+0".100
0
−0".100
Y(A) -Y(PZT)
+0".100
0
−0".100
D.J.=2439489.5 +
0
200
400
600
800
1000
1200
1400
1600
1800

Fig. 2



$X_U - X_{IPMS}$
+0".050
0
−0".050
$X_U - X_0$
+0".050
0
−0".050
$Y_U - Y_{IPMS}$
+0".050
0
−0".050
$Y_U - Y_0$
+0".050
0
−0".050
D.J.-2439489.5 +
0
200
400
600
800
1000
1200
1400
1600
1800

Fig. 3



+0".1
$X_0 - X_{IPMS}$
0
−0".1
+0".1
$Y_0 - Y_{IPMS}$
0
−0".1
D.J.-2439489.5 +
0
200
400
600
800
1000
1200
1400
1600

Fig. 4

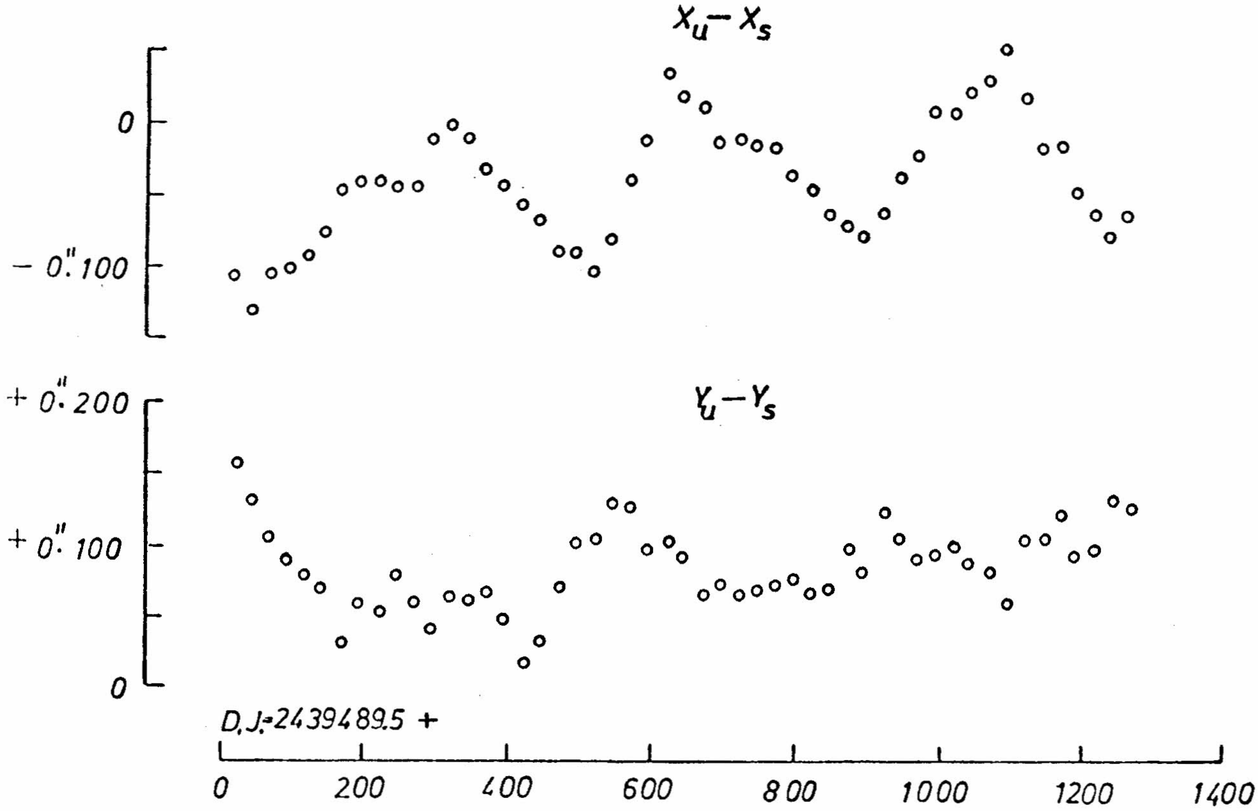

$X_u - X_s$
0
$-0''.100$
$Y_u - Y_s$
$+0''.200$
$+0''.100$
0
D.J.=2439489.5 +
0
200
400
600
800
1000
1200
1400

