BULLETIN

DE

L'OBSERVATOIRE ASTRONOMIQUE DE BELGRADE

ANNÉE 1971–1972 *№ 125* *VOLUME XXIX, F. 1*

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M. B. PROTITCH

BEOGRAD, 1972/73.

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THE MERIDIAN MARKS OF THE LARGE TRANSIT INSTRUMENT OF THE BELGRADE OBSERVATORY

I. PAKVOR

At the Observatory in Belgrade, three fundamental instruments are installed (Ascania, $\varnothing = 190$ mm, f=2578 mm). They were provided for absolute and differential determinations of both coordinates. One of the instruments is the Large Transit instrument destinated for determining the absolute right ascensions, but until now could not serve that purpose mainly because of non-existent meridian marks. In the last few years, intensive research into this problem has been carried out and is now at the fulfilment of technical realization.

Three meridian marks, two at the North and one at the South, have been planned. The one to the North is only a comparative one and is of secondary importance. The main innovations are the vacuum tubes which will be located between mark's objectives and the meridian marks themselves for the purpose of lessening the influence from the main obstacle of the precise determination of the azimuth — refraction. The above mentioned comparative meridian mark has been planned in the traditional way, without the vacuum tube, and is at a distance of approx. 240 m, situated on the wall of nearby dome. Its purpose is only to serve as a comparison between traditional meridian marks and those with vacuum tubes.

Please allow me to explain certain details concerning our vacuum tubes from which we, at the Belgrade Observatory, expect a qualitative change in the accuracy of reading the meridian marks. The tubes will be made of steel with diameter of approx. 30 cm. At the both ends they will be hermetically sealed with rigid planparallel glasses, specially made, which will remain planparallel under the vacuum of at least 1 mm Hg. This vacuum, we believe, will practicaly eliminate the refraction in the tube. The length of the tube at the North is 30 m and at the South 51 m. These relatively short distances of our main meridian marks are conditioned by our locality, but previous consultations have shown that such short distances would not have an detrimental effect on the accuracy of the results. For the control of the vacuum special instruments will be connected directly to the exterior of the tube. To ensure that the glasses at the both ends of the vacuum tubes remain exactly parallel, there will be a degree of flexibility for the corrections at the certain places along the tube itself. Special metereological shelters will be provided to try to nullify the influence of direct sun rays, rain etc. Similar shelters will enclose the meridian marks, also. For supporting the tubes steel pillars will be built. The ends of the tubes will lie like consoles i. e. they do not lei either on the pillar of meridian mark nor on the pillar of mark's objektive. The height of the tube will be between 2 and 3 m.

There is always the possibility of setting up supplementary vacuum tubes on a part of the line of vision between the instrument and mark's objectives if such a necessity occurs later. That would cover the whole path of the light ray. The decesion regarding this will be left until later.

As regards mark's pillars themselves, they will be built according to the generally accepted principles and we hope that they will fulfil strict conditions of stability. The isolation of the pillars, mechanical and that against atmospheric and underground water, is secured.

The northern vacuum meridian mark, besides its basic purpose, will serve as one of the collimators. The actual collimator, with the micrometer, will be located on the existing southern collimator's pillar, together with a construction for southern mark's objective frame.

If the technical realization succeeds, we consider that with such a new construction of meridian marks we have sufficient reason to hope for the elimination of the main cause of inaccuracy in determining the azimuth — refraction. This would be a remarkable step forward, and it is the main reason for drawing your attention to this subject.

The author of this project is Dr. Lj. Mitić, Head of The Large Transit Instrument Division of the Belgrade Observatory.

(Presented at the IAU meeting, Commission 8, Brighton 1970)

MICROMETER OF THE LARGE TRANSIT INSTRUMENT OF THE BELGRADE OBSERVATORY, 1971

I. PAKVOR

SUMMARY:

The second examination of the eye-piece micrometer of The Large Transit Instrument of the Belgrade Observatory is presented. The examination was carried out during 1971, eight years after the first one. Ridberg's method was used concerning periodic and progressive errors. Lost motion, the value of the revolution and contact width were also determined. Correlations between the results of the previous and present examinations are given and it is stated that the micrometer is further free of the mentioned digressions and that the constants have stayed practically unchanged.

The second complete examination of the micrometer of The Large Transit Instrument of The Astronomical Observatory in Belgrade was carried out mainly for two, generally accepted, reasons. Firstly, an adequate number of years has passed since the first examination (1963), [1], which could possibly affect the values of its errors and constants, so it is scientifically imperative to register it, and secondly, which may be more important at this moment, an approaching engagement of the instrument for the larger observations for its first catalogue of stars.

The micrometer is mostly tested in the identical way as the first time as we wanted to ensure the objective comparation, but if there were few digressions they could not influence the wanted comparison very much.

When examining the existence of periodic and progressive errors of the micrometer screw, the micrometer and examinator were installed in the astronomical pavilion on the observation pillar. Examinations of the mentioned errors were carried out in June during the morning hours so it can be considered that a certain constancy of temperature has been reached. This has been proved by its registration. Lost motion and the constants of the micrometer, value of a revolution and contact width,were determined when the micrometer was already returned to the instrument. The value of the revolution was found by astronomical observations while the contact width was determined through an existing chronograph.

1. PERIODIC ERRORS

As the first time, Ridberg's method was used [3], [4], in a zone of 8 middle revolutions (around the central thread). Pointings were carried out so that at each fifth reading 16 individual data exist. It has been shown that such frequency ensures a sufficent accuracy.

Table 1. represents the final values of the periodic errors at each fifth reading of a micrometer drum. Values are given in units of the scale.

Table 1

drum reading	periodic error	drum reading	periodic error
0	−0.012	50	−0.039
5	+0.035	55	−0.031
10	+0.032	60	−0.027
15	−0.007	65	−0.002
20	+0.021	70	+0.015
25	0.000	75	+0.032
30	−0.005	80	+0.018
35	+0.006	85	+0.011
40	−0.006	90	+0.013
45	−0.044	95	0.000

The real value of these errors can be more easily estimated if we transform them into units of time. Each one is under $0^s.001$ which is again far above the accuracy of the instrument itself, so we consider that conserning these digressions, the micrometer retained its good qualities and the errors can be neglected.

It is interesting now to compare the present results with those of eight years previous. This is shown on the given diagram (Fig. 1). Although the values are so small, negligible even for such a large instrument, the harmony between the two examinations is unequivocal, which is on other hand a fine proof of the accuracy of the method and its application. Naturally, this is not of a special importance for the general application, but has its value if the examination is taken by itself.

The average value of the mean square of determining the periodic errors is placed also in the limits of neglect and is equivalent, in units of the scale, to

$$\varepsilon = \pm 0.023$$

This value is also comparable with the previous one which came to $\pm$ 0.031.

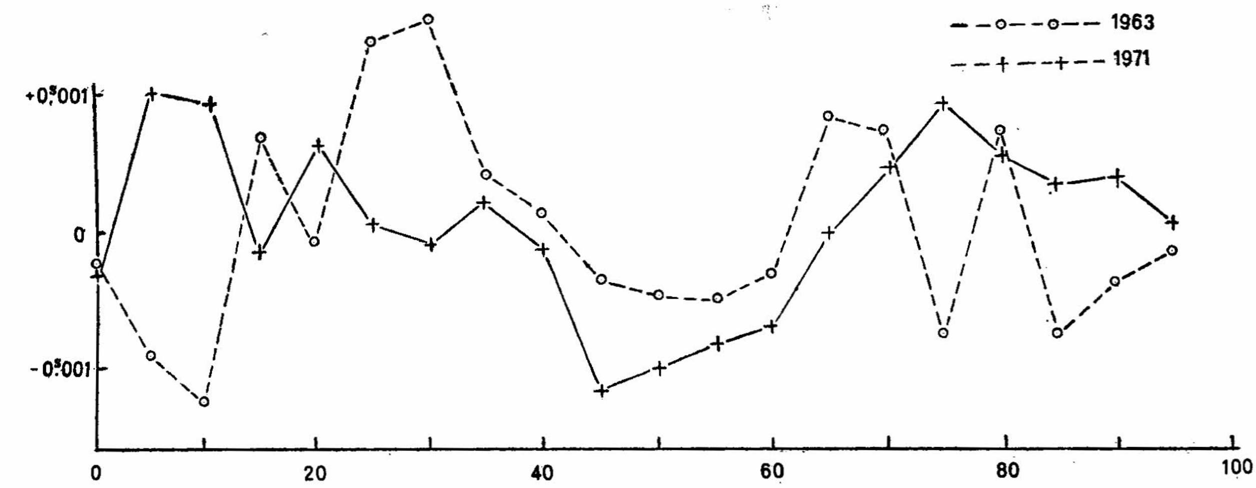

Fig. 1

2. PROGRESSIVE ERRORS

While the micrometer was still on the examinator, together with the periodic errors, the progressive digressions were examined. This was carried out at each individual revolution starting with the 25th until the 35th. Settings were made on the 20th drum reading for practical reasons. In this slight matter the present examinations differ from the previous ones.

With the usual treatment of the examination's material, we obtained the following values which, with their size, prove the high quality of the micrometer, the quality of which surpasses the power and the requirement of such an instrument.

Table 2

revolution	progressive error	revolution	progressive error
25.2	0.000	30.2	+0.002
26.2	−0.004	31.2	+0.007
27.2	−0.005	32.2	+0.002
28.2	−0.004	33.2	+0.012
29.2	−0.003	34.2	+0.009
30.2	+0.002	35.2	0.000

The valuese are given in units of the scale For the purpose of information it can be stated that the larger error is under 0.0005 time seconds.

At the given comparative diagram (Fig. 2) a

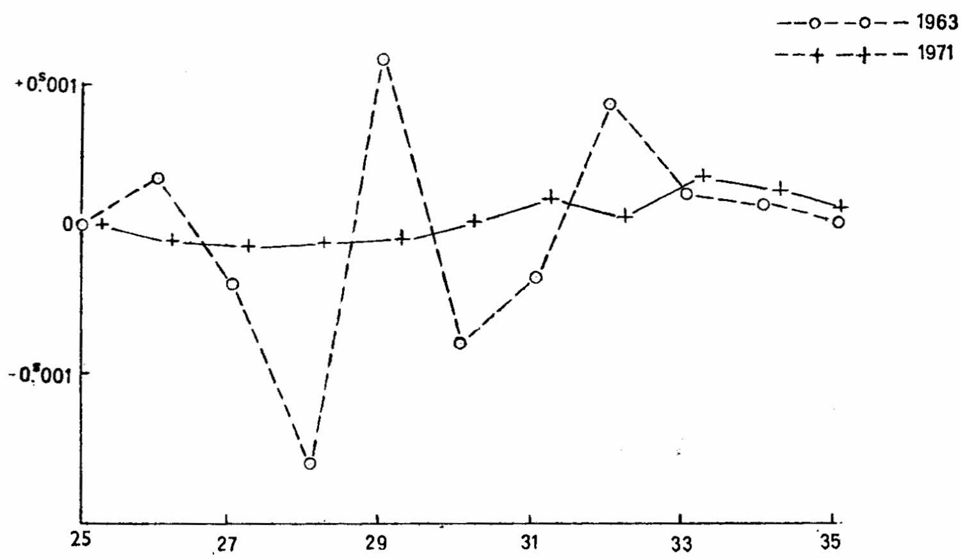

Fig. 2

certain general agreement can be seen, although the remarkable smoothness of present errors must be stated. Still, both previous and present are well within the limits of neglect.

The average value of the mean square error of determining the progressive errors is equivalent, in units of the scale, to

$$\varepsilon = \pm 0.036$$

and it is under the limit of $0^s.001$, so it can be considered as very satisfactory.

3. LOST MOTION

Examination of the lost motion of the micrometer screw was made when the micrometer was mounted on the instrument, from two positions of the observer — facing the south and the north. If we add that 120 pointings were made, then we could consider that the authenticy, the amount of data and the elimination of gravitation effect were ensured.

With the following result

$$L_m = 0^s.0001 \pm 0^s.0003$$

we can be very satisfied and state that, in the limits of a required accuracy, the micrometer screw is free of lost motion.

4. THE VALUE OF THE REVOLUTION AND THE CONTACT WIDTH

Using the well known formula of meridian astrometry

$$R' = \frac{\Delta T}{K} \cos \delta - \frac{15^2}{206265} \cdot \frac{\Delta T^2}{6K} \cos \delta \sin^2 \delta,$$

where R′represents the value of the revolution not free from refraction influence, ΔT recorded time in seconds between the two, first and final, moments of the observed star, K the number of whole revolutions needed for the travelling wire to move from the beginning position of the star to the last one, δ declination of the star, we obtained the value of the revolution of the micrometer screw with the astronomical method.

Observing 21 stars, from which each in average gave about 17 individual data and taking care of the influence of refraction

$$R = R' - 1/3600\, R'$$

we adopted a new value for the revolution

$$R = 2^s.699 \pm 0^s.003$$

The contact width is determined by a laboratory method when the micrometer was mounted on the instrument. All contacts of 4 middle revolutions were taken in consideration; the chronograph played the assisting role during the examinations. Following the familiar transformations and taking care of the new value of the revolution, the following value for the contact width was adopted.

$$K = 0^s.027 \pm 0^s.0001.$$

For information and comparison purposes let it be reminded that the previous values of the revolution, contact width and lost motion resulted in $2^s.696 \pm 0^s.003$, $0^s.031 \pm 0^s.001$ and $0^s.0003 \pm \pm 0^s.0014$ respectively.

5. CONCLUSION

We mentioned in the preface that the question of the quality of micrometer at this time was put forward mainly for two reasons. What is the answer? Firstly, concerning the possible screw errors, a high quality is preserved entirely and what is of special importance for the accuracy of the method it coincides with the one from 1963. As regards the constants, they have remained practically unchanged too, although the reasons for this have existed (the micrometer has been dismounted several times). The final conclusion is that the micrometer screw of the Large Transit Instrument of the Belgrade Observatory is of the highest quality and is ready, together with the micrometer itself, for the approaching responsible tasks.

At this point the author wishes to express his gratitude to S. Bogić, the technical collaborator at Belgrade Observatory, who, with the conscientious work on the treatment, contributed to the realization of this research.

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AUTOMATIC DEVICE (A. D.) FOR CONTACT-MICROMETER ON THE TRANSIT INSTRUMENT

S. PETKOVIĆ and M. KRALJ

1. INTRODUCTION

In this paper, consideration is given to the basic electro-mechanical principles of A. D.

The Introduction of the A. D. for contact-micrometer on the Transit Instrument was predeterminated by the following conditions:

— The observer had to switch the mechanism for recording off and on. This operation distracts the observer's concentration. The A. D. would eliminate this operation.

— Improvement of the security of observation.

The synchronous motor which drives the printing chronograph is driven by means of an electronic frequency driver, to ensure constant rotating speed. The A. D. controls whether the printing chronograph is out of synchronization.

— Only the imprints of the moments when micrometer contacts are in the working area are needed on the recording tape. Series of observations and the groups within each observation must be clearly separated.

These conditions make future automatisation possible. The information from the observing object is prepared for feeding into the computer. To satisfy the last three conditions, the outlook of recording tape must be as follows:

— The moment before the star comes into the working area, there must be an imprint from the sec. pulse from the same quartz clock which drives the synchronous motor of the printing chronograph.

This treatment must be repeated when the star goes out of the working area.

In this way the possible error of the synchronization is eliminated.

— These two pieces of information must be separated from the other imprints on the recording tape.

— The working area is determined with two full revolutions of the micrometer drum, before the star passes the meridian plane and two full revolutions after the star has passed the meridian plane. The micrometer drum has ten working contacts and two pointer contacts. The first working contact and pointer contacts do not come into calculation and therefore this triple contact does not have imprints on the recording tape.

The triple contact divides the working area into four parts with blanks on the recording tape instead of imprints.

The definite outlook of the recording tape, for one star passage is as follows:

— Imprint information about synchronous work of printing chronograph. (Printed information from quartz clock.)

— A blank recording tape.

— 4×9 working contacts with blanks between every group.

— A blank recording tape.

— Imprint information about synchronous work of printing chronograph.

— Blanks which separate the star passages one from another.

If special measurements are required, the device makes it possible to print all contacts. This is done with one switch. The control of the synchronization of printing chronograph is also possible whenever the observer desires.

2. WORKING PRINCIPLES OF THE DEVICE

The electric wiring diagram for A. D. is shown in Fig. 1. At the moment when the switching circuit

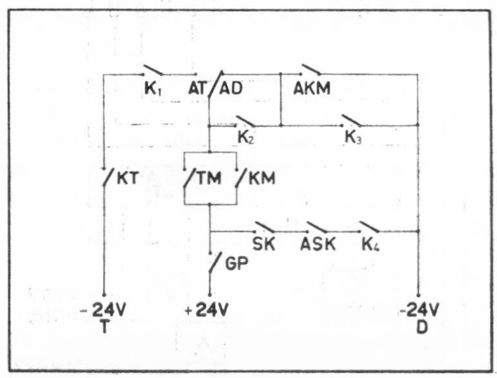

Fig. 1

is closed between the terminals +24V and —24VD, here is an imprint on the recording tape. In the case when the switching circuit is closed between the terminals +24 V and —24 VT the paper recording tape remains blank.

The working contacts are denoted as KM, and the triple contact is denoted as TM. The GP switch enables the work of device. The switch which puts A. D. out of work, has four contacts (K_1, K_2, K_3, and K_4). During automatic work, K_1 and K_4 are closed, K_2 and K_3 are open. The other contacts belong to the A. D.

The position of switch AT/AD determines whether the moment of closing KM will be printed or remain blank.

	KM	TM	GP	KT	K_1	AT	AD	K_2	AKM	K_3	SK	ASK	K_4
The star is outside the working area	x	x	1	x	1	x	x	0	0	0	x	0	1
The moment before the star enters the working area	x	x	1	x	1	x	x	0	0	0	1	1	1
The star is in the working area	1	1	1	1	1	1	1	0	1	0	x	0	1
After out of the star % exit the working area	x	x	1	x	1	x	x	0	0	0	1	1	1

1 — contact closed; 0 — contact open.

AKM determines the working area. SK is the sec. contact of the quartz clock, and connected with it in series ASK determines the moment just before the star enters the working area and also the moment of exit.

The following TABLE gives the contact position if A. D. is switched on.

3. THE SOLUTION FOR A. D.

The A. D. is made of two functional parts. One part is on the instrument (Fig. 2) and the other is with the servicing equipment. These two parts are interconnected with slide ring contacts. The working part on the instrument consists of two program discs (a and b) which are gear driven.

Program disc (a) fulfills two functions:

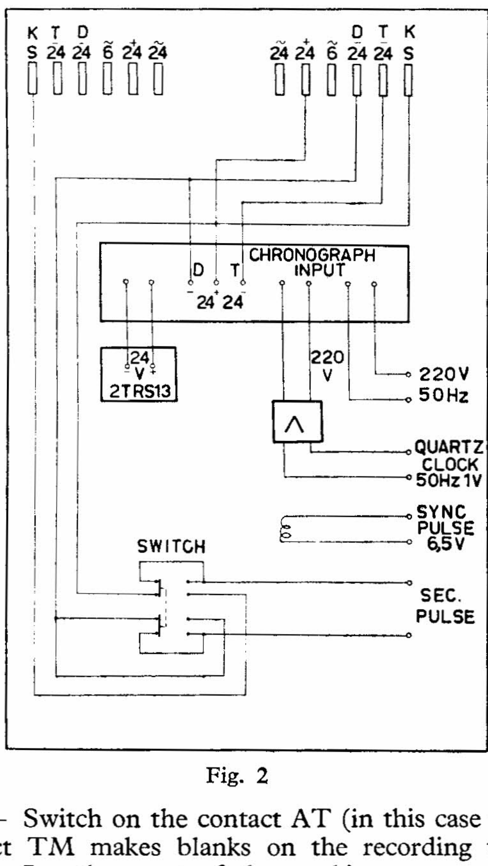

Fig. 2

— Switch on the contact AT (in this case triple contact TM makes blanks on the recording tape).

— In other part of the working area contacts KM make imprints. The Program disc (b) makes the contacts AT and AD possible in the working area only. The disc (b) also gives the information for checking the synchronization of printing chronograph.

Contacts K_1, K_2, K_3, and K_4 belong to the switch which disconnects the A. D.

On both sides of the Instrument there are six slide-contacts. Contacts denoted with ~ 6 and ~ 24V are for light and motor drive respectively.

The second part of the A. D. consists of:

— Printing chronograph

— Power amplifier for synchronous motor driving

— DC power supply

— Switch for automatic or manual testing of the synchronization of the printing chronograph.

The wiring diagram of this part is shown on Fig. 3.