Fig. 5

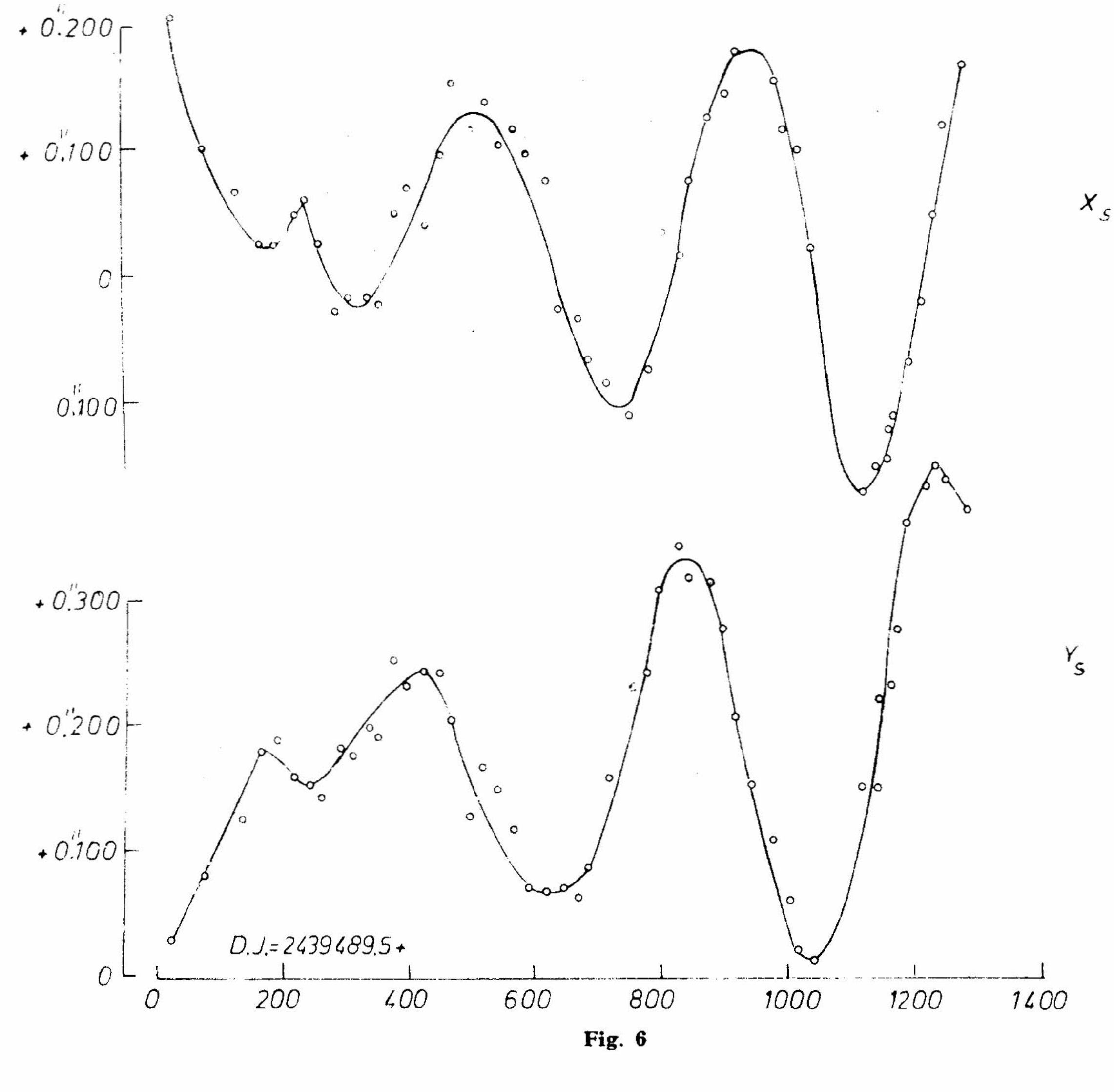

$+0''.200$
$+0''.100$
0
$0''.100$
X_s
$+0''.300$
$+0''.200$
$+0''.100$
0
Y_s
D.J.=2439489.5 +
0
200
400
600
800
1000
1200
1400

Fig. 6

On constate:

a) les coordonnéés données par l'IPMS varient par rapport à x_u et y_u et, aussi, par rapport à x_0 et y_0 avec une période annuelle et une amplitude d'environ 0''.05;

b) des variations similaires sont appréciables dans $x_u - x_s$ et $y_u - y_s$.

2. *La recherche des termes harmoniques dans les coordonnées du pôle.*

Pour la détermination et la recherche des termes harmoniques dans les latitudes nous avons utilisé les méthodes de l'analyse spectrale de Fourier et de Gibbs (Lanczos C., 1957).

Dans le domaine de périodes comprises entre 10 et 40 jours nous avons analysé les fonctions x_u et y_u avec un pas de 0.2 jour. Les résultats obtenus (Table 1) montrent que dans ce domaine il n'y a pas de variations harmoniques dont les amplitudes dépasseraient 0''.003. Les amplitudes des pics identifiés dans les spectres de ces fonctions peuvent être expliquées par des effets accidentels.

L'écart-type d'une valeur x_u ou y_u est $\varepsilon(x_u) = \varepsilon(y_u) = 0''018$. Le nombre total des paires (x_u, y_u) est $2N = 364$. On peut facilement démontrer que l'écart-type de l'amplitude est $\varepsilon(A) = \varepsilon(x_u)/\sqrt{N+1} = \varepsilon(y_u)/\sqrt{N+1} = \pm 0''.0014$.

Toutes les amplitudes données dans la Table 1 sont inférieures à $2\varepsilon(A)$.

M. Feissel et al. (1972) ont identifié dans les fonctions x_0 et y_0 les termes harmoniques de 16.2 (en x_0) et de 15.5 (en y_0) jours. Leurs amplitudes sont égales 0''.006.

Dans les spectres de x_u et de y_u on trouve des pics à 15.4 jours, mais leurs amplitudes sont très petites. Il n'y a pas de pic à 16,4 jours. Nous en concluons que les termes identifiés par M. Feissel et al. résulteraient de défauts de la méthode de l'analyse ou bien d'erreurs des coordonnées du pôle. Nous avons montré dans un autre travail (Đurović D. 1975) que certains pics dans le spectre de TU1—TUC représentent les sousharmoniques des termes principaux: biannuel, annuel et semiannuel.

Dans l'intervalle des périodes comprises entre 60 et 900 jours l'analyse a également été effectuée sur les fonctions x_0 et y_0 couvrant l'intervalle de six ans: 1966—1971.

Après l'élimination de la dérive éventuelle (par moindres carrés) nous avons obtenu les spectrogrammes représentés sur les figures 7 et 8.

Les amplitudes A (calculées par la méthode de Fourier) et les périodes des pics dans les spectres sont données dans la Table 2.

On ne doit pas perdre de vue que la sélectivité des méthodes utilisées est limitée, aussi certains résultats de la Table 2 se rapportent aux mêmes harmoniques même si l'on a obtenu pour les périodes des résultats un peu différents et ces périodes peuvent être groupées comme dans la Table 3. Pour la plupart de ces termes on ne possède pas d'explication théorique et l'on peut logiquement se poser la question si ces termes représentent des sousharmoniques du terme annuel et du terme de Chandler.

La fonction $R(\lambda) = \sin\lambda/\lambda$, ou $\lambda = (\omega_{j+1} - \omega_j)\cdot L$ (ω_{j+1}, ω_j sont les vitesses angulaires et $2L$ — *la* longueur de l'intervalle d'observation), qui caractérise la sélectivité de la méthode, est extremum pour $\lambda = 4.49$, 7.72, 10.91, etc. radians. Si on sait que pour x_u et y_u $L = 910$ jours et si on prend pour la période de Chandler $P = 1.208$ ans (Melchior P., 1954) les abscisses des extrêmes seront: 676 (0.22), 329 (0.22), 277 (0.13), 240 (0.09), 212 (0.07), 189 (0.06), 172 (0.05), 157 (0.04), 134 (0.03), 124 (0.03), 117 (0.03), 109 (0.03), 103 (0.02), . . . jours. Les nombres entre parenthèses, représentent approximativement les amplitudes de la fonction $R(\lambda)$ relatives au terme de Chandler.

P_m et A_m dans la Table 3 sont les moyennes des périodes et des amplitudes des termes donnés, tandis que A_m' est une composante qui trouve son origine dans le terme de Chandler. Pour l'amplitude du dernier nous avons pris $A = 0''.1197$ (la moyenne de la Table 3).

Une estimation grossière montre que 51% des amplitudes des termes identifiès peut être expliqué par l'influence du terme de Chandler. Le reste peut être expliqué par le terme annuel.

Dans la Table 2, en outre, on remarque un terme qui correspond à la nutation presque diurne deMolodenskiy (Molodenskiy M. S., 1961) qui provoquerait une variation des latitudes de période apparente de 204 jours moyens.

Jeffreys, Vicente, puis Molodenskiy ont calculé la fréquence propre de cette nutation pour deux modèles de la Terre. Les périodes pour ces deux modèles diffèrent de 2 sec.

Table 1.

Amplitudes A (en 0''.0001) et périodes P (en jours) des termes harmoniques en x_u et y_u.