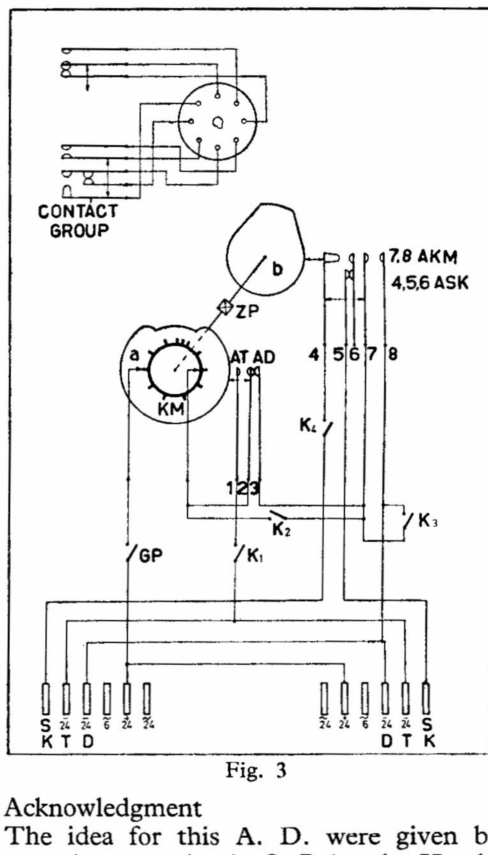

Fig. 3

Acknowledgment

The idea for this A. D. were given by Ivan Pakvor assistant at the A. O. Belgrade. He also gave the technical conditions with a high degree of precision.

REFRACTIONAL PAIRS OF THE INTERNATIONAL LATITUDE SERVICE AND METEOROLOGICAL ELEMENTS

G. TELEKI

1. In every group of the first observation program of the International Latitude Service (ILS) there were also two pairs with mean zenith distances of about 60° (in total 24 pairs). These, so called refractional pairs were observed till the end of 1905, with the aim of giving some information on anomalous refraction at the stations of the ILS. Albrecht's and Wanach's (1906) analysis showed that they could not give the expected information, and therefore the refractional pairs were eliminated from the program of the ILS at the beginning of 1906.

We analysed (Teleki, 1970a) once more the results of observations of these refractional pairs collected at the five stations of the ILS in the interval from 1900 to 1905 and published by Albrecht and Wanach (1909).

For all stations and observation groups we achieved values

$$\Delta\varphi_{ki} = \varphi'_{Rk} - \varphi''_{Rk}$$

where φ'_{Rk} denotes the latitude of the first refractional pair in k-group and φ''_{Rk} the latitude of the second pair in the same group. From $\Delta\varphi_{ki}$ we form a mean value $\Delta\varphi_{ks}$ for interval (one month) when that group was observed as a morning group and evening group, separately. For every value $\Delta\varphi_{ks}$ the mean square error ε_{ks} of this determination was calculated.

With the view of comparison, we select (Teleki, 1970b) in every group two Talcott pairs with the smallest zenith distances — the mean zenith distance of 24 such selected pairs (we call these pairs latitude pairs) is 3°21′, consequently, they can be practically treated as zenith pairs. As in case of refractional pairs, we calculated the difference between the latitude of the first (Φ'_{Lk}) and the second (Φ''_{Lk}) selected latitude pair in every group:

$$\Delta\Phi_{ki} = \Phi'_{Lk} - \Phi''_{Lk}$$

and after that we determined, along analogous lines, the values $\Delta\Phi_{ks}$ and ε_{Lks}. The values $\Delta\Phi_{ki}$ are calculated only for the days for which we posses the values $\Delta\varphi_{ki}$ too. The data published by Albrecht and Wanach (1909) are used.

$\Delta\varphi_{ki}$ and $\Delta\Phi_{ki}$ don't point to particular characteristics and for this reason in this place we will discuss the values ε_{ks} and ε_{Lks} only. In Table 1 there are the results published earlier (Teleki, 1970b). Under the notation ε_k and ε_{Lk} (in units of $\pm$ 0″.01) we give the weighted mean values of ε_{ks} and ε_{Lks} for the six year interval 1900—1905, for the evening and the morning observations separately. The notation F indicates

$$F = \frac{\varepsilon_k^2}{\varepsilon_{Lk}^2}$$

The notations for stations of the ILS are usual: Mizusawa — Mi, Tschardjui — Ts, Carloforte — Ca, Gaithersburg — Ga, Cincinnati — Ci and Ukiah — Uk.

Out of the Table 1 we can draw these conclusions:

a) the evening and the morning observations have the same characteristics,

b) the values ε_k and ε_{Lk} are markedly the least at Carloforte (we notice that the values $\Delta\varphi_{ki}$ are also relatively the least in this station),

c) the accuracy of the values $\Delta\Phi_{ks}$ is really higher than the accuracy of the values $\Delta\varphi_{ks}$,

d) there are differences between the values F — the least is at Tschardjui and the largest at Mizusawa, and

e) there are sensible differences between the values ε_k for Carloforte and Mizusawa — we called particular attention to this fact earlier (Teleki, 1970a).

It is inferred that refractional pairs as well as the latitude pairs give information about local influences on the values of latitude, but the information from the refractional pairs is more marked, which is very important and useful for the investigation of non-polar variations.

2. In continuation of this reserach, we have processed such meteorological data which are collected during the observations of these pairs in the interval 1900—1905 and published in „Resultate des Internationalen Breitendienstes", Band I (pp. 48—68), Band II (pp. 31—57) and Band III (pp. 19—28). We used the meteorological elements of those nights only, when both refractional pairs in the group were observed.

We have analysed such meteorological elements only, which were recorded at all stations for the whole interval 1900—1905:

t_a — the air temperature outside observing house,

t_i — the air temperature inside observing house,

Δt — the hourly variation of air temperature outside observing house, and

b — the atmospheric pressure reduced to 0°C.

We employed the subjective estimates of observational conditions too:

B — the quality of image, and

R — the atmosheric stability (Ci is missing these data). The estimates are from 1 (the best) to 4.

As in the case of $\Delta\varphi_{ki}$ and $\Delta\Phi_{ki}$, we calculated the monthly and yearly weighted mean values of all mentioned elements. The average errors (η) of t_a, t_i, Δt and b means are also calculated. All these data are given by Supplements I—X.

The weighted mean values for the interval 1900—1905 are separated in the Table 2. In the basis of these data we establish the facts:

a) the most stable temperature conditions are at Carloforte — evidence about this gives the values Δt, η_{ta}, η_{ti} and $\eta_{\Delta t}$ which are the least at this station,

b) the mean temperature (t_a, t_i) and the mean pressure (b) are relatively the highest at Carloforte,

c) the mean air temperature is the least at Mizusawa,

d) it can be seen from Supplement I, that the smallest range of air temperatures is at Carloforte and Ukiah (12°.8 C), and the largest at Tschardjui (30°.4 C), and

e) information on the good stability of observatinal conditions at Carloforte is provided also by the values B and R, which are minimals here.

3. It results from Table 1 that the smallest variation of the values $\Delta\varphi_{ki}$ and $\Delta\Phi_{ki}$ during month, compared with other stations, are at Carloforte which is to say that the variation of latitude during night are relatively the most stable. At the same time, Table 2 informs on the very stable temperature conditions during the observations at Carloforte. These two facts can be interlinked: it can be expected that the stable temperature and observational conditions conduce to the smaller dispersion of observational data. The stable temperature field from night to night exercieses useful influence on the observational data: it decreases the variations of instrumental characteristics and of anomalous refraction. The changes of temperature and of temperature gradients are the cause of the variations of instrumental characteristics, such as the influence on levels (Drodofsky, 1956), the variation of tube flexure (Teleki, 1970c), the variation of position of the line of sight (Milovanović, 1968) and the variations of instrumental constants. It is a known fact (Teleki, 1967) that the temperature gradients are the most important factors in the occasioning of anomalous refraction.

In the data of the ILS for the interval 1900—1905, it is impossible to separate what comes from instrumental and what from refractional influences. It is impossible because there are no adequate numbers of meteorological data, and direct separation out from the observational data is out of question either. The only possibility is the making of certain estimation. The investigations of the influence of the temperature field on instruments and observational data, initiated by Pavlov (1963), don't raise doubts that there are influences of the same sort in the ILS data of the interval 1900—1905 too; as far as refractional influences are concerned, Ikeda's (1962) and others investigations showed their presence. Our data about B and R (Table 2), although they are subjective estimates, primarily point to the difference of refractional influences at the different stations of the ILS.

In addition to instrumental and refractional influences, there is no need to exlude the possibility of the existence of some others as well. Okuda (1969) called attention to one of these influences.

All these investigations give reason to the usefulness of the introduction of refractional pairs in the observational program of latitude services, which would be accompanied by special meteorological investigations (Teleki, 1972).

We are obliged to Mrs. B. Kubičela, who carried out all calculations.

Table 1

The mean values of ε_k, ε_{Lk} (in units of $\pm$ 0″.01) and F at the different stations of the ILS, separately for the evening and the morning obsrevations, for the interval of 1900—1905.

Value	Observations	Mi	Ts	Ca	Ga	Ci	Uk
ε_k	evening	42	37	27	37	38	38
	morning	45	38	27	38	35	38
ε_{Lk}	evening	23	26	16	24	24	22
	morning	23	26	17	24	24	22
F	evening	3,3	2,0	2,8	2,4	2,5	3,0
	morning	3,8	2,1	2,5	2,5	2,1	3,0

Table 2

The mean values of meteorological elements (t_a, t_i, Δt and b), their average arrors (η_{ta}, η_{ti}, $\eta_{\Delta t}$ and η_b) and the estimates of observational conditions (B, R) at the different stations of the for the interval 1900—1905.

Value	Mi	Ts	Ca	Ga	Ci	Uk
t_a	5,8	13,9	17,4	8,7	11,4	10,1
t_i	6,4	14,6	17,2	9,0	11,6	10,6
Δt	−0,7	−0,7	−0,2	−0,5	−0,8	−1,0
b	758,6	745,8	762,4	751,4	744,2	747,3
B	2,4	1,6	1,5	2,4	3,0	2,0
R	2,1	1,7	1,5	2,4	—	2,0
η_{ta}	2,2	2,4	1,3	3,1	3,2	2,0
η_{ti}	2,0	2,3	1,3	3,1	3,2	2,0
$\eta_{\Delta t}$	0,2	0,3	0,1	0,2	0,2	0,2
η_b	2,6	2,5	2,4	3,1	2,2	1,8

Supplement I

Monthly and yearly mean values of the meteorological element t_a (in °C).

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	−4°,5	−5°,9	10°,4	−2°,6	−0°,7	3°,6
II	−7,0	−0,1	11,1	−6,2	−4,0	3,9
III	−1,6	5,3	11,8	0,5	3,6	8,0
IV	2,3	9,1	13,2	4,9	7,5	7,3
V	6,0	14,8	14,0	10,5	12,7	9,0
VI	9,7	19,5	16,9	14,7	17,0	10,9
VII	13,7	23,6	20,5	18,9	19,2	13,7
VIII	20,1	24,5	23,2	20,8	21,4	16,2
IX	18,3	20,3	22,5	17,9	19,0	14,7
X	7,2	11,2	19,1	10,3	12,6	11,2
XI	1,9	4,8	14,0	2,1	4,2	6,1
XII	−3,6	1,3	11,4	−1,0	−1,3	3,4
Mean value	5,8	13,9	17,4	8,7	11,4	10,1

Station	1900	1901	1902	1903	1904	1905
Mi	6°,0	5°,2	5°,2	7°,6	7°,0	3°,3
Ts	12,4	13,8	15,6	13,3	13,4	15,3
Ca	17,2	17,0	17,4	17,6	18,1	17,1
Ga	9,7	8,0	9,7	8,5	6,8	8,3
Ci	11,4	11,1	12,3	11,4	11,1	11,4
Uk	10,0	10,4	9,9	9,3	10,7	10,2

Supplement II

Monthly and yearly vaues of η_{ta} (in °C).

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	2°,0	3°,7	1°,1	3°,4	4°,4	1°,4
II	2,5	2,7	1,3	3,3	3,2	2,4
III	2,2	2,7	1,1	4,1	4,5	1,3
IV	1.7	3.3	0,8	2,8	2,5	2,4
V	2,3	3,1	1,2	3,0	3,6	2,4
VI	2,5	2,2	1,7	2,8	2,9	2,2
VII	1,9	1,8	1,7	3.3	3,1	2,3
VIII	2,0	1,4	1,1	2,3	2,0	2,2
IX	2,5	2,6	1,1	2,7	3,2	1,9
X	2,4	2,7	1,5	2,8	3,5	1,9
XI	1,2	2,2	1,3	4,0	3,8	1,8
XII	3,0	1,8	1,3	3,5	3,3	1,6
Mean value	2,2	2,4	1,3	3,1	3,2	2,0

Station	1900	1901	1902	1903	1904	1905
Mi	2°,2	2°,3	1°,9	2°,2	1°,9	2°,5
Ts	2,3	2,6	2,4	2,4	2,3	2,4
Ca	1,3	1,4	1,4	1,2	1,3	1,2
Ga	3,3	3,1	2,9	3,1	3,3	3,0
Ci	3,2	3,3	3,1	3,3	3,3	3,2
Uk	1,9	2,3	1,8	2,0	2,1	2,0

Supplement III

Monthly and yearly mean values of the meteorological element t_i (in °C).

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	−4°,0	−5°,3	10°,1	−2°,4	−0,°6	3°,5
II	−6,1	0,6	10,8	−5,5	−3,9	3,8
III	−1,5	5,9	11,5	0,6	3,8	8,5
IV	2,5	10,7	12,9	5,0	7,6	7,5
V	6,5	15,8	13,7	10,6	12,8	9,3
VI	10,4	20,3	16,6	14,8	17,1	11,3
VII	13,9	24,3	20,1	19,0	19,5	14,1
VIII	20,6	25,1	22,8	21,0	21,6	16,6
IX	18,8	21,0	22,1	18,0	19,2	15,3
X	8,1	12,0	18,8	10,4	12,8	11,6
XI	2,6	5,5	13,8	2,3	4,4	6,5
XII	−3,0	1,8	11,2	−0,2	−1,2	3,7
Mean value	6.4	14.6	17,2	9,0	11,6	10,6

Station	1900	1901	1902	1903	1904	1905
Mi	6°,6	5°,7	5°,7	8°,2	7°,7	4°,0
Ts	13,6	14,8	16,3	13,7	14,1	16,0
Ca	17,0	16,7	17,0	17,1	18,5	16,8
Ga	10,0	8,2	9,3	10,0	6.9	8.5
Ci	11,7	11,3	12,4	11,6	11,3	11,4
Uk	11,0	10,8	10,3	9,6	11,1	10,7

Supplement IV

Monthly and yearly values of η_{tt} (in °C).

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	1°,9	3°,6	1°,1	3°,4	4°,4	1°,5
II	2,0	3,0	1,3	3,4	3,2	2,4
III	1,9	2,7	1,1	4,1	4,5	1,0
IV	1,7	2,3	0,8	2,8	2,5	2,4
V	2,3	3,0	1,2	3,0	3,6	2,4
VI	2,4	2,2	1,7	2,8	2,8	2,3
VII	1,7	1,8	1,6	3,3	3,1	2,3
VIII	1,9	1,4	1,1	2,3	2,0	2,3
IX	2,5	2,5	1,1	2,7	3,2	2,0
X	2,2	2,7	1,5	2,8	3,5	1,9
XI	1,5	2,3	1,2	4,0	3,7	1,8
XII	2,4	2,0	1,3	3,4	3,3	1,5
Mean value	2,0	2,3	1,3	3,1	3,2	2,0

Supplement IV — continued

Station	1900	1901	1902	1903	1904	1905
Mi	2°,0	2°,1	2°,0	2°,1	1°,8	2°,3
Ts	2,3	2,3	2,5	2,3	2,3	2,4
Ca	1,2	1,4	1,4	1.1	1,3	1,1
Ga	3,4	3,1	2,9	3,1	3,2	3,0
Ci	3,1	3,3	3,1	3,3	3,3	3,2
Uk	1,8	2,3	1,8	2,0	2,2	2,0

Supplement V

Monthly and yearly mean values of the meteorological element Δt (in °C).

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	−0°,7	−0°,6	−0°,2	−0°,4	−0°,5	−0,°8
II	−0,7	−0,6	−0,2	−0,5	−0,6	−0,9
III	−0,7	−0,7	−0,2	−0,5	−0,6	−0,9
IV	−0,7	−0,7	−0,1	−0,6	−0,7	−0,8
V	−0,9	−0,8	−0,2	−0,7	−0,8	−1,0
VI	−0,9	−0,8	−0,2	−0,6	−0,8	−1,0
VII	−0,6	−0,7	−0,2	−0,5	−0,7	−1,1
VIII	−0,6	−0,6	−0,2	−0,6	−0,8	−1,2
IX	−0,6	−0,6	−0,2	−0,5	−0,8	−1,1
X	−0,7	−0,7	−0,2	−0,6	−0,9	−1,0
XI	−0,7	−0,7	−0,2	−0,4	−0,6	−1,0
XII	−0,5	−0,5	−0,2	−0,3	−0,5	−0,7
Mean value	−0,7	−0,7	−0,2	−0.5	−0.8	−1,0

Station	1900	1901	1902	1903	1904	1905
Mi	−0°,7	−0°,8	−0°,7	−0,°7	−0°,7	−0°,7
Ts	−0,9	−0,7	−0,6	−0,6	−0,6	−0,7
Ca	−0,2	−0,2	−0,2	−0,2	−0,2	−0,2
Ga	−0,6	−0,5	−0,5	−0.6	−0,5	−0,4
Ci	−0,8	−0,8	−0,7	−0,8	−0,7	−0,7
Uk	−0,9	−1,0	−1,0	−1,1	−1,0	−1,0

Supplement VI

Monthly and yearly values of $\eta\Delta_t$ (in °C).

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	0°,3	0°,3	0°,2	0°,2	0°,1	0°,2
II	0,4	0,4	0,1	0,2	0,1	0,2
III	0,3	0,2	0,1	0,2	0,2	0,2
IV	0,3	0,2	0,2	0,3	0,2	0,2
V	0,3	0,1	0,1	0,3	0,1	0,3
VI	0,2	0,2	0.2	0.1	0,1	0,3
VII	0,2	0,3	0,2	0,2	0,1	0,2
VIII	0,1	0,3	0,1	0,2	0,1	0,2
IX	0,2	0,3	0,1	0,2	0,4	0,2
X	0,2	0,3	0,1	0,2	0,2	0,3
XI	0,2	0,2	0,2	0,2	0,2	0,2
XII	0,3	0,2	0,2	0,2	0,2	0,2
Mean value	0,2	0,3	0,1	0,2	0,2	0,2

Station	1900	1901	1902	1903	1904	1905
Mi	0°,3	0°,3	0°,2	0°,2	0°,3	0°,3
Ts	0,2	0,2	0,2	0,3	0,2	0,3
Ca	0,1	0,1	0,1	0,1	0,2	0,2
Ga	0,2	0,2	0,2	0,2	0,2	0,2
Ci	0,2	0,2	0,1	0,1	0,2	0,3
Uk	0,2	0,2	0,2	0,2	0,4	0,2

Supplement VII

Monthly and yearly mean values of the meteorological element b (in mm Hg).

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	760,8	754,5	768,2	752,7	743,9	749,5
II	57,6	53,2	63,9	51,7	45,2	47,6
III	59,9	50,9	61,4	53,9	43,2	49,0
IV	60,8	48,8	62,0	50,0	43,5	46,2
V	59,1	45,9	61,2	51,8	43,8	45,8
VI	56,3	43,6	61,5	49,3	41,8	45,7
VII	52,9	40,0	61,6	48,9	43,8	44,7
VIII	53,0	39,1	61,6	49,5	43,8	44,8
IX	55,8	42,7	61,7	50,6	44,5	45,6
X	60,8	48,6	62,6	52,7	45,5	48,6
XI	62,6	50,2	63,3	53,7	45,4	50,4
XII	60,2	52,7	65,8	51,9	44,5	53,3
Mean value	758,6	745,8	762,4	751,4	744,2	747,3

Station	1900	1901	1902	1903	1904	1905
Mi	758,8	757,7	759,1	758,8	758,0	759,2
Ts	46,8	45,9	45,1	45,6	46,2	45,5
Ca	62,6	61,8	61,8	63,4	62,5	62,6
Ga	50,7	51,8	50,0	52,1	53,1	51,8
Ci	44,4	44,0	43,5	44,6	45,2	43,9
Uk	750,2	754,4	745,2	745,7	745,5	744,7

Supplement VIII

Monthly and yearly values of η_b (in mm Hg).

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	3,0	2,9	3,5	5,3	5,3	1,9
II	3,2	2,1	3,4	3,3	3,1	2,8
III	2,9	2,9	3,9	3,4	2,5	1,9
IV	2,7	2,5	3,1	3,3	2,8	2,0
V	2,5	2,1	2,4	2,7	2,6	1,4
VI	3,7	2,6	2,2	2,6	1,7	1,6
VII	1,9	2,1	1,6	2,7	1,1	1,4
VIII	1,4	1,7	1,5	1,6	1,3	1,4
IX	2,1	2,6	1,7	2,5	1,9	1,4
X	1,9	2,5	2,3	2,8	1,8	1,8
XI	2,2	2,6	3,0	4,3	3,1	2,6
XII	3,4	3,5	4,1	3,6	3,0	1,9
Mean value	2,6	2,5	2,4	3,1	2,2	1,8

Station	1900	1901	1902	1903	1904	1905
Mi	2,4	2,5	2,7	2,1	2,6	3,3
Ts	2,5	2,9	2,8	2,3	2,3	2,4
Ca	2,7	2,6	2,4	2,4	2,1	2,1
Ga	2,9	3,2	3,1	3,0	3,3	3,3
Ci	2,1	2,6	1,9	2,3	2,2	2,3
Uk	2,0	1,8	1,8	1,6	1,6	1,8

Supplement IX

Monthly and yearly values of B.