Fonction: x_u		y_u	
P	A	P	A
15.4	11	14.2	11
16.8	12	15.4	14
19.6	16	16.4	13
20.6	14	20.6	12
21.6	20	22.8	12
24.0	16	24.2	15
24.6	18	24.8	15
25.0	16	26.6	14
26.0	16	28.2	16
27.2	18	29.8	26
28.0	20	31.2	18
31.2	16	33.4	14
33.8	15	35.4	26
36.4	17	38.8	20

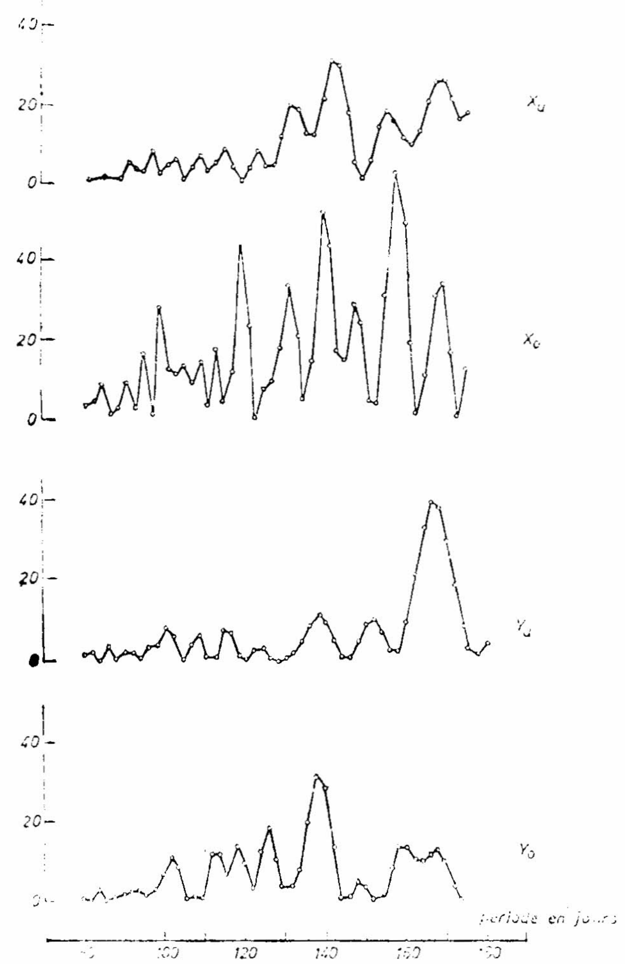


Fig. 7

Table 2.

Amplitudes A (en 0″.0001) et périodes P (en jours) des pics dans les spectrogrammes des fonctions x_u, y_u, x_0 et y_0.

x_u		x_0		y_u		y_0	
P	A	P	A	P	A	P	A
90	41	98	87	86	37	102	55
96	53	104	61	100	56	114	57
102	46	112	69	108	48	118	61
108	50	118	108	114	52	126	71
114	55	130	94	124	33	138	92
122	52	138	118	138	63	148	38
130	83	146	87	152	60	158	62
140	103	156	122	166	118	168	60
154	79	168	97	184	56	182	65
168	95	180	198	212	178	196	67
186	206	196	173	277	260	212	145
212	203	217	231	362	982	237	148
242	162	237	164	412	1309	262	197
277	275	262	316			297	326
362	982	297	407			352	941
412	1168	352	1010			442	1203
692	304	442	1108			632	528
		602	499				

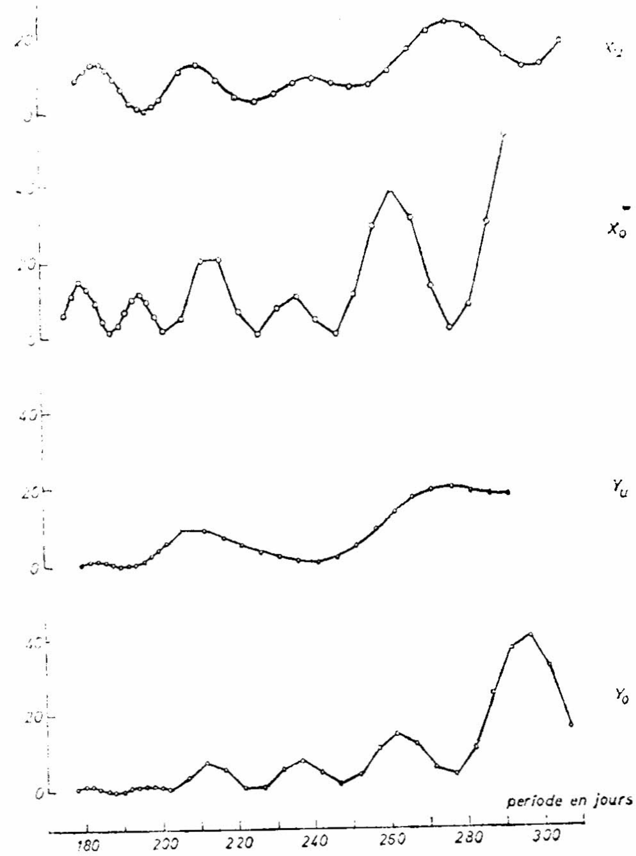


Fig. 8

Table 3.

Function:						
x_u	102	114	122	140	154	185
x_0	104	112	118	138	156	180
y_u	100	114	124	138	152	184
y_0	102	114	118	138	158	182
P_m	102	114	120	138	155	183
A_m	0″.0054	0″.0058	0″.0064	0″.0094	0″.0081	0″.0131
A'_m	24	36	36	48	48	72
x_u	212	242	277	362	412	692
x_0	217	237	297	352	442	602
y_u	212	...	277	362	412	–
y_0	212	237	297	352	442	632
P_m	213	239	287	357	427	642
A_m	0″.0189	0″.0158	0″.0317	0″.0979	0″.1197	0″.0444
A'_m	84		156	263		263

De nombreux auteurs ont cru mettre en évidence cette nutation presque diurne. Or le terme annuel et le terme de Chandler peuvent donner un effet parasite de fréquence voisine. On voit que l'identification de la nutation presque diurne nécessite des séries d'observation très longues.

Les grandes différences des résultats obtenus pour l'amplitude et la phase de ce terme de 204 jours montrent l'incertitude de sa détermination.

L'amplitude en est si petite qu'il est nécessaire de s'assurer que les périodes du terme annuel, de Chandler et de 204 jours soient commensurables sur l'intervalle d'observation.

Puisque 204 jours =0.56 ans, les intervalles de 42 n (n=1, 2, 3, ...) ans satisferions la condition ci-dessus. Pour la période de Chandler on a pris P=1.20 ans.

3. *Le terme annuel et le terme de Chandler.*

Les deux raies spectrales ne sont pas théoriquement séparables sur cinq ans et le calcul de l'influence mutuelle en amplitude donne 15%. Toutefois, dans le paragraphe 1 nous avons déjà vu que les différences systématiques des coordonnées peuvent contenir les termes périodiques dans la même région des périodes dont les amplitudes dépasssent l'amplitude de l'influence mutuelle des termes mentionnés. Donc, de point de vue pratique ce calcul a un certain sens.

Comme nous avons dit, les fonctions x_0 et y_0 couvrent l'intervalle de 6 ans.

Pour les amplitudes A_a, A_c et les phases F_a et F_c par rapport à la date julienne DJ=2440 222,0 (1969,0 janvier, 12^h TU) nous avons obtenu les résultats suivants (l'indice „a" se réfère au terme annuel, l'indice „c" au terme de Chandler):

Function:	Aa	Fa	Ac	Fc
x_u	0''.098	213°.2	0''.117	285°.2
x_0	.101	190 .3	.111	315 .1
y_u	.098	311 .7	.131	20 .7
y_0	.094	107 .2	.120	55 .9

Du Service International des Latitudes de 77 ans (1890—1966) A. Stoyko (1972) a obtenu pour le terme annuel:

Function:	Aa	$F'a$
x	0''.087	113°.1
y	.067	204 .4

Ces résultats diffèrent des notres, d'une part à cause des variations périodiques non-polaires des latitudes et, d'autre part, à cause de l'influence du terme de Chandler qui est plus prononcé dans nos résultats.

Quand il s'agit du terme de Chandler plusieurs auteurs (H. et Y. Labrouste, 1946, P. Melchior, 1954. T. Nicolini, 1949, A. Stoyko, 1972, Y. Yatskiv, 1965, etc.) ont obtenu deux périodes voisines: P_1=1.20 et P_2=1.17 ans. Les amplitudes correspondantes diffèrent systématiquement. C'est evident des résultats des auteurs mentionnés qui sont présentés dans la Table 4.

D'une analyse de x et y par rapport à l'Origine Internationale Conventionnelle — x_a, y_a, publiés par Vicente et Yumi (1969), A. A. Mihailov (1971) obtient que le mouvement annuel est elliptique de demi-axes 0''.098 et 0''.076 et le mouvement chandlérien également elliptique de demi-axes 0''.125 et 0''.120.

Table 4.

Terme de Chandler.

Auteur	P_1	A_1	P_2	A_2	Période. d'observ.
Labrouste	1.208	0''.089	1.170	0''.102	1900—1940
Melchior	.233	.087	.183	.162	1890—1950
Nicolini	.230	.072	.185	.136	1890—1948
Stoyko *A.*	.203	.096	.177	.153	1890—1965
Yatskiv	.215	.080	.165	.118	1891—1960

Le calcul de la période Pc et de l'amplitude Ac à partir de x_0 et y_0 donne des résultats proches de $1/2\,(P_1+P_2)$ et $1/2\,(A_1+A_2)$ de la Table 4.

Les amplitudes du terme annuel et du terme de Chandler, calculées à partir de x_u et y_u sont très proches des résultats obtenus à partir de x_0 et y_0, mais la période du terme de Chandler est plus courte. Nous sommes d'avis que c'est à cause de l'influence du terme annuel.