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	2,5	1,5	1,6	2,4	3,4	2,3
II	2,4	2,0	1,7	2,4	3,1	2,2
III	2,4	1,5	1,8	2,2	3,1	2,3
IV	2,6	1,6	1,5	2,4	2,9	2,1
V	2,3	1,6	1,6	2,4	3,1	2,3
VI	2,2	2,0	1,6	2,3	2,7	2,1
VII	2,4	1,6	1,4	2,4	3,1	2,0
VIII	2,3	1,6	1,3	2,0	2,9	1,7
IX	2,6	1,6	1,3	2,2	3,1	1,9
X	2,4	1,4	1,4	2,5	3,1	1,9
XI	2,5	1,4	1,5	2,5	3,2	1,9
XII	2,4	1,4	1,5	2,5	3,0	2,3
Mean value	2,4	1,6	1,5	2,4	3,0	2,0

Supplement IX — continued

Station	1900	1901	1902	1903	1904	1905
Mi	2,3	2,2	2,8	2,9	2,0	2,5
Ts	2,1	1,7	1,7	1,3	1,3	1,6
Ca	1,3	1,3	1,7	1,4	1,3	1,8
Ga	1,7	2,3	2,5	2,7	2,7	2,8
Ci	2,7	3,0	3,1	2,8	3,2	3,4
Uk	2,2	2,5	2,2	1,9	1,7	1,8

Supplement X

Monthly and yearly values of R.

Month	Mi	Ts	Ca	Ga	Ci	Uk
I	2,0	2,1	1,4	2,3	—	2,1
II	2,0	1,8	1,6	2,4	—	2,2
III	2,2	1,7	1,4	2,5	—	2,1
IV	2,3	1,6	1,5	2,5	—	2,1
V	2,1	1,6	1,6	2,6	—	2,3
VI	1,8	2,0	1,5	2,2	—	2,1
VII	1,8	1,6	1,4	2,5	—	2,2
VIII	2,1	1,5	1,5	2,0	—	1,8
IX	2,1	1,8	1,4	2,3	—	1,8
X	2,3	1,6	1,5	2,7	—	1,9
XI	2,4	1,8	1,6	2,4	—	2,0
XII	2,3	1,8	1,6	2,4	—	2,2
Mean value	2,1	1,7	1,5	2,4	—	2,0

Station	1900	1901	1902	1903	1904	1905
Mi	1,6	1,7	2,5	2,4	2,3	2,5
Ts	2,0	1,9	1,9	1,7	1,4	1,3
Ca	1,5	1,5	1,5	1,4	1,6	1,4
Ga	1,9	2,4	2,6	2,7	2,7	2,6
Ci	—	—	—	—	—	—
Uk	2,4	2,4	2,2	1,9	1,7	1,8

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SUR L'INFLUENCE DES IRRÉGULARITÉS DES TOURILLONS DE L'INSTRUMENT DE PASSAGES SUR LA VALEUR OBSERVÉE DE Cp.

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La qualité des tourillons de l'axe horizontal d'un instrument de passages, peut influencer dans certaine mesure la correction observée Cp d'un garde-temps quelconque. Les effets dépendent donc principalement de l'état de la surface d'appui des tourillons, ou en d'autres termes, des irrégularités de ces tourillons.

Afin de pouvoir décider sur la validité de l'hypothèse précédente, nous avons entrepris les examens nécessairs à l'instrument de passages „Askania-Bamberg, № 63131" du service de temps de l'Observatoire de Belgrade. Les mesures ont été faites au moyen des intérféromètres convenablement adaptés (v. fig. 1), le long du contour tout entièr de la section travaillante des tourillons en question.

Malgré le fait, que c'est précisment la partie de la section, se rapportante aux distances zénithales, resp. aux déclinaisons des étoiles du programme d'observations adopté, qui présente un intérêt particulier pour nous, dans la Table I on trouvera les résultats de détermination des irrégularités des tourillons Δr_i pour les étoiles réparties entre $+70°$ et $-35°$ de déclinaison.

Table I

		Δr_W		Δr_E	
L	δ	A_W	B_W	A_E	B_E
335°	+70°	+0.16	+0.17	+0.11	−0.00
340	+65	− 9	+ 2	− 14	− 7
345	+60	+ 7	− 3	+ 2	− 10
350	+55	− 24	− 9	− 25	− 32
355	+50	− 25	− 28	− 30	− 48
0	+45	− 54	− 71	− 92	− 76
5	+40	− 43	− 55	− 51	− 57
10	+35	+ 25	− 27	− 23	− 37
15	+30	+ 16	− 20	+ 9	− 17
20	+25	+ 25	− 6	+ 12	+ 3
25	+20	+ 40	− 3	+ 30	+ 4
30	+15	+ 39	+ 8	+ 30	+ 8
35	+10	+ 27	− 12	+ 19	+ 5
40	+ 5	+ 21	− 5	+ 26	+ 12
45	0	+ 43	0	+ 71	+ 11
50	− 5	+ 33	− 4	+ 39	+ 3
55	−10	+ 4	+ 8	+ 16	+ 13
60	−15	+ 15	+ 12	+ 16	+ 13
65	−20	+ 3	+ 15	+ 24	+ 7
70	−25	− 7	+ 14	+ 4	+ 16
75	−30	− 16	+ 6	+ 7	+ 19
80°	−35°	−0.18	+0.09	−0.05	+0.01

Outre la lecture du cercle vertical et les déclinaisons correspondantes, allant de gauche à droite, les différentes colonnes de la Table donnent les écarts (en microns) du profil par rapport au contour normal des tourillons: le tourillon près du cercle vertical (A) et le tourillon qui lui est opposé (B), respectivement dans les positions ouest (W) et est (E).

La fig. 1. montre l'instrument de passages examiné, avec les intérféromètres montés. Lors des mesures le tube de l'instrument a été remplacé par un contre-poids approprié.

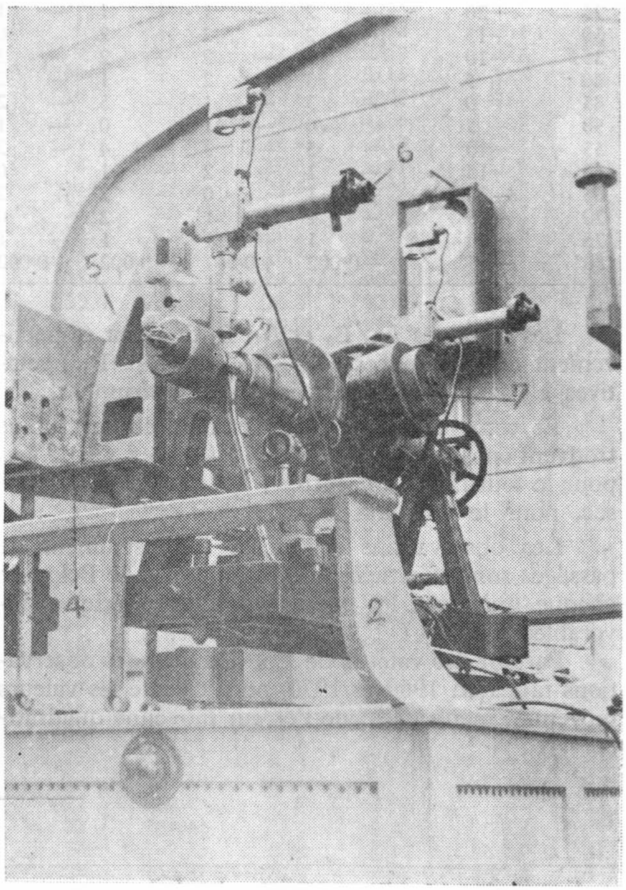

Fig. 1

NOTATIONS: 1 — L'instrument de passages examiné; 2 — cadre d'appui de l'observateur; 3 — tourillon B; 4 — support de l'intérféromètre; 5 — l'intérféromètre lui-même; 6 — l'occulaire de l'intérféromètre; 7 — contre-poids.

Pour déduire les corrections de l'azimut et de l'inclinaison, dues aux irrégularités des tourillons, on a appliqué les relations connues, exprimant ces corrections en fonction de Δr_i. Les valeurs tirées de cette manière et exprimées en millièmes de seconde du temps, nous présentons dans la Table II, pour les déclinaisons déjà citées.

Table II

L	δ	Azimut		Inclinaison	
		Tourillon			
		A_a	B_a	A_i	B_i
335°	+70°	+0ˢ001	−0ˢ000	−0ˢ002	+0ˢ002
340	+65	+ 1	− 1	− 2	0
345	+60	0	− 1	− 1	− 1
350	+55	+ 2	− 1	− 1	+ 3
355	+50	+ 1	− 2	+ 1	+ 3
0	+45	+ 1	− 3	+ 6	+ 2
5	+40	+ 1	− 2	+ 1	+ 1
10	+35	− 4	− 1	0	+ 1
15	+30	− 1	− 1	− 2	− 1
20	+25	− 3	− 1	+ 2	− 2
25	+20	− 2	− 1	+ 1	− 1
30	+15	− 2	− 2	+ 2	0
35	+10	− 2	− 2	+ 2	− 3
40	+ 5	− 3	− 2	+ 1	− 2
45	0	− 3	− 1	− 5	− 2
50	− 5	0	− 1	0	− 1
55	−10	− 5	− 3	− 4	− 2
60	−15	− 1	+ 2	+ 1	0
65	−20	− 1	0	− 2	+ 2
70	−25	− 1	+ 1	− 2	0
75	−30	− 1	+ 1	− 1	− 1
80°	−35°	−0ˢ002	+0ˢ001	−0ˢ002	+0ˢ002

Les colonnes A_a, B_a et A_i, B_i donnent respectivement les différences $(A_E - A_W)$ et $(B_E - B_W)$ relatives à l'azimut et l'inclinaison de l'instrument.

Et comme l'on voit, les erreurs en azimut se trouvent encadrées entre $+2 \times 10^{-3}$ et -5×10^{-3} sec, pour le tourillon A, et entre $+2 \times 10^{-3}$ et -3×10^{-3} sec, pour le tourillon B.

Les observations régulières à l'instrument de passages sont effectuées à l'Observatoire de Belgrade chaque nuit avec les conditions atmosphèriques favorables.

Partant des valeurs de Cp, déduites des observations faites en 1969 et 1970, on a calculé les valeurs moyennes mensuelles: de l'erreur moyenne quadratique par passage d'une même étoile ε_1, de l'erreur ε_2 moyenne quadratique de la moyenne arithmétique, ainsi que des erreurs en azimut ε_a pour la série respective. La Table III fournit les valeurs moyennes mensuelles de ces quantités pour les années mentionnées plus haut, et séparément pour la période moyenne 1969/70. Les valeurs des erreurs en azimut s'échelonnent respectivement entre $\pm$ 15−31, et $\pm$ 18−25 millisécondes en 1969. et 1970.

Table III

Mois	1969.			1970			1969/1970		
	ε_1	ε_2	ε_a	ε_1	ε_2	ε_a	ε_1	ε_2	ε_a
I	±33	±11	±26	±29	± 9	±20	±31	±10	±23
II	35	11	24	39	13	25	37	12	24
III	48	17	31	31	11	20	40	13	26
IV	43	14	27	29	10	18	36	12	22
V	41	14	26	32	11	21	36	12	23
VI	33	11	23	35	12	24	32	11	23
VII	29	10	20	33	11	22	30	10	20
VIII	24	8	15	28	9	18	26	9	14
IX	25	8	16	32	10	22	26	8	17
X	25	8	17	28	9	19	27	9	18
XI	33	11	22	30	10	20	31	10	20
XII	±25	± 8	±27	±35	±12	±24	±30	±10	±26
Moy	±32	±11	±23	±31	±10	±20	±32	±10	±21

Remarquons encore que les erreurs précedentes sont généralement déterminées d'après une dizaine des passages observés des étoiles.

Quant à l'inclinaison de l'axe horizontal, elle se déduit des lectures du niveau accroché. D'après les déterminations effectuées en 1969 et 1970, les erreurs moyennes quadratiques de l'inclinaison sont de l'ordre de 6×10^{-3} sec.

Or, une ispection des valeurs de la Table II, montre que les corrections correspondantes de l'inclinaison, dues aux irrégularités des tourillons, se rangent entre $+6 \times 10^{-3}$ et -5×10^{-3} pour le tourillon A, et entre $+3 \times 10^{-3}$ et -3×10^{-3} sec, pour le tourillon B. Ajoutons que les valeurs qui precèdent sont déduites des mesures isolées.

De tout ce qui a été dit, il est facile de conculure, que dans notre cas les effets provenant des irrégularités des tourillons sont suffisamment petits, pour pouvoir influencer d'une façon sensible les Cp observés d'une garde temps astronomique.

DÉTERMINATION ASTRONOMIQUE DE L'HEURE

par M. JOVANOVIĆ, D. VESIĆ et M. LONČAREVIĆ

Date		Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
			1970			
I	3	590.21	17ʰ0	0078	+ 0°4	J
	4	591.21	17.0	0036	+ 2.5	J
	4	591.24	17.8	9864	+ 3.3	J
	8	595.20	16.8	9765	− 2.5	J
	8	595.23	17.6	9874	− 3.6	I
	11	598.32	19.6	9827	+ 0.3	J
	13	600.32	19.7	9886	+ 2.8	J
	13	600.36	20.7	0032	+ 2.5	J
	16	602.65	3.6	9764	+ 8.1	J
	16	602.68	4.4	9918	+ 8.4	J
	21	608.34	20.1	9707	− 3.2	J
	24	611.37	20.8	9913	− 4.7	J
	24	611.41	21.8	9874	− 4.9	J
	29	616.25	17.9	9955	− 0.2	J
	29	616.28	18.7	9867	—	J
	29	616.32	19.6	9922	− 1.6	J
	30	617.21	17.0	9932	+ 0.2	J
	30	617.24	17.8	9787	—	J
	30	617.28	18.7	9788	− 0.8	J
II	6	623.67	4.1	9828	+ 8.7	J
	8	626.23	17.2	9650	+ 4.9	J
	12	630.28	18.8	9932	+ 0.2	J
	12	630.32	19.6	9900	− 1.0	J
	20	638.30	19.2	0134	− 2.8	J
	20	638.33	20.0	9899	− 3.2	J
	21	639.33	19.9	9577	− 1.4	J
III	2	648.26	18.3	9794	− 1.4	L
	2	648.30	19.3	9681	− 2.0	L
	5	650.60	2.4	9387	+ 4.9	J
	5	650.63	3.2	9645	+ 5.8	J
	6	652.41	21.8	9579	+ 6.1	J
	8	654.25	18.0	9661	+ 2.0	V
	9	655.25	18.0	9712	+ 3.2	L
	9	655.29	18.8	9518	+ 2.2	L
	18	664.22	17.4	9682	+ 5.6	V
	18	664.26	18.3	9671	+ 5.0	V
	20	666.25	18.0	9744	+ 4.3	J
	20	666.33	20.0	9640	+ 2.2	J
	22	668.24	17.9	9642	+ 8.8	J
	24	670.24	17.9	9355	+13.3	V
	24	670.28	18.7	9301	—	V
	24	670.32	19.6	9827	+12.7	V
	29	675.34	20.2	9645	+ 1.8	J
	29	675.38	21.1	9166	+ 2.2	J
	30	676.23	17.5	9421	+ 8.6	L
	30	676.26	18.3	9470	+ 8.0	L
	30	676.30	19.2	9637	+ 7.4	L
IV	4	681.25	18.0	9376	+ 5.3	J
	4	681.28	18.7	9506	+ 3.6	J
	5	682.23	17.4	9442	+ 8.3	L
	5	682.28	18.8	9498	—	L
	6	683.25	17.9	9392	+ 6.9	V
	6	683.28	18.7	9495	—	V
	6	683.32	19.6	9342	+ 5.2	V
	9	686.42	22.1	9467	+11.5	J
	9	686.46	23.0	9310	—	J
	9	686.50	24.0	9451	+ 8.8	J
	19	696.28	18.8	9759	+15.5	J
	19	696.32	19.6	9959	—	J
IV	19	696.36	20ʰ5	9683	+14°8	J
	20	697.28	18.7	9556	+17.2	V
	20	697.32	19.6	9553	+18.7	V
	22	699.27	18.6	9418	+13.7	V
	22	699.31	19.5	9237	+12.9	V
	23	700.31	19.4	9181	+17.4	J
	23	700.35	20.3	9412	—	J
	23	700.38	21.1	9331	+17.5	J
	26	703.37	21.0	9332	+19.0	J
	26	703.45	22.8	9229	+17.0	J
	29	706.29	19.0	9554	+10.2	V
	29	706.33	19.9	9603	—	V
V	6	713.27	18.5	9357	+13.8	V
	6	713.39	21.3	9388	+11.5	J
	6	713.42	22.2	9395	+11.1	J
	9	716.37	21.0	9352	+18.8	J
	10	717.41	21.9	9115	+20.4	J
	10	717.45	22.8	9228	+20.1	J
	12	719.40	21.7	9329	+14.5	J
	14	721.29	18.9	9413	+17.2	L
	14	721.33	19.8	9197	+16.0	L
	14	721.40	21.5	9922	+15.2	J
	23	730.30	19.2	9178	+10.2	J
	23	730.34	20.2	9119	+ 9.0	J
	25	732.26	18.3	9014	+12.5	L
	25	732.30	19.1	9057	+11.8	L
	25	732.33	20.0	9258	+10.4	L
	26	733.29	19.0	9373	+13.1	L
	26	733.33	20.0	9060	+12.0	L
	29	736.32	19.8	9196	+13.6	J
	29	736.36	20.7	9062	—	J
	29	736.40	21.6	9425	+12.1	J
VI	5	743.29	19.0	9505	+15.2	J
	5	743.34	20.2	9220	—	J
	5	743.38	21.1	9165	+14.5	J
	6	744.30	19.2	9254	+16.5	J
	6	744.34	20.2	9505	+15.6	J
	12	750.30	19.2	9174	+20.0	V
	15	753.28	18.7	9237	+20.0	V
	15	753.32	19.6	9181	+19.0	V
	16	754.32	19.8	9248	+21.6	J
	17	755.35	20.4	9591	+23.3	J
	17	755.39	21.4	9307	+22.8	J
	21	759.34	20.1	9348	+19.8	J
	22	760.31	19.5	9567	+22.4	J
	22	760.35	20.4	9202	—	J
	22	760.38	21.1	9549	—	J
	22	760.41	21.9	9250	—	J
	22	760.46	23.2	9375	+20.2	J
	24	762.33	19.9	9716	+23.7	J
	24	762.37	20.9	9648	+22.2	J
	25	763.37	20.8	9811	+20.7	J
	25	763.41	21.8	9434	+19.3	J
	27	765.36	20.7	9371	+21.5	J
	27	765.40	21.6	9106	+20.1	J
	28	766.36	20.6	9202	+22.8	J
	28	766.40	21.5	9233	+21.1	J
	30	768.31	19.4	9511	+24.0	V
VII	2	770.27	18.5	9330	+21.1	V
	2	770.31	19.4	9325	—	V