Par la méthode du développement TUO—TUC en série de Taylor (Đurović D., 1975) nous avons obtenu les résultats suivants:

Fonc.	A_a	F''_a
x	0''.081	52.0
y	0''.087	152.4

La phase F''_a est calculée par rapport à la date julienne DJ=2440 399.5

On peut tirer des conclusions suivantes:

1. Dans le domaine des périodes entre 10 et 40 jours les coordonnés du pôle n'ont pas de variations périodiques d'amplitudes significatives.

2. Entre 60 et 900 jours les spectres des coordonnés du pôle contiennent un nombre relativement grand de pics qui représentent des sous-harmoniques du terme annuel et du terme de Chandler.

3. La nutation presque diurne, théoriquement prévue par Poincaré, n'est pas identifiée.

Certains auteurs qui considèrent que la nutation presque diurne est identifiée dans leurs résultats n'ont pas tenu compte de l'influence mutuelle des termes principaux et de celui de 204 jours. Leurs résultats, par conséquent, ne permettent pas de confirmer et de déterminer les variations périodiques de 204 jours.

Table A.

GROUPE 1: observatoires équipés de tubes photographiques zénithaux.

OBS	LATITUDE	LONGITUDE	POIDS
H	+53°35'50''.205	-0^h40^m	0.92
G	+50 52 18.230	−0 01	2.42
MZP	+39 08 03.332	−9 25	0.45
MS	−35 19 17.463	−9 56	1.45
N	+46 59 52.128	−0 28	0.82
O	+45 23 37.125	+5 03	2.49
RCP	+25 36 46.888	+5 22	0.69

TO	+35 40 20.605	−9 18	1.90
W	+38 55 17.195	+5 08	0.41
CL	+50 52 22.252	+7 37	1.90
OS	+45 24 59.688	+5 04	1.06

GROUPE II: observatoires équipés d'astrolabes.

AL	+36 48 06.702	−0 12	0.68
BS	+47 14 57.236	−0 24	0.98
BW	+52 17 58.919	−0 42	0.59
CT	−33 56 05.206	−1 14	0.59
MZA	+39 08 03.577	−9 25	0.47
PA	+48 50 09.257	−0 09	1.65
POA	+49 36 13.834	−2 18	0.62
PTA	+52 22 54.773	−0 52	1.06
Q	−00 12 56.487	+5 14	0.78
RCA	+25 36 47.443	+5 22	1.07
SP	−23 39 09.870	+3 06	0.39
SFA	+36 27 43.813	+0 25	0.16
SC	33 23 57.000	+4 42	1.26
UA	+50 47 51.645	−0 17	1.26

GROUPE III: observatioires équipés de lunettes *I*énithales.

OBS	LATITUDE	LONGITUDE	POIDS
BLZ	+44°48′10″.255	−1ʰ22ᵐ	0.76
BK	+50 19 09.502	−8 30	1.42
BOZ	+52 16 38.063	−1 08	0.69
CA	+39 08 08.931	−0 33	1.05
D	+51 03 16.182	−0 55	0.46
GT	+39 08 13.189	+5 09	1.00
IRZ	+52 16 44.010	−6 57	1.00
EK	+55 50 20.128	−3 15	0.67
KB	+39 08 01.787	−4 28	1.03
KZ	+39 08 00.427	4 28	1.10
MZZ	+39 08 03.595	9 25	0.74
PYZ	+49 54 56.266	−0 59	0.65
POZ	+49 36 13.137	−2 18	0.62
PUZ	−59 46 15.638	−2 01	1.79
TT	−60 24 57.457	1 30	1.69
UK	+39 08 12.156	−8 13	0.92
VJZ	+52 05 56.017	−1 24	0.37

Remarque: Les abréviations pour les noms des observatoires sont celles des RAPPORTS ANNUELS du Bureau International de l'Heure.

Table B

Coordonnées du pôle (L'unité: 0″.001)

D. J = la date julienne − 2439 489.5. ε_x, ε_y = écarts-types de x_u et y_u.

D. J.	x_u	ε_x	y_u	ε_y	D. J.	x_u	ε_x	y_u	ε_y	D. J.	x_u	ε_x	y_u	ε_y
5	072	17	169	27	205	−009	12	240	17	405	029	17	244	17
10	052	18	211	17	210	004	09	215	11	410	020	15	262	14
15	105	12	194	13	215	012	13	223	15	415	038	13	251	16
20	109	16	171	16	220	013	15	206	15	420	015	19	253	15
25	057	15	166	18	225	006	13	212	15	325	006	14	285	13
30	061	19	172	20	230	−020	16	252	13	430	042	12	266	13
35	014	13	180	15	235	028	13	210	15	435	022	14	263	12
40	082	13	150	13	240	020	12	229	14	440	044	16	290	16
45	026	11	181	13	245	011	16	214	19	445	009	13	292	16
50	029	10	174	14	250	021	14	238	14	450	028	14	266	16
55	017	16	165	16	255	−035	12	208	12	455	023	11	284	14
60	026	18	152	18	260	−030	17	242	14	460	024	14	276	15
65	019	12	186	14	265	−005	16	224	15	465	018	14	275	14
70	041	15	158	15	270	007	14	199	16	470	055	11	293	14
75	013	16	173	14	275	−028	11	197	18	475	008	12	305	14
80	−013	12	189	15	280	002	18	207	15	480	021	12	280	15
85	−007	16	195	19	285	−012	17	189	20	485	026	16	294	17
90	−008	15	171	14	290	−030	12	221	14	490	061	15	284	14
95	017	15	158	19	295	−006	14	218	16	495	055	14	280	13
100	012	16	181	15	300	−016	11	198	12	500	022	13	252	14
105	018	14	191	12	305	−012	10	223	10	505	018	15	263	16
110	044	11	195	16	310	−043	16	229	18	510	047	15	255	15
115	−018	14	177	13	315	−029	11	250	15	515	024	14	241	14
120	−017	12	211	14	320	−034	17	290	23	520	032	14	226	14
125	−031	13	198	15	325	006	16	249	20	525	030	13	244	12
130	−030	13	190	16	330	−028	11	223	14	530	019	11	256	13
135	−018	10	232	11	335	−041	20	263	17	535	042	10	258	12
140	−040	13	206	13	340	−023	14	263	14	540	081	16	248	14
145	−029	12	227	14	345	−022	15	268	16	545	050	17	224	18
150	−024	13	204	16	350	−025	17	298	19	550	043	12	254	15
155	−024	12	189	14	355	−028	14	292	17	555	070	12	225	13
160	−015	13	189	15	360	−028	19	269	21	560	047	14	221	14
165	−008	13	200	16	365	−037	18	278	16	565	066	15	214	15
170	−020	11	217	15	370	−047	26	299	22	570	062	15	221	12
175	−019	12	229	14	375	−022	19	269	15	575	070	13	212	13
180	−014	13	239	11	380	−011	14	271	18	580	085	13	167	12
185	−023	10	241	13	385	−008	15	285	14	585	045	16	160	16
190	−001	10	224	11	390	036	15	262	16	590	058	16	166	12
195	−008	11	221	14	395	−034	22	315	20	595	069	12	163	12
200	−034	14	250	17	400	−027	14	272	14	600	054	14	199	14

Table B (suite)