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
VII	2	770.35	20^{h}3	9477	+19°6	V
	8	776.41	21.8	9411	+19.7	J
	8	776.45	22.7	9327	+19.2	J
	9	777.37	20.8	9562	+22.6	J
	9	777.41	21.8	9518	+21.8	J
	10	778.37	20.8	9487	+22.6	J
	10	778.40	21.7	9315	+21.1	J
	11	779.36	20.7	9484	+21.7	J
	12	780.40	21.6	9489	+22.0	J
	12	780.44	22.5	9097	+20.3	J
	13	781.32	19.6	9564	+22.5	L
	13	781.35	20.5	9369	+21.0	L
	15	783.38	21.2	9402	+21.0	J
	15	783.42	22.2	9467	+16.3	J
	21	789.30	19.1	9684	+21.0	L
	21	789.34	20.0	9388	+20.4	L
	22	790.29	18.9	9061	+24.1	L
	22	790.33	20.0	9182	+23.0	L
	23	791.29	19.0	9450	+25.4	J
	23	791.33	19.9	9441	+23.8	J
	24	792.29	18.9	9851	+24.7	J
	24	792.33	19.8	9799	+23.4	J
VIII	1	800.34	20 2	9839	+22.5	V
	1	800.38	21.1	9680	+21.4	V
	3	802.30	19.2	9719	+22.3	V
	3	802.33	20.0	9778	+22.0	V
	4	803.34	20.1	9731	+22.0	V
	4	803.37	20.9	9540	+21.0	V
	5	804.29	19.1	9756	+22.3	V
	5	804.33	20.0	9606	—	V
	5	804.37	20.8	9647	+21.1	V
	6	805.29	19.0	9466	+25.0	V
	6	805.33	19.9	9559	+23.3	V
	7	806.29	18.9	9506	—	V
	10	809.28	18.8	9500	+22.0	V
	10	809.32	19.6	9685	+20.2	V
	10	809.41	21.7	9630	+19.4	J
	12	811.27	18.6	9424	+19.9	V
	12	811.31	19.5	9442	+18.0	V
	13	812.31	19.5	9837	+17.8	J
	13	812.35	20.4	9654	+16.1	J
	14	813.27	18.5	9529	+20.2	V
	14	813.31	19.4	9584	+18.1	V
	15	814.27	18.4	9488	+22.0	V
	15	814.30	19.3	9601	+21.8	V
	18	817.30	19.1	9678	+17.5	J
	18	817.33	20.0	9675	+16.2	J
	19	818.29	19.1	9751	+18.1	J
	19	818.33	20.0	9409	+17.1	J
	20	819.29	19.0	9476	+21.3	J
	20	819.32	19.7	9594	+20.9	J
	21	820.25	18.0	9143	+23.7	V
	21	820.28	18.8	9387	+22.7	V
	23	822.31	19.5	9795	+17.9	J
	26	825.39	21.3	9655	—	J
	26	825.42	22.1	9494	—	J
	26	825.45	22.9	9367	+13.6	J
	27	826.35	20.3	9460	+16.9	J
	27	826.38	21.1	9667	+15.5	J
	28	827.27	18.5	9467	+17.1	V
	28	827.31	19.4	9443	+17.3	V
IX	3	833.33	19.8	9649	+19.2	J
	3	833.36	20.7	9887	+18.8	J
	7	837.28	18.7	9718	+14.3	J
	7	837.32	19.6	9746	+13.3	J
	8	838.31	19.5	9710	+17.8	J
	8	838.35	20.3	9765	—	J
	9	839.31	19.4	9507	+21.2	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
IX	9	839.34	20^{h}3	9749	+20°6	J
	10	840.31	19.4	9831	+23.0	J
	10	840.34	20.2	9913	+22.9	J
	11	841.23	17.6	0002	+23.9	J
	21	851.31	19.5	9929	+14.8	J
	21	851.34	20.2	0033	+13.4	J
	22	852.31	19.3	9971	+14.0	J
	23	853.27	18.5	9725	+11.2	J
	23	853.31	19.3	9862	+10.4	J
	24	854.27	18.5	9817	+11.6	J
	24	854.30	19.3	9898	+ 9.9	J
	25	855.27	18.4	9559	—	J
	25	855.30	19.2	9670	+ 9.7	J
	27	857.23	17.4	9637	+12.0	J
	27	857.26	18.3	9553	+10.0	J
	28	858.29	19.0	0023	+ 9.1	J
	28	858.33	19.8	9945	+ 6.9	J
	29	859.44	22.6	9733	+ 4.0	J
	29	859.47	23.3	9785	+ 3.8	J
	30	860.25	18.1	9496	+10.0	V
	30	860.29	18.9	9785	+ 9.8	V
X	2	862.21	17.1	9529	+11.5	V
	2	862.25	17.9	9469	+10.6	V
	6	866.27	18.5	9642	+13.4	J
	6	866.30	19.3	9580	+13.2	J
	7	867.20	16.8	9566	+16.4	V
	7	867.23	17.6	9408	+15.7	V
	8	868.23	17.5	9713	+16.6	J
	8	868.26	18.4	9716	+15.8	J
	9	869.19	16.6	9774	+17.5	V
	9	869.23	17.5	9826	+15.8	V
	10	870.22	17.4	9637	+16.2	J
	12	872.19	16.5	9487	+15.9	V
	12	872.22	17.3	9458	+15.8	V
	13	873.32	19.7	9591	+12.8	J
	13	873.36	20.7	9714	+12.5	J
	16	876.18	16.2	9608	+ 7.0	V
	16	876.21	17.0	9524	+ 4.3	V
	19	879.17	16.0	9451	+ 9.0	V
	19	879.20	16.8	9609	+ 8.0	V
	20	880.45	22.9	9661	+11.8	J
	20	880.49	23.7	9843	+11.1	J
	26	886.21	17.1	9425	+ 9.9	V
	26	886.25	18.0	9669	+ 9.2	V
	27	887.28	18.8	9612	+ 9.3	J
	28	888.41	21.7	9453	+ 9.8	J
	30	890.17	16.1	9611	+11.4	V
	30	890.21	16.9	9644	+11.0	V
	30	890.32	19.6	9355	+11.4	V
	30	890.36	20.5	9488	+12.8	V
	31	891.24	17.7	9722	+12.1	J
XI	1	892.20	16.8	9522	+12.0	J
	1	892.23	17.6	9630	+11.4	J
	2	893.16	15.9	9393	+12.7	V
	2	893.20	16.8	9542	+12.8	V
	2	893.24	17.7	9539	+12.9	V
	3	894.23	17.5	9537	+15.0	J
	3	894.27	18.4	9589	+15.0	J
	3	894.34	20.3	9485	+14.9	V
	3	894.38	21.0	9531	+13.9	V
	4	895.30	19.3	9628	+11.9	J
	4	895.34	20.2	9575	+10.6	J
	5	896.16	15.8	9367	+12.0	V
	5	896.19	16.5	9352	+11.8	V
	7	898.22	17.2	9826	+ 5.4	J
	11	902.24	17.8	9564	+ 6.2	J
	11	902.28	18.8	9533	+ 5.4	V
	11	902.32	19.8	9822	+ 3.9	V

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
XI	12	903.28	$18^{h}8$	9369	$+9^{\circ}5$	J
	12	903.32	19.7	9208	+ 9.0	J
	13	904.20	16.8	9697	+ 9.7	V
	13	904.24	17.8	9611	+ 9.7	V
	15	906.23	17.5	9373	+12.0	J
	17	908.19	16.5	9406	+ 6.7	V
	19	910.18	16.4	9382	+13.7	V
	19	910.22	17.3	9350	+13.8	V
	25	916.24	17.8	9526	+ 6.7	J
	25	916.28	18.8	9570	+ 5.4	J
	29	920.27	18.6	9308	+ 5.3	J
	29	920.31	19.3	9405	+ 5.1	J
XII	3	923.66	3.9	9701	+ 6.0	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
XII	3	923.70	$4^{h}7$	9713	$+5^{\circ}0$	J
	3	924.22	17.4	9521	+ 6.5	J
	3	924.26	18.3	9519	+ 6.0	J
	4	925.26	18.2	9718	+ 3.2	J
	4	925.29	19.0	9606	+ 2.9	J
	7	928.25	18.1	9837	+ 2.1	J
	7	928.28	18.8	9790	+ 1.5	J
	20	941.18	16.3	9550	− 1.2	J
	20	941.22	17.2	9795	− 2.1	J
	21	942.21	17.1	9421	− 0.9	J
	21	942.25	17.9	9882	− 1.4	J
	24	945.28	18.7	9585	− 2.0	J
	24	945.30	19.3	9766	− 3.4	J
	30	951.34	20.1	9698	+ 6.7	J

1971

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
I	15	967.22	$17^{h}2$	0283	$-2^{\circ}0$	V
	15	967.25	18.0	0094	− 3.5	V
	19	971.17	16.0	9924	+ 5.8	V
	19	971.20	16.9	9710	+ 2.9	V
	25	977.15	15.7	9974	+ 9.4	V
	27	978.66	3.9	0011	—	J
	27	978.70	4.9	9666	+ 5.2	J
	28	980.19	16.5	9762	+ 6.4	L
II	4	987.17	16.1	9496	0.0	L
	5	988.19	16.7	9449	+ 0.1	V
	5	988.23	17.4	9740	− 1.4	V
	11	994.18	16.3	9714	+ 3.4	V
	11	994.21	17.1	9784	+ 1.7	V
	12	995.21	17.0	9864	+ 2.0	L
	12	995.24	17.8	9828	+ 1.0	L
	16	999.20	16.7	9779	+ 6.6	V
	16	999.23	17.6	9913	+ 4.9	V
III	13	1024.35	20.3	9568	+ 0.2	J
	13	1024.38	21.2	9423	+ 1.0	J
	19	1030.37	20.8	9982	+12.1	J
	19	1030.40	21.7	9907	+11.3	J
	20	1031.29	19.0	9937	+13.0	J
	20	1031.32	19.8	0094	+12.6	J
	25	1035.65	3.7	9495	+ 3.8	J
	25	1036.28	18.7	9651	+ 7.1	V
	25	1036.31	19.5	9479	+ 6.3	V
	25	1036.43	22.3	9866	+ 5.5	J
	26	1037.23	17.5	9597	+ 9.4	L
	26	1037.28	18.6	9597	+ 9.0	L
	31	1042.34	20.1	9570	+ 7.2	J
	31	1042.37	20.9	9414	+ 7.0	J
IV	3	1045.30	19.2	9611	+10.1	J
	7	1049.32	19.6	9781	+12.2	J
	7	1049.35	20.3	9632	+12.1	J
	8	1050.32	19.6	9562	+11.2	V
	8	1050.35	20.4	9653	+11.0	V
	9	1051.27	18.5	9648	+13.4	J
	9	1051.31	19.5	9488	+11.5	J
	12	1054.36	20.6	9437	+11.5	J
	14	1056.26	18.2	9703	+10.7	V
	14	1056.30	19.1	9788	+ 9.7	V

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
IV	15	1057.33	$20^{h}0$	9335	$+6^{\circ}8$	J
	15	1057.37	20.8	9110	+ 6.5	J
	16	1058.25	18.1	9583	+ 9.7	V
	16	1058.33	20.0	9565	+ 9.0	V
	18	1060.25	18.0	9349	—	J
	18	1060.29	18.9	9598	+11.6	J
	19	1061.39	21.5	9309	+11.8	J
	19	1061.44	22.5	9261	+ 9.7	J
	20	1062.28	18.7	9589	+11.6	V
	20	1062.32	19.6	9597	+11.0	V
	21	1063.24	17.8	9628	+13.0	L
	21	1063.28	18.7	9605	+11.9	L
	22	1064.31	19.5	9285	+14.9	J
	22	1064.35	20.4	9260	+14.1	J
	27	1069.37	20.9	9369	+14.6	J
	29	1070.63	3.2	9296	+11.3	J
V	3	1075.29	19.0	9342	+17.3	J
	7	1079.46	23.1	9083	+12.3	J
	9	1081.38	21.1	9433	+14.0	J
	9	1081.43	22.3	9187	+13.3	J
	10	1082.30	19.3	9711	+16.6	V
	10	1082.34	20.1	9608	+16.3	V
	11	1083.26	18.2	9585	+18.0	L
	11	1083.30	19.1	9592	+18.0	L
	12	1084.30	19.1	9558	+18.3	V
	12	1084.33	20.0	9528	+17.7	V
	13	1085.29	19.0	9615	+18.1	L
	13	1085.33	19.9	9436	+18.0	L
	14	1086.40	21.7	9710	+18.5	J
	15	1087.36	20.7	9517	+20.0	J
	15	1087.41	21.8	9267	+19.4	J
	17	1089.40	21.5	9547	+21.0	J
	17	1089.43	22.4	9416	+19.9	J
	18	1090.28	18.7	9470	+21.4	V
	18	1090.32	19.6	9465	+20.2	V
	19	1091.27	18.6	9455	—	V
	19	1091.32	19.6	9519	+20.6	V
	20	1092.39	21.3	9442	+21.8	J
	20	1092.43	22.2	9185	+21.5	J
	24	1096.30	19.2	9485	+18.9	V
	24	1096.34	20.1	9469	+18.0	V
	26	1098.29	19.0	9616	+20.0	V
	26	1098.33	20.0	9642	+19.5	V
	28	1100.44	22.6	9617	+16.9	J
	28	1100.50	23.9	9275	+15.2	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_t	Obs
VI	2	1105.43	22h4	9329	+18°3	J
	2	1105.47	23.3	9055	+17.1	J
	3	1106.43	22.2	9562	+18.6	J
	3	1106.47	23.2	9326	+17.8	J
	4	1107.31	19.5	9416	+20.9	V
	4	1107.35	20.3	9370	+20.0	V
	5	1108.30	19.3	9314	+21.7	V
	5	1108.34	20.2	9237	+21.3	V
	10	1113.30	19.2	9358	+21.7	V
	10	1113.33	19.9	9257	+21.2	V
	11	1114.29	18.9	9480	+22.3	V
	11	1114.33	19.8	9234	+21.4	V
	12	1115.28	18.8	9326	+17.7	V
	14	1117.32	19.7	9710	+18.8	J
	14	1117.36	20.6	9426	+17.9	J
	15	1118.28	18.7	9302	+23.2	V
	15	1118.32	19.6	9402	+22.7	V
	16	1119.32	19.6	9384	+20.5	J
	16	1119.35	20.4	9096	+17.6	J
	22	1125.30	19.1	9284	+20.0	V
	23	1126.40	21.5	9365	+18.1	J
	24	1127.29	19.0	9351	+19.9	V
	24	1127.33	19.9	9484	+19.0	V
	28	1131.29	18.9	9435	+21.4	V
	28	1131.32	19.7	9425	+20.1	V
	29	1132.36	20.8	9396	+16.0	V
	29	1132.40	21.6	9422	+14.6	V
	30	1133.39	21.4	8939	+15.6	J
	30	1133.43	22.4	9156	+14.8	J
VII	1	1134.43	22.4	9535	+15.3	J
	3	1136.30	19.3	9327	+17.3	V
	3	1136.24	20.3	9411	+17.2	V
	5	1138.46	22.9	9411	+19.0	J
	5	1138.49	23.8	9709	+18.8	J
	6	1139.33	19.9	9655	+20.3	V
	6	1139.37	20.9	9444	+20.0	V
	8	1141.28	18.8	9439	+21.0	V
	8	1141.32	19.8	9409	+20.0	V
	9	1142.41	21.8	9411	+20.2	J
	9	1142.44	22.7	9715	+20.0	J
	10	1143.29	18.9	9615	+21.5	V
	10	1143.33	19.9	9715	+20.0	V
	11	1144.36	20.6	9568	+21.7	J
	11	1144.40	21.7	9409	+21.0	J
	12	1145.40	21.6	9904	+21.7	J
	12	1145.44	22.5	9757	+21.4	J
	13	1146.36	20.6	9372	+23.8	J
	13	1146.40	21.5	9424	+23.1	J
	15	1148.42	22.2	9496	+21.0	J
	15	1148.46	23.1	9450	—	J
	16	1149.42	22.1	9821	+21.2	J
	22	1155.47	23.2	9397	+17.4	J
	23	1156.33	19.9	9322	+18.7	J
	23	1156.36	20.7	9075	—	J
VIII	6	1170.27	18.4	9665	+25.4	V
	6	1170.31	19.3	9924	+24.4	V
	7	1171.26	18.4	9926	+26.2	V
	7	1171.30	19.2	9792	+26.0	V
	8	1172.26	18.3	9651	+27.0	V
	8	1172.30	19.2	9651	+26.0	V
	9	1173.26	18.3	9663	+22.1	V
	9	1173.30	19.3	9614	+21.0	V
	10	1174.28	18.7	9369	+21.2	V
	10	1174.31	19.6	9740	+20.2	V
	11	1175.28	18.7	9705	+22.6	V
	11	1175.31	19.5	9515	+22.6	V
	13	1177.27	18.5	0064	+21.5	J
	13	1177.31	19.3	9917	+20.5	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_t	Obs
VIII	14	1178.31	19h4	9423	+21°9	J
	14	1178.35	20.3	9175	+21.5	J
	15	1179.34	20.2	9627	+22.9	J
	15	1179.38	21.1	9135	+22.4	J
	16	1180.26	18.3	9226	+24.8	V
	16	1180.30	19.1	9395	+24.8	V
	18	1182.28	18.7	9347	+20.0	V
	18	1182.32	19.6	9346	—	V
	19	1183.42	22.5	9735	+19.8	J
	19	1183.47	23.3	9842	+19.3	J
	20	1184.25	18.1	9397	+21.6	V
	20	1184.29	19.0	9405	+21.1	V
	21	1185.29	19.0	9860	—	J
	21	1185.32	19.7	9646	+20.9	J
	23	1187.25	18.0	9276	+23.2	V
	26	1190.31	19.5	9585	+20.8	J
	26	1190.35	20.4	9647	+21.0	J
	28	1192.41	21.9	9027	+18.3	J
	29	1193.26	18.3	9425	+18.4	J
	29	1193.31	19.3	9316	+18.0	J
	30	1194.26	18.3	9437	+21.9	V
	30	1194.30	19.1	9434	+20.9	V
	31	1195.22	17.4	9280	+21.6	V
	31	1195.29	19.1	9276	+21.1	V
IX	3	1198.40	21.5	9197	+17.4	J
	3	1198.43	22.4	9223	+17.1	J
	4	1199.32	19.8	9571	+18.4	J
	4	1199.36	20.6	9504	+18.4	J
	5	1200.39	21.3	9124	+18.2	J
	9	1204.31	19.5	9351	+12.1	J
	9	1204.35	20.3	9385	+11.3	J
	12	1207.30	19.3	9499	+16.5	J
	12	1207.34	20.1	9533	+16.1	J
	20	1215.35	20.3	9356	+12.9	J
	21	1216.35	20.3	9570	+13.8	J
	22	1217.21	17.0	9191	+16.1	V
	22	1217.24	17.8	9287	+15.9	V
	23	1218.31	19.4	9216	+14.1	J
	23	1218.34	20.2	9203	+13.5	J
	24	1219.21	17.0	9340	+16.1	V
	24	1219.25	17.9	9505	+15.3	V
	26	1221.34	20.0	9409	+16.1	J
	26	1221.37	20.9	9176	+15.8	J
	27	1222.20	16.8	9413	+17.4	V
	27	1222.23	17.6	9384	+17.0	V
X	2	1227.28	18.8	9204	+15.1	J
	2	1227.32	19.6	9070	+14.8	J
	3	1228.43	22.3	9500	+15.0	J
	3	1228.46	23.1	9441	+14.7	J
	4	1229.20	16.8	9345	+17.5	V
	4	1229.24	17.8	9412	+16.9	V
	5	1230.25	18.1	9295	+10.9	V
	5	1230.29	19.0	9310	+10.1	V
	6	1231.32	19.7	9227	+ 9.1	V
	6	1231.36	20.6	9143	+ 8.6	V
	7	1232.27	18.4	9221	+ 8.6	J
	7	1232.30	19.3	9053	+ 8.2	J
	8	1233.30	19.2	9055	+11.3	J
	8	1233.34	20.1	9003	+11.5	J
	8	1233.49	23.7	9230	+11.1	J
	9	1234.26	18.3	9054	+14.3	J
	9	1234.30	19.1	9294	+15.2	J
	10	1235.23	17.4	9222	+14.4	J
	10	1235.26	18.2	9282	+14.2	J
	11	1236.19	16.5	9449	+15.0	V
	11	1236.22	17.4	9581	+14.1	V
	12	1237.19	16.7	9461	+15.9	V

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
X	12	1237.23	$17^{h}5$	9086	$+16^{\circ}0$	V
	12	1237.48	23.4	9296	+14.2	J
	13	1237.51	24.2	8950	+14.1	J
	14	1239.19	16.6	9312	+18.4	V
	14	1239.23	17.5	9269	+18.1	V
	19	1244.20	16.8	9132	+ 9.6	V
	19	1244.24	17.7	9332	+ 9.1	V
	19	1244.49	23.8	9232	+ 7.6	J
	20	1245.20	16.8	9362	+11.0	V
	20	1245.23	17.6	9528	+10.6	V
	22	1247.38	21.1	8983	+10.9	J
	22	1247.41	21.8	9520	+11.0	J
	22	1247.45	22.8	9172	+11.1	J
	23	1248.26	18.2	8949	—	J
	23	1248.30	19.1	8860	+14.4	J
	24	1249.26	18.2	9242	+11.5	J
	24	1249.29	19.1	9309	+11.2	J
XI	5	1261.23	17.4	9337	+10.1	J
	5	1261.26	18.2	9064	+10.8	J
	6	1261.51	0.3	9054	+10.8	J
	6	1261.55	1.2	9080	+11.2	J
	6	1262.19	16.5	9370	+11.9	J
	8	1264.27	18.6	8969	+12.2	V
	8	1264.31	19.5	9029	+12.4	V
	9	1265.32	19.7	9174	+15.2	V
	10	1266.18	16.3	9128	+15.4	V
	10	1266.21	17.0	9055	+15.4	V
	11	1267.32	19.6	9140	+13.1	J
	11	1267.36	20.5	9011	+12.4	J

	Date	Date Julienne 2440000	TU	TUO-TUC	t_i	Obs
XI	12	1268.64	$3^{h}4$	9353	$+10^{\circ}7$	J
	12	1268.68	4.3	9419	+ 9.9	J
	15	1271.26	18.2	8942	+ 8.0	V
	18	1274.28	18.7	8931	+ 8.3	J
	18	1274.31	19.5	8786	+ 9.6	J
	21	1277.18	16.3	9076	+ 0.3	J
	21	1277.22	17.2	8803	− 1.8	J
	21	1283.21	17.1	8642	+ 3.5	J
XII	7	1293.25	18.1	8557	+ 5.2	J
	7	1293.28	18.8	8749	+ 4.1	J
	10	1296.35	20.3	8368	− 3.4	J
	15	1301.27	18.4	8670	+ 5.2	V
	15	1301.30	19.3	8580	+ 5.0	V
	16	1302.33	20.0	8751	+ 5.1	J
	16	1302.37	20.8	8653	+ 5.1	J
	17	1303.26	18.2	8837	+ 5.0	J
	17	1303.30	19.1	8347	+ 4.8	J
	23	1309.22	17.3	8836	+ 9.0	V
	23	1309.25	18.1	8874	+ 9.0	V
	23	1309.30	19.2	8647	+ 9.0	V
	24	1310.21	17.0	8450	+ 5.1	V
	24	1310.24	17.7	8555	—	V
	25	1311.38	21.0	8823	+ 4.0	J
	25	1311.41	21.9	8658	+ 4.0	J
	29	1315.28	18.6	8734	+ 1.9	V
	29	1315.31	19.5	8852	+ 2.1	V
	30	1316.21	16.9	8512	+ 1.3	V
	30	1316.24	17.8	8789	+ 1.1	V

EXAMINATION OF THE FLEXURE OF BELGRADE MERIDIAN CIRCLE BY THE DAYTIME

M. MIJATOV

SUMMARY:

This paper lays out the results of the flexure examination of the Belgrade Meridian Circle in day conditions in the closed pavilion.
The accidental error of one flexure determination in these conditions is $\varepsilon_b = \pm 0'',13$.
It was pointed out that the basic systematic influences, that had provoked systematic errors in the flexure determination were the moving of collimators and refraction.
It was stated that there had been an outstanding variation of flexure relevant to temperature, as well as seasonal changes in winter-spring periods.

1. Until now, the examinations of the flexure of meridian instruments have been carried out almost entirely in the night conditions. Meanwhile, as lately meridian observations of the Sun and major planets, are being intensified and also preparations are being made for observations of these celestial bodies with the Belgrade Meridian Circle as well, we were interested to find out whether it were possible to determine the flexure of this instrument also in the daytime conditions whith satisfactory accuracy. With this purpose we undertook the examination of the flexure of this instrument (Askania 190/2578 mm) by the daytime and this paper contains the results of our examinations.

2. The examinations were carried out from September 1966 until May 1968 by day at the closed dome, and during a few evenings at the open dome. The evening determinations were made in order to make some comparisons of the day flexure values obtained at the closed dome and of the night values obtained at the open dome.

Table 1 shows the number of the day flexure determinations separated into the time-intervals of these measurements.

As shown in the Table 1, the greatest part of the values, about 65%, were determined between 10^h—14^h CET, at the time when all of observations of the Sun and most of observations of the Mercury and the Venus are made.

The weather conditions during the day determinations were: on 45% of days examinations the sky was clear, and on other days it was either moderately or very cloudy. During the night determinations it was clear in general.

During the day examinations the temperature varied from $-2^\circ.2$ C up to $+25^\circ.3$ C. The mean temperature was $+9^\circ.8$ C. The highest change in the course of one series of measurements was about 1°C. The mean change was 0°.35 C.

Table 1

Hours CET	Number of flexure determinations
6^h — 7^h	1
7 — 8	8
8 — 9	14
9 — 10	13
10 — 11	16
11 — 12	40
12 — 13	24
13 — 14	24
14 — 15	4
15 — 16	2
16 — 17	6
17 — 18	3
18^h — 19^h	4

Determinations were made in East and West instrument positions depending upon the position of the instrument at the moment of examination. The instrument position depended upon the needs for observations of the Latitude Star Cataloque. Therefore the number of determinations in the position West is more than twice higher than that of determinations in the position East.

3. Bessel's method, with horizontal collimators, was used for examinations. The collimators (d=8 cm, f=100 cm) were installed on massive concrete pillars, the latter laving a shape of a truncated pyramid. The height of these pillars above the pavilion floor is 1.7 m.

Most of the determinations were made by two observers: M. Mijatov (MM) and B. Kubicela (BK). The first observer MM was determining the flexure either all by himself or together with the second observer BK. Thereby MM was on the eyepiece micrometer, and BK on the vertical circle. D. Saletić (DS) assisted once in the examinations on the eyepiece micrometer, and S. Sadzakov (SS) and A. Vojnović (AV), each of them once, on the vertical circle.

In the course of 126 days, 159 determinations of the flexure were made by day conditions and during 7 evenings 10 determinations by night conditions. Table 2 gives a survey of the number of determinanations by observers.

Table 2

Observers	The number of detrminations by day	The number of detrminations at night
MM	97	3
MM,BK	61	5
DS, MM	1	—
MM, SS	—	1
MM, AV	—	1

4. The organization of the flexure measurements was carried out in the following way. First, one collimator was set on the other so that the travelling wire of the northern collimator micrometer was five times set on each wire of the double thread of the southern collimator micrometer, and then the northern collimator micrometer was put on the mean value of all the settings (rounded off on the entire division unit). After the setting of one collimator on the other, the telescope tube was set on one of the collimators and the eyepiece micrometer reading was performed by setting its travelling wire on double wires of collimators micrometers and the circle reading. Thereby, five settings of eyepiece micrometer thread were perfomed on the threads of collimators before and after the vertical circle reading. Thereafter, the tube was directed to the other collimator and the operations of the setting on the first collimator were repeated. By the end of the first semi-series, where one value of the flexure was obtained, the collimators were set one on the other again.

The second semi-series gave another value of the flexure and differed from the first one in the order of settings of the tube on collimators.

The mean value of both semi-series was taken as the final value of the flexure.

5. The following formula were applied for calculation of the flexure, when the measurement was made in the East instrument position:

$$b_1=\frac{1}{2}[(K_N-K_S)+(m_N-m_S)R-(k_1-k_0)R'] - 90^\circ$$

$$b_2=\frac{1}{2}[(K_N-K_S)+(m_N-m_S)R-(k_2-k'_0)R'] - 90^\circ$$

and in the West position:

$$b_1=\frac{1}{2}[(K_S-K_N)+(m_S-m_N)R-(k_1-k_0)R']-90^\circ$$

$$b_2=\frac{1}{2}[(K_S-K_N)+(m_S-m_N)R-(k_2-k'_0) R']-90^\circ$$

where are: K_N, K_S — the values of the circle readings while setting the tube on the northern (N) or southern (S) collimator; m_N, m_S-the mean values of 10 settings of the eyepiece micrometer travelling thread on the threads of corresponding collimators; R-the value of a revolution of the declination micrometer screw; k_1, k_2-the mean values of 10 readings of the northern collimator micrometer at its setting to the southern collimator by the end of the first or of the second semi-series; k_0, k_0'-the mean values of 10 readings of the northern collimator micrometer at its setting on the southern collimator at the beginning of the first or of the second semi-series (rounded off on the entire division unit); R'-the value of a revolution of the micrometer screw of the northern collimator.

The indices 1 and 2 mark the first respectively the second semi-series.

The final value b was calculated by means of the formula:

$$b = \frac{1}{2}(b_1 + b_2)$$

6. As the principal aim of the executed examinations was to investigate the most possible accuracy of the flexure determinations by day conditions with the closed pavilion and the order of systematic errors while making these determinations, so the analysis of obtained result was first of all aimed in this direction.

The interior accuracy of the determinations we characterize as accidental error of one determination ε_0 (Burmistrov G. A., 1963)

$$\varepsilon_0 = \pm \frac{1.25}{\sqrt{2}} \quad \frac{\Sigma\,|\Delta|}{n} \tag{1}$$

where are: Δ-the difference of two given values determined consecutively and n-the number of differencies. By means of this formula we calculated the accidental error of the flexure determinations of one semi-series. Consequently, the random error of one value b is:

$$\varepsilon_b = \pm \frac{\sqrt{2}}{2}\, \varepsilon_0 = \pm \frac{1.25}{2} \quad \frac{\Sigma\,|\Delta|}{n} \tag{2}$$

However, in our case, Δ might be overloaded with systematic errors that might influence the determination of ε_b. Therefore, in order to eliminate possible systematic errors in Δ, we undertook an examination of systematic influences on this quantity. Besides, these examinations may also point to sistematic errors in the determinations of the flexure.

We have investigated the values $\Delta_1 = b_{NS} - b_{SN}$ and $\Delta_2 = b_1 - b_2$ in the same series, in order to examine their distribution. The notatious are: b_{NS}-the value of the flexure obtained in the semi-series when the telescopes tube is set first on the northern collimator; b_{SN}-the value of the flexure in the semi-series, when the tube is set first on the southern collimator; b_1-the value of the flexure obtained in the first semi-series, and b_2-the value of the flexure obtained in the second semi-series. We used Pearson's chisquared distribution. For Δ_1 we obtained the probability of the normal distribution $P_1 = 0.30$, and for Δ_2-the probability $P_2 = 0.42$. Although it was not mathematically defined how high should the probability be if it has to be considered that the obtained distribution is normal, in the practice it is still considered that the concordance between the obtained and the normal distribution is satisfactory as soon as $P = 0.1$ (Ventcel', 1958). However, on the basic of the obtained probabilities it cannot be considered for certain that the obtained distributions are normal, in particular in the distribution Δ_1. Therefore, a more detailed investigation of the value Δ_1 and Δ_2 was undertaken.

The preliminary investigations showed that there is a significaiant systematic difference between b_{NS} and b_{SN}: $\Delta_1 = +0''.09 \pm 0''.02$. The dispersion analysis proved that Δ_1 depends upon the vertical circle position and of the observer, and does not depend upon the air temperature.

In Table 3 the values of Δ_1 are given separatly for different positions and observers.

Table 3

Systematic difference $b_{NS} - b_{SN}$			
East instrument position		West instrument position	
MM,BK	MM	MM, BK	MM
$+0''.02$ (18) ± 0.07	$-0''.18$ (29) ± 0.05	$+0''.21$ (43) ± 0.05	$+0''$,15. (68) ± 0.03

We have corrected the basic data with the values Δ_1 from the Table 3, and after this, the probability according to Pearson's chi-squared distributions was $P_1 = 0.59$. As it can be seen, with respect to basic data the probability has grown nearly twice, which is a proof of the reality of the obtained differences shown in Tables 3.

The systematic difference between b_1 and b_2 was $\Delta_2 = -0''.02 \pm 0''.02$. These differences are calculated by observers only, and they make: for MM, BK $\Delta'_2 = -0''.03 \pm 0''.04$, and for MM $\Delta''_2 = -$ $-0''.02 \pm 0''.03$. The obtained mean difference Δ_2, although insignificant, can be judged real because of the good concordance between observers values.

On the basic of the above given reasults, we may state that Δ is loaded with systematic errors which were specially pointed out in Table 3. Therefore, the accidental error of one b determination, calculated with (2), is determined as well by means of Δ obtained from basic observers data as by means of Δ corrected for systematic differences of Table 3. The values $\varepsilon'_b = \pm 0''.16$ and $\varepsilon''_b = \pm 0''.13$ were obtained respectively. As it can be seen, the accidental error ε_b was only insignificantly reduced after the application of systematic differencies from Table 3. However, a noticeable reduction cannot be because ε_b, obtained from basic observers data, is the same order of the quantity as the accidental errors obtained by night flexure determinations.

The a priori accidental error of the determination of a value b is $\varepsilon_b = \pm 0''.06$. It was determined on the basic of the accidental errors of the vertical circle reading $\varepsilon_k = \pm 0''.10$, of the reading of the eyepiece micrometer $\varepsilon_m = \pm 0''.04$, and of the setting of the collimator $\varepsilon_c = \pm 0''.06$.

As after elimination of the obtained systematic errors $b_{SN} - b_{SN}$ from Table 3, the a posterior error was twice higher that the a priori error, this makes us presume that there are also other influences of accidental and systematic character. These influences are presumably the result of the known distrurbance factors: the displacing of the collimators, the refraction, etc.

7. Let us consider those systematic errors which could have caused systematic errors while determining the flexure.

Systematic errors in the reading of the vertical circle are predominatly the result of personal errors in measuring and, if they exist, they are practically eliminated in the difference of the circle readings at the setting of the telescope tube on the southern or on the northern collimator.

Systematic influences which, throught readings of the eyepiece micrometer, can cause systematic errors in the determination of the flexure, are the following: the displacing of the collimators, the position changing of the instrument, the refraction in the telecope tube, the pavilion refraction, the refraction in the collimator tube and the thermal flexure.

In the accepted sequence of operations in which the measurements were performed, the eyepiece micrometer, as it was said in § 4, was read twice-before and after the reading of the vertical circle. Between these readings there was usually interval of 2—3 minutes. The analysis of the values $\Delta m = m_1 - m_2$, where m_1-are the readings of the eyepiece micrometer before the circle reading, and m_2-after the circle reading, may point to the possible sources of systematic errors in the values m. For the examination of the Δm values, we have used Pearson's chi-squared distribution too. For probability P, when the tube was set on the northern collimator, $P_N = 0.03$ was obtained, and for the probability P, when the tube was directed to the southern collimator, $P_S = 0.001$ i. e. in both cases less than 0.1. This suggested that the values Δm were loaded with influences of systematic character. Therefore, the values Δm are determined separatelly for both instrumental positions, for both collimators (the northern — N, and the southern S), as well as for both procedures of the setting of the telescope tube on collimators in the semi-series. These values are given in Table 4. The indices 1 and 2, for the collimators, designate whether the setting on them was the first or the second in the semi-series.

Table 4

Collimators	East instrument position	West instrument position
S_1	0″00 (47)	+0″03 (111)
S_2	−0.08 (47)	−0.03 (111)
N_1	−0.03 (47)	+0.03 (111)
N_2	−0″01 (47)	+0″10 (111)

The errors of the above quoted values Δm in Table 4 are $\varepsilon_{\Delta m} = \pm 0''.01$.

As shown in Table 4, there are significiant systematic differencies of the Δm order of magnitude 0″1 in the East instrument position by the southern collimator, when it is the second in the procedure in the semi-series, and in the West instrument position by the northern collimator, when it is also the second in the procedure in the semi-series.

When considering the values Δm one has to bear in mind that the setting of the telescope tube on the first collimator in the semi-series is carried out immediately after the setting of one collimator on the other (whereby the tube is in vertical position for 2—3 minutes with open cube), and the setting on the other collimator is done after the tube, which has been in horizontal position for 4—5 minutes, is rotated through zenith.

The examination of the Belgrade Vertical Circle (Teleki, 1970) showed that there is a slow accommodation of the telescope tube to the temperature regime of the surroundings that lasts for 8—10 minutes. This provokes constant changes in the temperature differencies between the upper and the lower surface of the telescope tube for this time-interval, or, the variation of the refraction in the tube and the change of termal flexure. As both telescope tube those of the Belgrade Meridian Circle and of the Belgrade Vertical Circle are equal in dimensions, made of the same material and in the same factory (Askania) nearly at the same time, so the technology of the manufacturing of the tubes was also probably the same, and therefore it can be supposed that the quality of the tubes of both instruments is nearly the same, which means that nearly the same effect can be expected also with the telescope tube of the Meridian Circle.

If we accept the assumtion that also in the telescope tube of the Belgrade Meridian Circle the accomodation of the temperature difference betveen the upper and the lower sufrace of the tube ΔT is being performed slowly, then the observed significant systematic differencies Δm at the setting on the other collimator in semi-series may be explained by the significant variation ΔT during the measuring.

A great deal of errors in the determinations of the flexure caused by the variation ΔT is eliminated when it is taken $m = \frac{1}{2}(m_1 + m_2)$, but, as these changes are not linear (Pavlov, 1953) a certain part of these errors certainly remains. However, without direct measuring of the value ΔT one cannot speak of the existence of this, influence and its change with certainty.

The systematic errors in values k_1 and k_2 are caused in general by the influence of two factors: by the displacement of collimators and by the pavilion refraction. At the reduction of observational data, as stated in § 5, corrections $-(k_1 - k_0)R'$ and $-(k_2 - k'_0)R'$ were introduced with the aim to reduce the influence of these two factors.

Let us consider their influence separately.

Supposing that only a translatory moving of the collimator is carried out upward and that the optic axes coincide with each other at the beginning, then the influence of the collimator moving on the flexure determination can be defined.

Let us cosider first the influence of the collimator moving while the telescope tube in the semi-series is set on the southern collimator first.

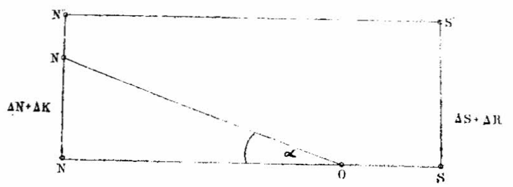

Fig. 1

Assuming that in the Fig. 1 the points N and S are the positions of the northern and the southern collimator cross-wires when they coincide with each other, and O the cross-section of the line NS with the plane of eyepiece micrometer reticule. Then, let us say that SS′ is the moving of the southern collimator during the semi-series (ΔS) and the total influence of pavilion refraction at the setting of one collimator on the other (ΔR), i. e., $SS' = \Delta S + \Delta R$ and $NN'' = NN' + N'N'' = \Delta N + \Delta k$-where ΔN are the moving of the northern collimator and Δk the difference of the northern collimator readings at the setting on the southern collimator at the end and at the beginning of the semi-series. Assuming that there has not been any moving of the southern collimator between the completion of the setting of one collimator on the other and the beginning of the setting of the telescope tube on it (direction OS), as well that there has not been any moving of northern collimator between the completion of the setting of the telescope tube on it and of the setting of one collimator on the other (direction ON) either, then the direction of the telescope tube setting on the northern collimator in relation to the direction of the setting on the southern collimator is $< N'OS$. Taking into account also the flexure influence, in Fig. 1 it is:

$$< N'OS + \alpha + 2b = 180^\circ,$$

or,

$$b = \frac{1}{2}\ N\hat{O}S - \frac{1}{2}\ \alpha + 90^\circ.$$

Consequently, the correction for the flexure is in this case $\frac{1}{2}\alpha = \frac{1}{2}\Delta N$.

But, if the telescope tube is set first on the northern collimator, and after that on the southern, under the assumtion that there has not been either moving of northern collimator in the semi-serie before the setting on it or moving of the southern collimator after the setting on it, then the correction for the flexure is, on the basic of similar considerations, i. e., it will depend exclusively upon the moving of southern collimator.

As it can be seen, in ideal conditions, when exclusively translatory moving of the collimator upward the height is performed, the applied corrections coused systematic errors that are different in different procedures of the setting of the telescope tube on collimators. The collimators moving is surely much more complex and therefore systematic errors in the determination of the flexure are more complex, but these errors depend upon the procedure of the telescope tube setting on collimators and they may provoke systematic difference $b_{NS} - b_{SN}$.

That the moving of collimators has been in effect can be concluded on the basic of the analysis of values $\Delta k = k_2 - k_0$ where k_0, k_2 are the values of northern collimator readings at the setting on the southern collimator at the beginning and at the end of the measurement series. In Fig. 2 these values are given for procedures of the setting on SNNS and NSSN, for three groups of temperature: $t_1 < +7^\circ.0C$, $+7^\circ.0C \leq t_2 \leq +16^\circ.0C$ and $t_3 > +16^\circ.0\,C$, and for observers MM and MM, BK.

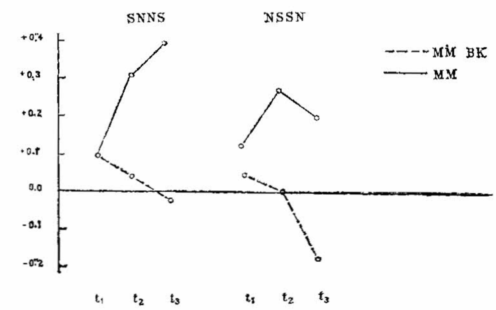

Fig. 2

This figure shows that for both procedures there is approximately the same difference of the value Δk among observers at the same temperatures. With the rising of the temperature this difference between observers growth on. As the time-interval for the determination of the flexure was longer for MM than for MM, BK, the prolonged moving of collimators could have caused this difference between the observers values. The growth of differencies with the temperature can be explained by the change of collimators moving with temperature.

The influence of pavilion refraction can be calculated approximately by means of the formula (Kazanskij, 1966):

$$\Delta R = \frac{1}{2} kD \qquad (3)$$

where k is the coefficient of terestrial refraction, and D-angular distance (in the centre of Earth sphere) between two points for which the refraction is being determined. Coefficient k, if the rays come on horizontally, can be calculated by means of the formula:

$$K = \eta \left(\frac{T}{p} \frac{dp}{dh} + \frac{dT}{dh} \right)$$

where: $\eta = 670 \frac{P}{T^2}$, T-absolute air temperature, P-air pressure in mm Hg and $\frac{dT}{dh}$-vertikal temperature gradient in °C/m. As $\frac{dp}{dh}$ for the half an hour (the duration of measuring) can be considered negligible, so for k we can take the approximate formula:

$$K = 670 \frac{P}{T^2} \frac{dT}{dh} \quad (4)$$

Assuming that the mean pressure had been approximately P=750 mm Hg, the mean absolute temperature approximately T=283°, and the mean vertical temperature gradient, according to our subseqwent measuring, $\frac{dT}{dh} \approx 0°.3$ C/m, then for D=3 m, which equals the distance between collimators, $\Delta R \approx \approx 0''.2$.

As it can be noted, the influence of pavilion refraction can be significant at the setting of one collimator on the other.

8. All systematic errors of measured quantities, except the errors in the vertical circle reading, which are, as alredy noted, the results of personal errors are causing systematic errors in determining b. Besides, systematic errors resulted also from disturbance factors, such as: the moving of colimators, the refraction in the tube and the paviilon refraction.

The collimators moving was not determined during examinations so that one cannot speak with certainty about the influence of this factor on the determination b, but judging by the differencies $b_{NS} - b_{SN}$ the moving might provoke systematic errors of the order 0″.1.