D.J.	x_u	ε_x	y_u	ε_y	D.J.	x_u	ε_x	y_u	ε_y	D.J.	x_u	ε_x	y_u	ε_y
605	081	11	164	16	955	153	9	237	10	1305	184	11	440	12
610	067	13	159	13	960	139	14	232	14	1310	206	11	409	13
615	073	14	197	13	965	156	13	204	14	1315	234	11	405	12
620	070	12	190	14	970	125	16	176	13	1320	248	14	372	14
625	041	10	145	11	975	176	13	163	13	1325	243	15	337	13
630	−002	13	188	13	980	143	14	187	14	1330	262	12	356	13
635	017	15	170	14	985	130	10	185	12	1335	255	14	339	14
640	031	15	189	15	990	137	10	162	12	1340	237	11	286	13
645	054	15	130	11	995	120	10	138	11	1345	264	12	294	12
650	−005	15	128	15	1000	110	10	158	13	1350	242	11	270	11
655	−008	11	133	11	1005	100	13	145	16	1355	244	12	259	12
660	004	14	099	17	1010	072	12	138	14	1360	245	10	230	13
665	−002	14	160	14	1015	079	10	141	12	1365	241	10	218	13
670	−048	16	133	15	1020	087	10	104	14	1370	237	11	189	13
675	−078	16	176	14	1025	059	12	119	15	1375	217	19	201	14
680	−066	15	170	16	1030	051	11	115	14	1380	207	13	134	13
685	−074	20	162	18	1035	059	13	101	16	1385	216	14	132	13
690	−069	20	150	20	1040	025	12	107	13	1390	202	13	124	15
695	−107	17	158	14	1045	016	14	099	15	1395	163	14	122	14
700	−124	09	177	10	1050	013	12	106	13	1400	153	13	108	15
705	−089	16	169	19	1055	−015	13	092	12	1405	142	11	117	13
710	−101	19	228	14	1060	−006	19	119	15	1410	093	13	112	14
715	−085	10	196	15	1065	−041	15	119	15	1415	115	14	112	15
720	−136	16	206	15	1070	−082	19	093	15	1420	119	24	095	20
725	−113	14	175	18	1075	−041	16	119	16	1425	086	15	075	15
730	−074	20	175	19	1080	−039	18	092	18	1430	057	12	059	19
735	−133	29	258	20	1085	−075	18	098	15	1435	033	14	048	13
740	−146	13	243	15	1090	−120	16	126	16	1440	037	11	044	14
745	−135	16	253	14	1095	−077	24	079	17	1445	010	17	074	18
750	−102	21	283	18	1100	−149	23	157	20	1450	−022	17	046	14
755	−148	13	294	15	1105	−120	16	193	18	1455	−016	13	093	13
760	−101	20	278	17	1110	−176	21	193	17	1460	−043	34	102	27
765	−096	16	310	16	1115	−115	19	214	16	1465	−036	29	058	32
770	−132	17	334	18	1120	−148	20	196	18	1470	−040	17	098	16
775	−073	18	281	16	1125	−184	15	218	14	1475	−097	17	082	26
780	−090	15	330	15	1130	−172	16	231	15	1480	−102	18	099	18
785	−075	15	345	13	1135	−172	11	239	14	1485	−084	19	115	15
790	−107	13	347	14	1140	−150	17	274	17	1490	−113	19	138	16
795	−085	10	351	11	1145	−166	19	311	20	1495	−184	18	108	19
800	−101	10	390	12	1150	−162	16	301	14	1500	−122	17	155	16
805	−063	14	361	15	1155	−157	16	316	15	1505	−177	16	173	15
810	−068	19	389	15	1160	−149	17	376	17	1510	−163	13	213	15
815	−080	13	415	14	1165	−145	15	365	15	1515	−217	18	200	17
820	−036	14	400	16	1170	−115	12	414	14	1520	−178	20	219	19
825	−044	11	398	11	1175	−101	19	412	13	1525	−193	14	268	17
830	−045	12	393	15	1180	−137	17	429	17	1530	−218	21	245	19
835	−012	13	401	13	1185	−099	18	441	17	1535	−246	15	295	18
840	−016	11	384	12	1190	−119	17	452	15	1540	−237	11	323	11
845	003	13	404	13	1195	−082	14	475	13	1545	−235	20	344	21
850	016	14	419	14	1200	−114	16	433	16	1550	−186	13	332	17
855	024	14	450	16	1205	−108	12	479	13	1555	−207	12	390	14
860	028	13	436	13	1210	−065	19	469	15	1560	−218	13	392	15
865	049	13	404	13	1215	−052	16	499	15	1565	−158	16	415	17
870	045	13	403	14	1220	−038	16	489	15	1570	−214	12	427	15
875	024	13	400	15	1225	−035	14	514	14	1575	−184	12	447	17
880	063	16	395	15	1230	−038	15	518	16	1580	−187	16	448	17
885	064	13	383	12	1235	−016	13	529	13	1585	−177	15	467	18
890	036	13	391	14	1240	010	15	535	13	1590	−163	13	477	17
895	095	8	335	12	1245	−005	12	559	14	1595	−184	11	462	14
900	115	12	358	16	1250	025	12	520	11	1600	−137	15	540	16
905	100	14	360	15	1255	044	09	537	11	1605	−155	17	522	17
910	099	12	352	12	1260	065	61	524	17	1610	−133	15	531	13
915	103	14	368	16	1265	077	12	499	13	1615	−105	17	548	19
920	130	10	355	10	1270	088	12	501	14	1620	−069	15	532	18
925	113	12	312	13	1275	146	12	519	14	1625	−048	12	567	14
930	160	9	288	11	1280	113	13	497	13	1630	−053	14	573	14
935	127	12	301	15	1285	151	15	474	14	1635	−041	13	566	15
940	142	11	274	14	1290	154	13	454	13	1640	013	12	587	15
945	142	11	236	12	1295	191	14	454	15	1645	021	14	585	13
950	151	12	230	13	1300	205	19	459	20	1650	041	10	555	15

Table B (Suite)

1655	081	08	588	13
1660	066	12	541	13
1665	106	12	554	14
1670	134	13	523	14
1675	141	10	502	12
1680	156	10	499	11
1685	182	11	499	13
1690	188	12	459	12
1695	220	09	455	10
1700	260	12	440	13
1705	263	12	447	12
1710	263	10	399	12
1715	275	8	398	12
1720	259	10	393	14
1725	298	12	355	15
1730	311	10	343	12
1735	271	20	320	18
1740	309	11	296	14
1745	281	09	295	12
1750	279	12	283	13
1755	252	13	288	14
1760	244	11	236	18
1765	231	09	220	11
1770	256	16	230	20
1775	204	11	157	15
1780	202	12	207	14
1785	200	15	191	14
1790	204	12	156	12
1795	182	17	161	16
1800	158	19	201	19
1805	149	16	157	15
1810	131	23	164	20
1815	133	18	115	19
1820	115	25	107	26

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