The reaction in the tube can also provoke noticeable systematic errors in determining b. To define this influence we must know the quantity ΔT.

As shown above, the influence of pavilion refraction at the setting of one collimator on the other could have provoked systematic errors in determining b of the order of the quantity 0″.1.

9. By now we have considered the influences which loaded upon the flexure determination. Now let us consider how b was changing in the course of time.

The quantities b, determined by day conditions by observers MM and MM, BK, were reduced to the system of the observer MM by application of systematic differencies MM−MM, BK=−0″.08 ± ± 0″.05. The reduction to this system was performed because the observer MM had carried out the greatest deal of determinations and had participated in all determinations.

By means of quantities b reduced to the system of the observer MM, the temperature variation of the flexure had been determined assuming linear relation:

$$b_i = b_0 + \alpha (T_i - T_0) \quad (5)$$

where b_i-the measured quantities of flexure, b_0-the most probable mean value b at $T_0 = 10°.0$ C; α-the most probable temperature coefficient for the temperature change of 1°C and T_i-the mean temperature in the series.

Using the formula (5), 158 data b_i yielded the following values:

$$b_0 = -0''.598 \pm 0''.038$$
$$\alpha = +0''.038 \pm 0''.005$$

As it can be noticed, the flexure temperature variation is significiant and makes about 0″.04 for 1°C. It should be of interest to note that also the determinations of the flexure temperature variation, performed in night conditions, in other meridian instruments of similar dimensions, yielded approximately the same result in absolute value. As the conditions in day and night determinations, at the same temperatures, differ significantly, it is probable that this variation is the result of the changes of the determination conditions.

Direct consideration of the value $\nu = b_i - [b_0 + + \alpha (T_i - T_0)]$ showed that they have distinct systematic variation in the course of time. Therefore, these values are grouped in 8 periods of time, mostly quarterly. These periods correspond to the periods of the seasons of the year. The values ν by periods are given in Table 5.

Table 5

Periods					ν
1966	IX,	X,	XI	autumn	−0″29 (16)
1966−1967	XII,	I,	II	winter	−0.59 (18)
1967	III,	IV,	V	spring	+0.09 (20)
1967	VI,	VII,	VIII	summer	−0.18 (15)
1967	IX,	X,	XI	autumn	−0.21 (13)
1967	XI,	XII			+1.10 (6)
1967−1968	XII,	I,	II	winter	−0.02 (33)
1968	III,	IV		spring	+0.33 (37)

This table shows that there are systematic flexure variations in the course of time, as well as sudden changes. The change that has been pointed out occured in November-December 1967, when the flexure was changed for more than 1″. This deformation lasted for about one month and consequently the flexure value returned to the former one. It is important to point out to the significant change that occurs in the transition from the winter period to the spring period. Namely, the flexure changed from winter period 1966—1967 to the spring period 1967 for about $\Delta b \approx +0''.7$ and from the winter period 1967—1968 to the spring period 1968 for about $\Delta b \approx +0''.3$. In autumn and summer periods the flexure was practically constant.

As already pointed out in § 2, 10 determinations of the flexure were performed in night conditions by the open dome. Practically there are no differences between the flexure values obtained in night conditions at the open dome and the values obtained in day conditions at the closed dome. This shows that there are no systematic errors in the flexure determination in day conditions by closed dome that could have consequences of these particular conditions.

10. The performed examinations of the Belgrade Meridian Circle flexure in day conditions of determinations in closed pavilion showed that accidental errors of these determinations are $\varepsilon_b = \pm 0''.13$, which means that they are of the order of the quantity of random errors obtained on other meridian instruments in night conditions, and even less. This shows that the factors that provoke random errors in the determination of the flexure, such as the moving of collimators, the refraction, instrumental errors etc., act probably both in night and day conditions of determination.

The examinations ofsystematic influences on the flexure determinations, in this conditions, pointed out to the existence of outstanding influences that spring out from the moving of collimators, from the refraction in the tube and from the pavilion refraction.

It was stated that there exists an outstanding variation of the flexure with temperature, as well as season change in winter-spring periods.

In conclusion, the author feels his duty to express his gratitude to all observers for their efforts, in particular to B. Kubicela, calculator of the Belgrade Astronomical Observatory, who, besides observations, took part also in the checking of calculations. The author expresses also his most sincere thanks to Dr G. Teleki for a number of useful advices, and remarks in the course of the elaborations of this study.

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ANALYSIS OF THE DETERMINATIONS OF THE CORRECTIONS THE MICROMETER SCREW VALUE OF THE BELGRADE ZENITH TELESCOPE

M. DJOKIĆ

1. In a previous work [1] it was noted that in order to explain the quality of observations of the corrections ΔR received from different scale pairs it was necessary to make an analysis of the instrument influence, particulary as regards Talcott levels, on the results of observations. This was one of the reasons for continued observations under a programme [2] set up according to the Washington zenith stars catalog.

2. In the period 1965.1 — 1968.0 the observations of scale pairs were made by G. Teleki (GT), R. Grujić (RG) and M. Djokić (MD). Table 1 presents the scale pair observations by years for the total observation period.

Table 1

Year	1965	1966	1967	Total
No. of scale pairs	78	44	102	224

Table 2 presents the scale pair observations by months throughout the observation period.

Table 2

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
No. scale of pairs	14	18	–	4	–	11	54	50	26	26	19	2

Table 3 presents the scale pair observations by observers during the whole observation period.

Table 3

Observer	GT	RG	MD
No. of scale pairs	1	109	114

3. Table 4 shows the mean values for ΔR corrections for every scale pair, numbers of observations for every scale pair (n), the mean square errors of the mean values for ΔR, (ε_m), and the mean square errors of single determination of the ΔR values (ε_i). All data pertain to the whole observation period.

Table 4

Scale pair	ΔR 1965.1–1968.0	n	ε_m	ε_i	Scale pair	ΔR 1965.1–1968.0	n	ε_m	ε_i
1	2	3	4	5	1	2	3	4	5
1	−0″057	4	±0″053	±0″106	11	−0″110	2	—	—
2	−0. 142	2	—	—	12	−0. 090	6	±0″033	±0″081
3	−0. 121	9	0. 032	0. 096	13	−0. 116	13	0. 018	0. 065
4	−0. 066	8	0. 024	0. 068	14	−0. 058	7	0. 035	0. 093
5	+0. 029	1	—	—	15	−0. 006	9	0. 026	0. 078
6	−0. 056	1	—	—	16	−0. 243	18	0. 085	0. 361
7	−0. 129	5	0. 051	0. 114	17	−0. 073	44	0. 013	0. 086
8	−0. 130	8	0. 031	0. 088	18	−0. 058	62	0. 017	0. 134
9	−0. 076	5	0. 016	0. 036	19	−0. 070	7	0. 034	0. 090
10	−0. 066	5	0. 012	0. 027	20	−0. 109	8	0. 039	0. 110

From Table 4, column 2, it may be seen that the differences among the ΔR values remained the same as in the previous paper [1]. The ε_m values for ΔR found for every scale pair now were higher than the comparative values in the previous observation period. The differences among the ε_i values (Table 4, column 5) compared with the values in the previous observation period tended to increase. In the previous observation period the ε_i values were in the range ± 0″.016 to ± 0″.152, whereas now they were in the range ± 0″.027 to ± 0″.361.

A high ε_i value for scale pair 16 was as evident now as in the previous observation period. Values for scale pairs 1, 7, 18 and 20 also increased, but for scale pairs 3, 9, 12 and 14 were slightly lower.

4. Several attempts were made to explain the influence of Talcott levels inclination (β) on the values for ΔR corrections. Mean values for β as the function of observation duration for every scale pair were compared with the mean values for ΔR. This was applied to the all available observation data. Figure 1 presents the relations among the curves corresponding to the data in Table 5.

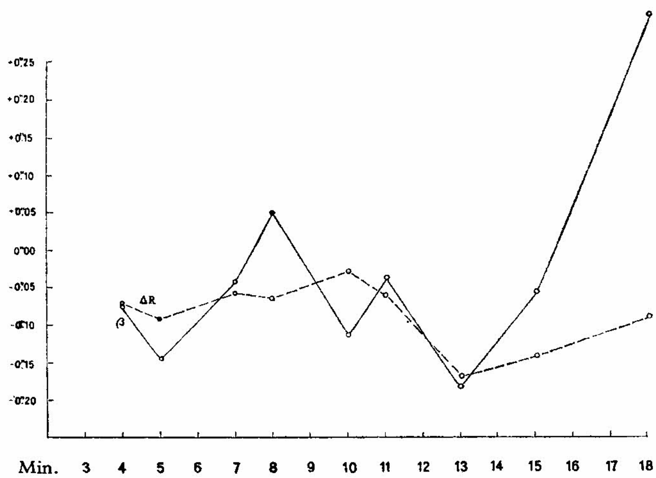

Fig. 1

Table 5 (in units of 0.″001)

Time, min.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
ΔR(t)	−76	− 91	—	−58	−66	—	− 28	−110	—	−169	—	−142	—	—	− 90
β(t)	−72	−146	—	−42	+50	—	−112	− 38	—	−184	—	− 56	—	—	−314

Figure 2 presents values ΔR from Table 4, column 2, and the mean values β for every scale pair and for the total observation period. Table 6 presents the data for β.

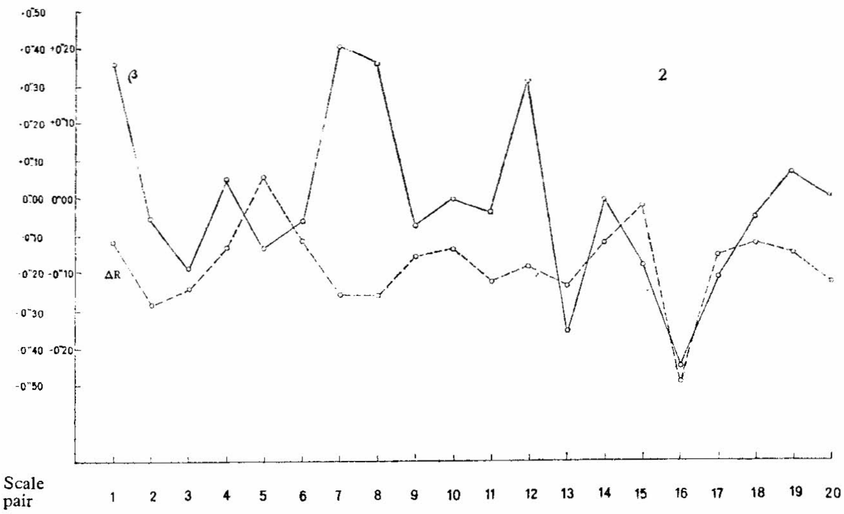

Fig. 2

Table 6 (in units of 0.″001)

Scale Pair	1	2	3	4	5	6	7	8	9	10
β 1965.1 – – 1968.0	+358	−56	−188	+50	−132	−62	+405	+360	−72	−4
Scale Pair	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
β 1965.1 – – 1968.0	−38	+314	−357	−1	−171	−444	−203	−46	+71	+8

There is an obvious accordance among values β and ΔR for the second part of observation programme from pair 11 to pair 20 (Fig. 2).

The above fact stirred up in a more detailed treatment of the inclination influences on the corrections of the micrometer screw value.

In connection with this, the quotient $\frac{\beta}{\Delta M}$ was separately treated to get a more detailed picture of the part of inclination that directly, by computation, enters the value ΔR.

Figure 3 presents the absolute mean values for

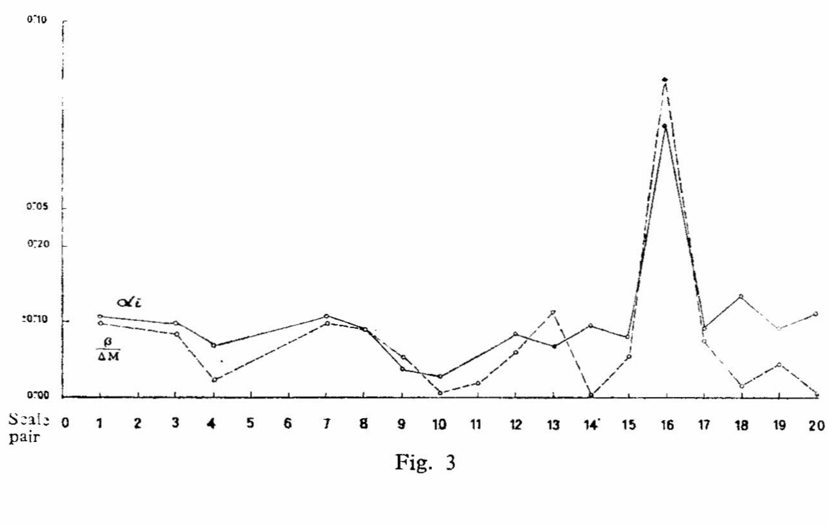

Fig. 3

quotients $\frac{\beta}{\Delta M}$ for every scale pair throughout the observation period, and the data ε_i from Table 4, column 5. The accordance of the curves in Fig. 3 in the second part of the observation programme is particulary expressed.

Table 7 (in units of 0.″0001)

Scale pair $\left\lvert\frac{\beta}{\Delta M}\right\rvert$ 1965.1–1968.0	1	2	3	4	5	6	7	8	9	10
	193	33	164	41	184	72	193	171	52	2
Scale pair	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
$\left\lvert\frac{\beta}{\Delta M}\right\rvert$ 1965.1–1968.0	33	117	222	2	103	845	143	26	82	9

It could be concluded that the Talcott level inclinations in a great extent influenced the error of single determination of the micrometer screw value correction.

To homogenise the observation data the values ΔR for cases $\left\lvert\frac{\beta}{\Delta M}\right\rvert > 0''.01$, $0''.02$ and $0''.055$ were eliminated separately. Table 8 presents the results of these eliminations. In every case the mean square errors for mean ε_m and single ε_i determinations for ΔR for every scale pair were determined.

In the case $\left\lvert\frac{\beta}{\Delta M}\right\rvert > 0''.01$ the observation data are reduced by 46.9%, and errors ε_m and ε_i related

Table 8 (in units of 0.″001)

Scale pair	$\left\lvert\frac{\beta}{\Delta M}\right\rvert < 0''.01$			$\left\lvert\frac{\beta}{\Delta M}\right\rvert > 0''.02$			$\left\lvert\frac{\beta}{\Delta M}\right\rvert > 0''.055$		
	ΔR	εm	εi	ΔR	εm	εi	ΔR	εm	εi
1	2	3	4	5	6	7	8	8	10
1	−85	±−	±−	−101	±42	±73	−101	±42	±73
2	−62	—	—	−142	—	—	−142	—	—
3	−86	33	66	−88	27	66	−94	21	59
4	−116	8	14	−90	24	59	−54	24	64
5	—	—	—	+29	—	—	+29	—	—
6	−56	—	—	−56	—	—	−56	—	—
7	−100	17	29	−100	17	29	−80	23	46
8	−100	8	21	−100	8	21	−100	8	21
9	−76	17	29	−76	16	36	−76	16	36
10	−66	12	27	−66	12	27	−66	12	27
11	—	—	—	−110	—	—	−110	—	—
12	−152	—	—	−87	45	78	−86	32	64
13	−69	12	27	−76	10	26	−95	14	46
14	−92	—	—	−70	61	122	−58	35	93
15	−41	10	22	−20	17	45	−27	16	45
16	−152	83	166	−92	48	136	−104	36	125
17	−49	10	51	−49	10	59	−54	10	62
18	−57	10	62	−63	10	71	−54	10	75
19	−56	47	105	−60	39	96	−70	34	90
20	−146	44	88	−141	35	78	−145	29	71

to the errors in Table 4 are also reduced. Scale pair 19 is the only exeption. In the case $\left\lvert\frac{\beta}{\Delta M}\right\rvert > 0''.02$ observation data are reduced by 25.4%, and in the case $\left\lvert\frac{\beta}{\Delta M}\right\rvert > 0''.055$ by 13.0%. In the last two cases errors ε_m and ε_i are in great accordance.F rom Table 8 it could be seen that for some scale pairs ε_i decreased with increasing the tolerance of quotient $\frac{\beta}{\Delta M}$, whith indicated that inclination (β) was not the only influence responsible for the differences among the ΔR corrections for every scale pair.

However, when the Student-Fisher statistical criterion with probability 0.95 was applied to every pair the observation data were reduced by 7.2%.

5. Table 9 presents the ΔR mean values, number of observations (n), and mean square error (ε_m) of the the ΔR mean value and mean square error (ε_i) of

single ΔR determination for every scale pair, after the Student-Fisher statistical criterion.

Table 9 shows good accordance among mean square errors ε_m for particular scale pairs, but the range $\pm$ 0".021 to $\pm$ 0".132 for the mean square errors ε_i related to those in Table 4 is considerably narrowed. Accordance among the values ε_i is evident too.

Table 9.

Scale pair	ΔR 1965.1 – – 1968.0	n	ε_m	ε_i
1	2	3	4	5
1	−0".057	4	±0".053	±0".106
2	−0 .142	2	—	—
3	−0 .121	9	0 .032	0 .096
4	−0 .066	8	0 .024	0 .068
5	+0 .029	1	—	—
6	−0 .056	1	—	—
7	−0 .129	5	0 .051	0 .114
8	−0 .100	7	0 .008	0 .021
9	−0 .076	5	0 .016	0 .036
10	−0 .066	5	0 .012	0 .027
11	−0 .110	2	—	—
12	−0 .090	6	0 .033	0 .081
13	−0 .116	13	0 .018	0 .065
14	−0 .058	7	0 .035	0 .093
15	−0 .006	9	0 .026	0 .078
16	−0 .101	15	0 .034	0 .132
17	−0 .059	41	0 .010	0 .064
18	−0 .046	53	0 .007	0 .051
19	−0 .070	7	0 .034	0 .090
20	−0 .109	8	0 .039	0 .110

From the data in Table 9, correction ΔR = = −0".0706 $\pm$ 0".0055 with mean square error of single determination $\pm$ 0".0793 was calculated.

6. Temperatures during observations varied in the range −8.9°C to +25.8°C. From the data in Table 9 the temperature coefficient α = +0".0013 $\pm$ $\pm$ 0".0006 of the ΔR correction was calculated and found to be very similar and of the same sign with the previously found value [3].

From a comparison between the temperature coefficient presented in this paper and the corresponding values adopted by the ILS stations whose zenith telescopes are of the same type and magnitude as the Belgrade telescope, it was seen that the value α we found and the value α at the Ukiah station were similar in absolute terms [4].

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[1] *M. Djokić*, Bulletin de l'Observatoire Astronomique de Beograd, Vol. XXVII, № 2, 1969.

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[3] *B. M. Ševarlić*, Publications de l'Observatoire Astronomique de Beograd № 8, 1961.

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OBSERVATIONS DES OCCULTATIONS À BELGRADE EN 1971

par *M. B. PROTITCH*

Dans le tableau suivant on trouvera le matériel d'observations des occultations que nous avons faites à Belgrade en 1971 avec l'équatorial Askania de 135 mm d'ouverture, muni d'un oculaire grossissant 128 fois.

La liste de prédiction des phenomènes, publiée dans ce Bulletin (Vol. XXVII, № 2, 1969), a été remplacée ensuite par une liste nouvelle plus complète, contenant les étoiles faibles et communiquée à l'Observatoire de Belgrade par H. M. Nautical Office.

Le temps d'observation, enregistré au chronographe, a été déterminé d'après la pendule R 507, comparée deux fois par jour avec les émissions de la station Pontoise (resp. à 8^h et 20^h TU). L'équation personnelle n'est pas appliquée.

Date	Etoile Z. C.	Phen.	T. U.	Rem
Janv. 31	0125	D	$18^h02^m50^s.4$	2
Févr. 04	0701_b	D	16 32 31 .0	3–4
Févr. 04	0701_a	D	16 32 37 .3	4
Avril 02	1068	D	18 19 49 .3	1
Avril 03	1215	D	23 03 50 .3	3–4
Avril 04	1312	D	17 48 06 .8	2
Juin 05	2046	D	21 24 13 .7	2
Juin 14	3334	R	23 49 09 .2	2
Juill. 11	3296	R	22 16 32 .1	1
Août 06	3086	R	19 59 10 .1	4
Août 14	0539	D	01 32 29 .1	3
Août 14	0536	R	02 00 43 .2	3
Août 14	0541	D	02 02 59 .7	3–4
Août 14	0541	R	02 30 03 .9	3
Août 14	0539	R	$02^h36^m36^s.5$	3
Août 14	0542	R	03 02 28 .9	3
Août 14	0543	R	03 03 19 .1	3
Août 28	2261	D	18 21 42 .5	2
Sept. 03	3173	D	20 33 17 .3	4
Oct. 13	1331	R	01 52 27 .8	3
Oct. 13	1335	R	02 50 31 .1	2–3
Nov. 05	0849	R	22 03 21 .3	2
Nov. 06	1030	D	22 19 04 .5	4
Nov. 06	1030	R	23 26 01 .8	4
Déc. 25	0089	D	19 24 08 .5	3

Remarques: 1 — faible; 2 — médiocre; 3 — bonne; 4 — très bonne.

RÉDUCTIONS DES OCCULTATIONS

observées à Belgrade

par M. B. PROTITCH et M. SIMIĆ

Ci-après nous présentons les résultats des réductions relatifs aux occultations observées par M. B. Protitch au cours de 1971. Les réductions sont faites de la même manière comme précedement (voir: Bulletin de l'Observatoire de Beograd, Vol. XXVIII, F. 2, № 124), la correction provisoire adoptée de ΔT étant $+41^s.0$.

Les valeurs de $\Delta\sigma$ données dans le tableau suivant sont brutes.

Date		Étoile Z. C.	Phen.	Red.	à jour	cos $(\chi-\rho)$	sin $(\chi-\rho)$	$\Delta\sigma$
Janv.	31	0125	D	$+0^s312$	+ 5″49	+0.267	+0.964	+1″45
Févr.	04	0701[b]	D	+1.747	+12.01	+0.943	−0.333	−2.09
	04	0701[a]	D	+1.737	+12.00	+0.943	−0.333	−1.90
Avr.	02	1068	D	+1.843	+ 5.92	+0.846	+0.533	+2.00
	03	1215	D	+2.095	+ 1.43	+0.502	−0.865	−0.79
	04	1312	D	+2.255	− 2.20	+0.771	+0.637	−2.02
Juin	05	2046	D	+3.093	−20.87	+0.999	+0.047	+2.32
	14	3334	R	+2.481	+12.17	−0.981	+0.196	+1.73
Juill.	11	3296	R	+3.406	+16.61	−0.407	−0.913	+0.31
Aout	06	3086	R	+4.366	+13.91	−0.939	−0.344	−2.32
	14	0539	D	+2.849	+13.02	+0.971	+0.237	+1.06
	14	0536	R	+2.851	+13.11	−0.314	+0.949	+0.29
	14	0541	D	+2.846	+13.04	+0.528	+0.849	+1.30
	14	0541	R	+2.848	+13.04	−0.228	+0.974	+0.25
	14	0539	R	+2.850	+13.02	−0.845	+0.535	−0.10
	14	0542	R	+2.851	+12.97	−0.894	+0.448	+0.03
	14	0543	R	+2.850	+12.97	−0.820	+0.572	−0.89
	28	2261	D	+3.073	−17.35	+0.879	+0.477	−0.40
Sept.	03	3173	D	+4.402	+17.59	+0.946	+0.324	−0.08
Oct.	13	1331	R	+3.015	− 7.19	−0.983	−0.185	+0.43
	13	1335	R	+3.002	− 7.32	−0.900	−0.436	+1.57
Nov.	05	0849	R	+5.152	+ 7.87	−0.933	−0.360	+1.38
	06	1030	D	+4.871	+ 0.38	+0.873	−0.489	+0.49
	06	1030	R	+4.872	+ 0.38	−0.917	+0.399	+1.84
Déc.	25	0089	D	+4.016	+28.41	+0.935	−0.356	−0.07

En utilisant les données des réductions des occultations observées en 1970 et celles qui précèdent, après avoir corrigé les valeurs de $\Delta\sigma$ pour les effets de l'irrégularité du disque lunaire, nous avons entrepris la détermination des écarts moyens $\Delta(\Delta T)$ par rapport aux valeurs provisoirement adoptées de ΔT, à savoir: $+40^s.0$ pour 1970, resp. la valeur citée plus hant.

Les résultats ci-après sont obtenus sur la base de la relation bien connue, traitée par la méthode des moindres carrés:

$$\Delta L.\cos(\chi-\rho)-\Delta B.\sin(\chi-\rho)=\Delta\sigma,$$

et nous ne présentons ici que les équations normales et leurs solutions, séparément pour 1970 et 1971 (époques moyennes):

$$1970:\quad 9.037.\,\Delta L - 1.002.\,\Delta B = +0.405$$
$$-6.965.\,\Delta B = +5.550$$

$$\Delta L = -0''.04 \pm 0''.22,$$
$$\Delta B = -0\,.80 \pm 0\,.25,$$

$$1971:\quad 16.769.\,\Delta L - 0.478.\,\Delta B = -7.947,$$
$$-8.233.\,\Delta B = -1.698,$$

$$\Delta L = -0''.47 \pm 0''.24,$$
$$\Delta B = +0\,.21 \pm 0\,.36.$$

Or,

$$\Delta(\Delta T) = -0^s.08 \pm 0^s.40,\text{ en 1970},$$

et

$$\Delta(\Delta T) = -0^s.85 \pm 0^s.44,\text{ en 1971},$$

ce qui donne pour ΔT les valeurs suivantes:

$$\Delta T = +39^s.92 \quad (1970),$$
$$\Delta T = +40^s.15 \quad (1971).$$

Les erreurs moyennes quadratiques assez fortes proviennent sans doute d'un nombre restreint des observations utilisées et du fait qu'on leur a donné un poids égal. Il faut noter cependant, que les valeurs précédentes sont dans les limites de ΔT éxtrapolés fournis par des grandes Ephémérides.

THE ORBITS OF FOUR VISUAL DOUBLE STARS

(ADS 1359, 2377, 9126 and 16873)

G. M. POPOVIĆ

<u>*β870 = ADS 1359 = IDS 01377N5702*</u>

α, δ (1950): $1^h\,41^m.0$ $+57°17'$
IDS: mag. 6.4 — 7.8, Sp = A2

From S. W. Burnham's first measurements in 1880 to the latest ones, which the author had at his disposal, from 1967, the position angle has decreased by 54° in 87 years. Such a small angle permitted only a *preliminary orbit.* From the curves $\theta = \theta$ (t) and $\rho = \rho$ (t) it was possible to conclude that the measurements would be well represented by the elements of a *circular orbit,* without an inclination on the tangent plane (i=180°).

So far the orbit elements of this double star have not been calculated. In the ADS catalogue we find two values for dynamical parallax: 0″.026 (J. — F.) and 0″.017 (R. — M.), as Battermann's value for proper motion: 0″.034 in direction of 126°.4. G. Van Biesbroeck gives for dynamical parallax value of 0″.013 (Publ. Yerkes Obs. *8,* P. VI.).

For this double star the following orbit and astrophysical elements have been obtained:

P = 573.52 years	
n = 0°.6277	
a = 1″.07	dp = 0″.010
e = 0.00	M_A = + 1.4
i = 180°.00	M_B = + 2.8
ω = 0°.00	$\mathfrak{M}_A$ = 2.1
Ω = 0°.00	$\mathfrak{M}_B$ = 1.5
T = $T_{\theta=0}$ = 1985.76	a = 107.0 AU

The mean values of group observations and the corresponding values O — C with the following table are given:

t	θ_t	ρ	*n*	Observer	Source	O — C	
1880.81	68°.9	1″.02	3	β	BDS	+3°.0	−0″.05
1890.21	59.6	0.94	6	Sp 3, β 3	BDS	−0.4	− .13
1900.84	52.9	1.16	9	β 1, A 2, Doo 6	BDS, ADS	−0.4	+ .08
1908.49	48.9	1.20	5	Lau 1, Dob 3, Sto 1	ADS	+0.4	+ .13
1914.36	43.7	1.14	5	Fox 3, GrO 1, Gui 1	ADS	−1.1	+ .07
1920.62	40.0	1.13	8	Sto 1, Chan 4, GrO 3	ADS	−0.9	+ .06
1923.63	38.3	1.01	11	VBs 3, B 5, GrO 3	ADS	−0.7	− .06
1934.12	31.9	1.07	4	Bz	J.O. *18,* 71	−0.5	.00
1944.34	27.0	1.02	2	VBs	Pub. Yerkes 0. *8,* P. VI	+1.0	− .05
1949.75	23.6	1.14	11	Markowitz 3, R 8	Pub. Naval 0. *17,* P. V Veröff. Stw. München *6*	+1.0	+ .07
1954.15	18.9	1.09	9	R 7, Domm 1	Veröff. Stw. München *6* Ann. O. R. Belg. *8,* F. 2	−0.9	+ .02
1958.37	16.2	1.07	19	R 6, Hz 10, Wolley 3	Veröff. Stw. München *6,* *5,* No 11, 13; Bull. R. O. No 38,212	−1.0	.00
1964.18	13.5	0.98	9	p 1, Djk 3, Walker Jr. 1, Hz 4	Veröff. Stw. Babel. *14,* 4 Bull. 0. A. Bgd. *26,* 71, Pub. Naval 0.*18,* P. VI, J. O. 50, 344.	0.0	− .09
1967.666	14.4	0.93	5	DZ 3, Djk 1, GP 1	Bull. O. A. Bgd. *27,* 3	+3.0	−0.14

For calculations of the masses the empirical relation $\mathfrak{M}$, M for the *main sequence* of HR diagram is used [1]. Obtained value for the absolute luminosity M_A =+ 1.4 which for the main sequence require spectrum A2 shows that the selection of empirical relation $\mathfrak{M}$, M has been correctly done.

At Fig. 1 the time changes of θ and ρ according to the given table are shown.

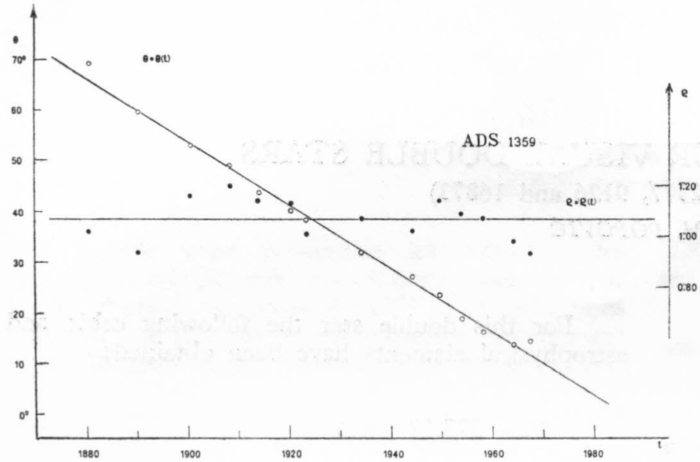


Fig. 1

Ephemeris

1972.0	8°.6	1″.07	1979.0	4°.2	1″.07
1973.0	8 .0	1 .07	1980.0	3 .6	1 .07
1974.0	7 .4	1 .07	1981.0	3 .0	1 .07
1975.0	6 .8	1 .07	1982.0	2 .4	1 .07
1976.0	6 .1	1 .07	1983.0	1 .7	1 .07
1977.0	5 .5	1 .07	1984.0	1 .1	1 .07
1978.0	4 .9	1 .07	1985.0	0 .5	1 .07

For ephemeris calculations we have, from a system of elements, a suitable system of equations:

$$\theta = 0°.6277\ (1985.76 - t)$$
$$\rho = 1''.07.$$

The orbit elements are published in: C.I. № 56, Commission des etoiles doubles, U.A.I., Mars 1972.

OΣ 50 = ADS 2377 AB = IDS 03027N7110

α, δ (1950): $3^h07^m.6$ +71°22′
IDS: mag. 8.5 — 8.5, Sp = F8.

The primary elements of this double star were calculated by A. V. Bespalov in 1961 [2]. Catalogue [3] registers this pair giving the constants A, B, F and G, too. The last measurements carried out in Belgrade in 1971 have showed particularly large degressions with the ephemeris which was the reason for carring out a new orbit. In the new system of elements the period is almost shortened by half.

Both of the orbits of this double star are:

1972, G. M. Popović
C. I. UAI, № 56

P = 344.89 years
n = 1°.04380 A = + 1″.035
a = 1″.102 B = + 0.079
e = 0.26 F = − 0″.240
i = 125°.18 G = − 0.694
ω = 24°.21 C = ± 0.369
Ω = 18°.88 H = ± 0.822
T = 2117.31

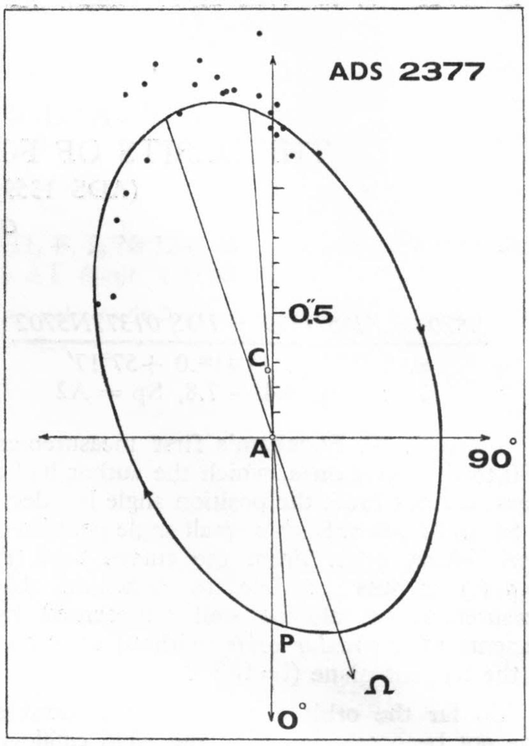


Fig. 2

1961. A. V. Bespalov
Trudy, GAIŠ, T. 30, 99.

P = 626 ±34 years
n = 0°.5751 A = −1″.5587
a = 2″.618* B = +0.2416
e = 0.52 F = +2.0653
i = 103° G = +0.6691
ω = 235° C = ∓2.0895
Ω = 9° H = ∓1.4632
T = 1947

*Originally it is stated as 1″.618

The author's orbit was calculated by the Thiele-Innes-Van den Bos method [4]. In the following table the mean values of group measurements and the corresponding values O−C are given.

I would like to express sincere gratitude to Prof. Dr. P. Muller for completing the list of observations for this pair.

The orbit elements are published in: C. I. № 56, Commission des etoiles doubles, U. A. I., Mars 1972.

t	θ_t	ρ	n	Observer	O−C	
1847.22	232°.5	0″.88	2	OΣ	+1°.1	−0″.01
1850.22	228.2	0.85	2	OΣ	−0.6	− .07
1870.16	215.8	1.07	6	Δ 5,0Σ 1	+0.3	− .06
1886.73	211.1	1.14	9	T 4, Nis 5	+3.7	− .12
1893.06	204.7	1.22	5	Jones 2, Maw 3	0.0	− .07
1898.58	203.4	1.50	3	Hu	+1.0	+ .18
1902.81	200.2	1.51	10	Doo 3, Maw 2, Pos 2, Dob 3	−0.5	+ .18
1909.50	197.6	1.57	16	Prz 1, Dob 3, Has 4, Fox 3, Schil 3, Sto 3	−0.5	+ .22
1914.76	196.2	1.35	9	Dob 6, R 1, VBs 2	+0.1	− .01
1923.54	192.7	1.45	10	Dob 6, B 4	0.0	+ .09
1928.49	190.7	1.54	10	GΣ 4, Kom (6)	−0.1	+ .19
1931.60	187.8	1.40	16	Kom (6), Dob 3, Sim (3), Dob 4	−1.6	+ .05
1934.81	188.2	1.39	3	Bz	−0.2	+ .05
1937.29	188.9	1.46	8	Vat. Obs. 4, R 2, M 1, Woolley 1	+1.5	+ .13
1939.56	186.7	1.40	20	R 17,Fox 2, Sémirot 1	+0.2	+ .07
1947.17	182.25	1.625	2	Mündler	−1.2	+ .32
1950.75	182.4	1.37	17	Fokker 2, Wieth-Knudsen 4, R 11	+1.5	+ .09
1953.95	180.4	1.30	17	R 11, M 2. Wor 4	−0.1	+ .04
1955.68	180.3	1.24	16	R 10, Djk 3, Wor 3	+0.6	− .02
1957.76	179.4	1.21	18	R 9. B 4, Berlin Obs. 5	+0.6	− .03
1959.85	179.3	1.33	9	Wor 3, hz 6	+1.5	+ .10
1962.65	178.6	1.23	22	Bz 3, hz 4, VBs 3, Wor 8, B4	+2.1	+ .02
1965.30	176.2	1.13	7	Walker Jr. 7	+1.0	− .07
1971.904	172.2	1.15	3	GP 2. DZ 1	+0.4	0.00

The measurements in the above table are taken from the following publications:

ADS Catalogue,
BDS Catalogue,
Veröff. Stw. Babelsberg, *14*, H. 1
J. O.: *18*, 89; *38*, 222; *47*, 6; *46*, 4
Veröff. Stw. München B. 6,
Lick O. Bull.: № 541, № 564, № 584,
Bull. O. A. Beograd: *20* p. 5 = № 94; № 125,
Pub. Yerkes Observ. *9*, P. I,
A. N.: *285*, 249; *254*, 42; *243*, 122,
Kitt Peak N. O. Contribution № 180,
Pub. U. S. Naval Observ.: *18*, P. 4; *18*, P. 6,
A. J. № 1313, 589,
P. Muller, private communication.

In the catalogue ADS for Russell's and Moor's dynamical parallax of this system, we find: dp= =0″.022. G. Van Biesbroeck gives the value of 0″.016 for it (Kitt Peak Contribution № 180). A. V. Bespalov based on his own orbit finds two parallaxes: hypothetical = 0″.021 and dynamical dp=0″.016. At A. V. Bespalov we find also the values for absolute luminosity $M_A=M_B=+3.5$ and masses of components $\mathfrak{M}_A=\mathfrak{M}_B=1.3$.

Based on the new orbit the following astrophysical values are obtained:

Absolute luminosity of components:	$M_A=M_B=4.9$
The orbit parallax of system:	dp =0″.019
Masses of components:	$\mathfrak{M}_A=\mathfrak{M}_B=0.82$
Major axis in AU:	a =58.0
Time of nodes passage:	t_Ω =2104.0,
	$t_\mho$ =2252.4.

For calculations of these data the following value for apparent magnitude has been used: $m_A=m_B=8.5$. The masses are calculated from empirical relation $\mathfrak{M}$, M for the sequence *below the main sequence* of HR diagram [1]. The relation for main sequence requires a later spectrum than spectrum F8.

Ephemeris

1972.0	171°.8	1″.15	1979.0	167°.8	1″.09
1973.0	171 .2	1 .14	1980.0	167 .2	1 .08
1974.0	170 .6	1 .13	1981.0	166 .6	1 .08
1975.0	170 .1	1 .12	1982.0	166 .0	1 .07
1976.0	169 .5	1 .11	1983.0	165 .4	1 .06
1977.0	168 .9	1 .10	1984.0	164 .8	1 .05
1978.0	168 .3	1 .10	1985.0	164 .1	1 .04

Hu 742 = ADS 9126 = IDS 14044N3369

α, δ (1950): $14^h\ 06^m.6 + 33°\ 55'$

IDS: mag. 8.8 — 12.3, Sp. = —

So far orbit elements have not been calculated for the double star Hu 742. From 1904 to 1969 the system has covered an arc of 56°, passing in this period the phase of apastron. Therefore, only a *preliminary orbit* has been calculated for this system also. For the areal constant $C=\rho^2\, d\theta/dt$, after a few approximations of curves $\theta=\theta\,(t)$ and $\rho=\rho\,(t)$, the value −0.0032 was obtained.

In Catalogue ADS, we find the value of G. Van Biesbroeck for dynamical parallax: dp=0″.013. In the „Pub. Yerkes Observ. *9*. P. II, p. 65" from 1959 G. Van Biesbroeck states for this pair: „Physical conection is confirmed by the centennial proper motion of $-1^s.13$ and $+1''.0$ (2 nd Greenwich Catalogue of 1925)".

With the Thiele-Innes-Van den Bos [4] method the following system of elements is obtained:

P = 305.56 years	
n = 1°.17816	
a = 0″.564	A = − 0″.3810
e = 0.066	B = + 0.4165
i = 119°92	F = + 0.2105
ω = 0°.55	G = + 0.1870
Ω = 132°.73	C = ± 0.0047
T = 1950.43	H = ± 0.4888

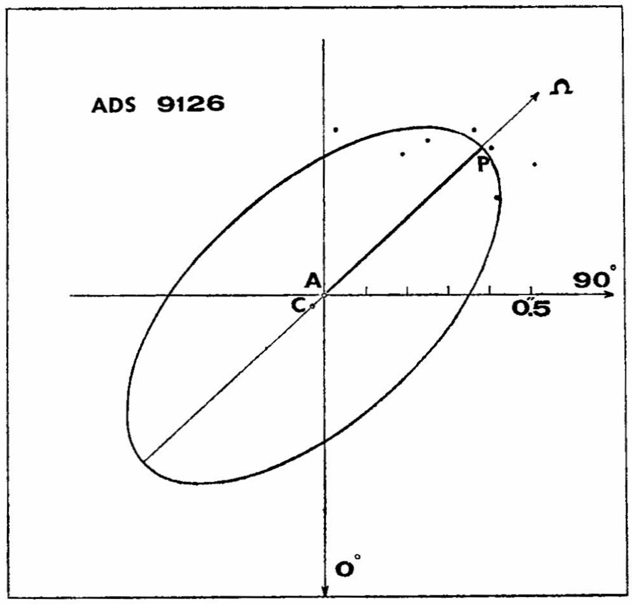


Fig. 3

The value of apparent magnitude of components m_A and m_B of this system differs from author to author. As this value is necessary for the determination of the astrophysical constants of the system, the mean value, which is obtained from the estimations of different observers, is adopted. In the given table the values of such apparent magnitudes are noted.

The table of measurements and O−C

t	θ_t	ρ	*n*	Observer	Source	O−C	
1904.51	175°.6	0″.40	3	Hu	BDS	+1°.6	+0″.04
1922.55	150.7	0.39	3	VBs	ADS	−2.6	− .06
1929.12	146.0	0.45	5	VBs	Pub. Yerkes 0. *8*, P. II	−1.7	− .03
1944.97	137.5	0.54	3	VBs	Pub. Yerkes 0. *8*, P. VI	+1.3	+ .02
1955.02	131.2	0.54	13	Bz 4, VBs 6, C 3	J.O. *40*,180 Pub. Yerkes 0.*9*, P. II J. O. *39*, 144	+1.9	+ .02
1962.44	121.3	0.60	4	Bz	J. O. *47*, 16	−2.8	+ .09
1969.17	119.2	0.48	3	Morel	A. A. Supp. *3*, 75	+0.1	−0.01

The spectrum of the system until nowadays is unknown. Therefore for calculation of the mass of the system the empirical relation $\mathfrak{M}$, M for *main sequence* of HR diagram is used [1]. Considering the hypothesis that the system belongs to the main sequence of HR diagram, from the obtained values M_A and M_B results that for the system should be expected: for component A spectrum F2 and for component B spectrum G5. On the basis of obtained orbit the following astrophysical values are calculated:

t	m	Obs.
1904.51	8.5−12.0	Hu 3
1944.97	8.9−10.4	VBs 3
1954.48	8.5−10.6	Bz 4
1955.36	8.5− 9.5	C 3
1962.44	8.6−10.0	Bz 4
1969.17	8.2− 9.4	Morel 3
	8.5−10.3	20 n

absolute luminosity of the components:	$M_A = +3.3$, $M_B = +5.1$
the orbit parallax of the system:	dp = 0″.009
masses of the components:	$\mathfrak{M}_A = 1.4$, $\mathfrak{M}_B = 1.0$
major axis in AU:	a = 62.7
time of node passage:	tΩ = 1950.10, t℧ = 2102.66.

Ephemeris

1972.0	116°.8	0″.48	1979.0	110°.7	0″.45
1973.0	116 .0	0 .47	1980.0	109 .8	0 .44
1974.0	115 .3	0 .47	1981.0	108 .8	0 .44
1975.0	114 .3	0 .47	1982.0	107 .8	0 .44
1976.0	113 .4	0 .46	1983.0	106 .8	0 .43
1977.0	112 .6	0 .46	1984.0	105 .8	0 .42
1978.0	111 .6	0 .45	1985.0	104 .7	0 .41

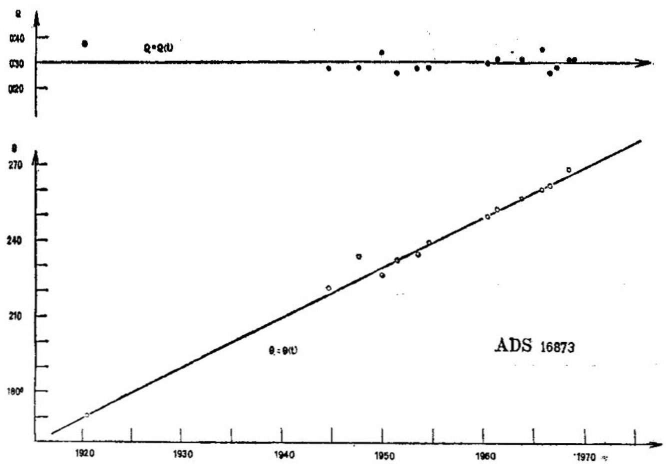
The orbit elements of this double star will be published in C. I. № 57, Commission des etoiles doubles, UAI, Juillet 1972.

Fox 102 = ADS 16873 AB = IDS 23323N0704

α, δ (1950): $23^h\,34^m.8 + 7°\,21'$
IDS: mag. 9.3—9.3, Sp. = F5.

Double pair Fox 102 AB did not have the orbit elements determined. This is P. Fox's first pair (from 235 of his pairs, according to IDS) to which it came up to calculate the orbit elements. During the period 1920—1969, an arc of 95° was formed, while ρ remained constant. As the time changes of θ in this period also remained constant, it was possible to work out the circular orbit without an inclination to the tangent plane.

Fig. 4



G. Van Biesbroeck in 1960 states for dynamical parallax for this system the following value: dp = =0″.011 (Pub. Yerkes 0. *8*, P. VI).

The following orbit and astrophysical elements are obtained:

$$P = 182.56 \text{ years}$$
$$n = 1°.9720$$
$$a = 0''.30$$
$$e = 0.00$$
$$i = 0°.00$$
$$\omega = 0°.00$$
$$\Omega = 0°.00$$
$$T = T_{\theta=0} = 1833.86$$

$$dp = 0''.006$$
$$M_A = M_B = +\,3.3$$
$$\mathfrak{W}_A = \mathfrak{W}_B = \quad 1.5$$
$$a = 50 \text{ AU}$$

The table of measurements and O—C

t	θ_t	ρ	n	Observer	Source	O—C	
1920.42	170°.7	0″.38	3	Fox	ADS	0°.0	+0.08″
1944.50	221.0	0.28	3	Bz	J. O. *31*, 160	+2.8	— .02
1947.699	233.7	0.276	3	M. Camichel	J. O. *32*, 96	+9.2	— .02
1950.00	226.1	0.34	3	VBs	Pub. Yerk. O. *8*, P. VI	−2.9	+ .04
1951.45	231.9	0.26	5	Bz 3, VBs 2	J. O. *37*, 111, Pub. Yerk. 0. *9*, P. II	0.0	—. 04
1953.62	234.5	0.28	3	Mlr 3	Lick. O. Bull. N. 530	−1.7	— .02
1954.82	238.6	0.28	6	Mlr 3, VBs 3	J. O. *38*. 250, Pub. Yerk. O. *9*, P. II	+0.1	— .02
1960.55	249.5	0.30	3	C	J. O. *45*, 54	−0.3	.00
1961.653	252.2	0.31	11	Wor 4, C 3, B4	P. Naval O. *18*, P. VI J. O. *45*, 241 Lick O. Bull. N. 572	+0.2	+ .01
1963.88	256.4	0.31	2	C	J. O. *47*, 246	0.0	+ .01
1965.784	260.0	0.35	4	Walker Jr. 2, Mlr 2	P. Naval O. *22*, P. I A. A. Suppl. *1*, 407	−0.2	+ .05
1966.841	261.5	0.26	5	Walker Jr.	P. Naval O. *22*, P. I	−0.7	— .04
1967.422	243.4	0.28	5	GP	Bull. O. A. Bgd. *27*, 21	−20.0	— .02
1968.58	268.0	0.31	6	Morel 5, GP 1	A. A. Supp. *3*, 81, Bull. O. A. Bgd. *27*, 21	+2.3	+ .01
1968.98	253.0	0.31	4	Hz	A. A. Supp. *1*, 398	−13.4	+0.01

An attemt to derive the masses of this system from the empirical relation $\mathfrak{M}$, M for main sequence of HR diagram did not succeed. The spectrum F5 was not in agreement with the spectrum which would result in the case of adoption of the main sequence. Therefore the empirical relation $\mathfrak{M}$, M which is more acceptable for stars above the main sequence [1] and which gave a better agreement of spectra, has been chosen.

The time shanges of θ and ρ are given in Fig. 4. Also in this case from the elements the following system of equations for calculations of ephemeris is resulting:

$$\theta = 1^\circ.9720\,(t - 1833.86),$$

$$\rho = 0''.30.$$

Ephemeris

1972.0	272°.4	0″.30	1979.0	286°.2	0″.30
1973.0	274 .4	0 .30	1980.0	288 .2	0 .30
1974.0	276 .4	0 .30	1981.0	290 .2	0 .30
1975.0	278 .3	0 .30	1982.0	292 .1	0 .30
1976.0	280 .3	0 .30	1983.0	294 .1	0 .30
1977.0	282 .3	0 .30	1984.0	296 .1	0 .30
1978.0	284 .2	0 .30	1985.0	298 .0	0 .30

The orbit elements are published in: C. I. № 56, Commission des etoiles doubles, U. A. I., Mars 1972.

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ORBITE DU SYSTÈME ADS 2531 = A 829

par D. M. OLEVIĆ

Les données générales se rapportant au système sont les suivantes:

α: $03^h\,20^m.7$, δ = +12°08′ 1900.0

Magn.: 8.3—9.8, Classe sp.: GO

En utilisant la méthode de Thiele-Innes-Van den Boss, on a obtenu un prémier système des éléments de cette binaire, à savoir:

P = $249^a.67$	A = + 0″.0650	M_A = 2.6
T = 1731.61	B = − 0.3200	M_B = 4.1
n = 1°.4419	F = − 0.3950	$\mathfrak{M}_A$ = 1.77
a = 0.403	G = − 0.0800	$\mathfrak{M}_B$ = 1.26
e = 0.14	C = ± 0.23610	π (dyn) = 0″0070
i = 144°.13	H = ± 0″.00000	
Ω = 11°.4	a = 57.57 U. A.	
ω = 89°.9	$t_{\Omega, \mho}$, = 1930.03, 1783.08	

ÉPHÉMÉRIDES

t	θ	ρ
1972.0	303°.2	0″.289
1974.0	298 .4	0 .287
1976.0	294 .0	0 .285
1978.0	289 .2	0 .283
1980.0	284°.6	0″.281

Faute des données plus récentes le calcul a été fait d'après les positions disponibles suivantes:

t	θ 2000	ρ	*n*	Références	O−C	
1904.85	40°.1	0″.33	2 A	ADS	−0°.2	−0″.07
1914.75	29.2	0.44	2 A	ADS	+0.2	+0.03
1922.05	18.0	0.42	2 A	ADS	−2.8	+0.02
1934.82	7.3	0.40	6 A2, V4	(P. Muller)	+1.8	+0.02
1942.64	348.1	0.41	3 Vou	J. O. N°6, v. 38	−7.1	+0.05
1949.98	348.1	0.35	4 VBS	Publ. Y. O. v. VIII, part VI	+3.6	0.00
1959.07	322.4	0.35	3 COU	J. O. 42,2	+3.0	+0.03
1962.92	322°.4	0″.31	7 B4,COU3	Bull. Lick. N°579, (P. Muller)	+0.2	0.00

MESURES MICROMÉTRIQUES DES ÉTOILES DOUBLES FAITES EN 1971 À L'OBSERVATOIRE DE BELGRADE
(série 21)

par G. M. POPOVIĆ, D. J. ZULEVIĆ et D. M. OLEVIĆ

Les mesures de cette série font une suite continue des mesures publiés dans la série 20 (Bull. OAB, № 124, p. 81). La série comprend 228 pairs avec 406 mesures, faites comme précedement au refracteur Zeiss 65/1055 cm, et s'étend jusqu' à l'époque 1971.955 inclusivement. Cette époque tombe justement au vingtième anniversaire des mesures des étoiles doubles à l'Observatoire de Belgrade. 21 séries de mesures des systèmes doubles du programme standard adopté, et 3 séries du programme de nouvelles étoiles doubles (Supp. I, II, III, Bull. OAB, № 121, 124, 125) ont été publiées au cours de ces vingt ans. Toutes ces mesures seront réunues et publiées sous forme d'un catalogue, dans un des volumes prochains des „Publications OA Belgrade". La préparation de ce catalogue est au cours.

M. P. M. Đurković s'étant retiré du service au mois d'août 1971, les mesures qu'il a faites en qualité d'un observateur actif, sont inclues dans cette série. Le nombre total indiqué de mesures est réparti cette fois entre les observateurs comme suit:

P. M. Đurković	(Dj)	12
G. M. Popović	(GP)	104
D. J. Zulević	(DZ)	131
D. M. Olević	(OLE)	159
Nombre total:		406

ADS 1	IDS 2	Nom. 3	Comp 4	1900+ 5	θ 6	ρ 7	*m* 8	*n* 9	Obs. 10	Orbite et remarques 11
61	00010N5753	STF 3062		71.343	268°0	1″21	6.9−8.0	2	DZ	Baize, 58: + 0°.8, − 0″.19
–	00143N3511	GP 35		71.676	303.2	0.71	Δ*m*=1.5	1	GP	GP 35 = BD + 34°.33 (9ᵐ.4)
285	00157N3226	AC 1		70.868	287.3	1.64	7.6−8.4	1	OLE	
				71.662	286.0	1.49	7.5−8.0	1	DZ	Le mouvement direct très lent.
–	00267N3504	GP 38		71.739	91.2	2.28	9.0−13.0	1	GP	GP 38=BD+34°.72 (9ᵐ.2)
638	00408N4253	BU 866	AB	71.846	76.6	1.61	8.5−8.7	1	GP	En 91 ans l'angle θ a augmenté de 8°.
660	00426N2232	J 636		71.846	259.9	1.67	9.0−10.5	1	GP	Sans changement depuis 1911.
755	00496N2305	STF 73	AB	70.868	222.7	0.69	6.2−6.8	1	OLE	Muller, 56: − 2°.6, +0″.09.
768	00500N3007	BU 500		71.753	298.8	0.60	Δ*m*=0.1	1	GP	En 93 ans l'angle θ a augmenté de 10°.
				71.753	296.4	0.55	–	1	OLE	
805	00530N2052	BU 302		71.769	148.6	0.53	Δ*m*=1.2	1	OLE	
873	00584N3456	HO 213		70.901	266.7	0.43	Δ*m*=0.0	1	OLE	
883	00594N3617	A 1515		71.772	238.	0.2	Δ*m*=0.0	1	GP	En 64 ans l'angle θ a angmenté de 121°.
955	01042N2316	BU 303		71.737	290.2	0.64	Δ*m*=0.3	1	OLE	
999	01084N6025	BU 1100		71.810	33.2	0.48	7.4−7.4	1	DZ	Muller, 55: −0°.8, +0″.02.
–	01190N3439	J 2387		70.972	308.2	3.03	12.0−13.5	1	GP	Le mouvement direct en θ.
1105	01170N5737	STF 115	AB	71.810	321.2	0.68	7.3−7.5	1	OLE	
1254	01308N0708	STF 138	AB	71.737	233.0	1.52	–	1	OLE	
1264	01301N7613	HU 1030		71.769	323.1	0.58	Δ*m*=0.0	1	OLE	
1305	01342N3828	STF 141		71.778	302.2	1.54	8.0−8.5	1	OLE	
1320	01341N7402	BU 783		71.846	317.4	0.87	Δ*m*=0.3	1	GP	Sans changement depuis 1881.
1369	01390N0859	STF 155		70.868	325.7	4.86	7.6−7.6	1	OLE	
				70.868	326.7	4.79	7.6−7.6	1	DZ	Le mouvement retrograde très lent.
1538	01507N0121	STF 186		71.775	52.2	1.23	7.0−7.0	1	DZ	Cid, 52: +1°.0, −0″.10.
1562	01521N3241	A 1920		71.827	228.3	1.25	8.5−8.8	1	DZ	Le mouvement direct lent.
1579	01537N2421	STF 194		71.863	273.7	1.27	8.0−8.4	2	GP	En 140 ans l'angle θ a augmenté de 10°.
				71.933	275.9	1.14	Δ*m*=0.5	1	DZ	
1645	02001S0087	BU 516		71.778	306.6	0.74	8.0−8.0	1	OLE	
1709	02076N4701	STF 228		71.810	258.9	0.98	6.4−7.3	1	OLE	Heintz, 54: +0°.1, +0″.01.
1738	02102N5527	STF 235		71.816	46.2	1.75	Δ*m*=0.5	1	GP	Sans changement depuis 1866.
1746	02107N5518	BU 786		71.816	351.3	4.62	8.0−9.5	1	GP	Sans changement en θ.
1780	02143N2921	A 961		71.769	312.8	0.50	Δ*m*=0.0	1	OLE	Heintz, 69: −0°.2, +0″.06
1862	02219N4042	A 659		71.778	268.9	0.70	–	1	OLE	
2004	02327N3259	STF 285		70.901	164.8	1.38	7.8−8.8	1	OLE	
				71.351	166.2	1.66	7.0−7.7	3	DZ	Le mouvement retrograde très lent.

ADS 1	IDS 2	Nom 3	Comp. 4	1900+ 5	θ 6	ρ 7	m 8	n 9	Obs. 10	Orbiue et remarques 11
2012	02338S0161	HO 315		71.737	358°7	1″45	$\Delta m=0.2$	1	OLE	
2052	02358N4216	STT 44	AB	71.810	56.0	1.31	7.8−8.5	1	OLE	
2257	02535N2056	STF 333	AB	71.854	206.1	1.45	5.7−6.0	1	OLE	
2261	02541N0615	STF 334		71.883	311.8	1.21	7.9−8.4	2	GP	En 141 ans les θ et ρ ont diminué de
				71.933	309.9	1.15	$\Delta m=0.3$	1	DZ	11° et 0″.4.
2353	03012N2029	AG 61		70.901	25.4	0.77	8.8−9.5	1	DZ	Sans changement depuis 1901.
				70.901	26.9	0.84	$\Delta m=0.2$	1	OLE	
2366	03034S0358	BU 528	AB	71.769	189.8	0.52	8.5−8.5	1	OLE	
2377	03027N7110	STT 50	AB	71.890	172.1	1.16	7.8−7.9	2	GP	Bespalov, 61: +120°.4, +0″.70
				71.933	172.4	1.13	7.5−7.5	1	DZ	: +120 .6, +0 .67
2416	03089N0022	STF 367		71.737	147.9	0.96	$\Delta m=0.0$	1	OLE	Heintz, 63: −0°.1, −0″.01.
2422	03087N3521	HO 502		71.810	18.1	0.82	8.5−9.0	1	OLE	
2442	03113S0048	A 1285		71.882	289.1	1.71	10.7−11.2	2	GP	
				71.933	289.8	1.89	—	1	DZ	Sans changement depuis 1906.
2554	03226N2843	STF 395		71.897	93.2	1.66	8.5−10.2	2	GP	En 139 ans θ diminué de 13°.
				71.933	94.0	1.65	8.5−9.5	1	DZ	
2616	03285N2408	STF 412	AB	71.775	10.9	0.57	6.6−6.7	1	DZ	Luyten, 34: +0°.3, −0″.02
2625	03291N3321	STF 413		71.737	126.8	2.44	—	1	OLE	
2628	03294N3121	BU 533		71.737	225.2	0.93	—	1	OLE	
2679	03345N2827	STF 427		71.778	208.9	6.76	$\Delta m=0.9$	1	OLE	
2801	03444N2222	STF 457	AB	71.778	93.7	0.93	$\Delta m=0.0$	1	OLE	
2911	03536N0930	HU 27		71.737	277.3	0.48	—	1	OLE	
2980	03595N4309	A 1710		71.775	347.5	0.38	8.3−8.3	1	DZ	Heintz, 69: +11°.8, +0″.03
3002	04012N5000	HU 211		71.902	271.7	1.49	8.2−9.3	2	GP	Sans changement depuis 1900.
				71.933	269.5	1.31	8.6−10.3	1	DZ	
3026	04036N1030	HU 301		71.789	280.3	0.74	8.5−9.6	2	OLE	
3038	04046N4136	BU 546		71.114	40.7	0.87	9.0−9.0	1	DZ	En 93 ans θ augmenté de 16°.
3082	04096N3127	STT 77	AB	71.775	265.3	0.62	8.2−8.2	1	DZ	Muller, 57: −0°.8, −0″.17
3297	04278N1748	STF 559		71.769	276.3	2.88	$\Delta m=0.0$	1	OLE	
3398	04370N2026	HO 332		71.778	304.0	1.50	9.0−9.0	1	OLE	
3600	04553N1422	D 6		71.769	95.5	0.98	$\Delta m=0.0$	1	OLE	
3689	04597N5451	STF 635		71.810	301.2	1.01	8.3−8.3	1	OLE	
3711	05024N0822	STT 98		71.769	47.2	0.73	$\Delta m=0.8$	1	OLE	Baize, 69: +2°.7, −0″.02
—	05136N3555	GP 70		71.934	8.2	1.12	—	1	DZ	GP 70=BD+35°.1056 ($9^m.5$).
—	05148N3509	GP 69		71.934	307.8	3.90	$\Delta m=0.2$	1	DZ	Precéde BD+35°.1071 ($9^m.0$) de 5^s, 3′ au Sud.
3981	05179N2452	STF 694	AB	71.114	13.2	1.10	8.2−8.2	1	DZ	En 142 ans θ augmenté de 8°.
4001	05186N3428	BU 191	AB	71.587	24.4	3.01	9.8−10.1	2	GP	Sans changement depuis 1875.
				71.934	25.4	3.04	$\Delta m=0.1$	1	DZ	
		BU 191	AC	71.934	147.4	—	9.8−13.5	1/0	GP	
4060	05222N3741	BU 890		71.778	285.9	1.26	$\Delta m=0.0$	1	OLE	
4208	05309N2652	STF 749	AB	71.115	329.2	1.10	7.1−7.2	1	DZ	En 142 ans θ diminué de 53°.
4222	05325S0129	BU 89		71.810	12.3	0.83	7.9−8.5	1	OLE	
—	05583N3504	GP 14		71.063	118.8	3.60	$\Delta m=0.2$	1	GP	
				71.063	118.0	3.73	$\Delta m=0.1$	1	DZ	
4779	06049N3042	STF 861	BC	71.934	315.3	1.67	$\Delta m=0.0$	1	GP	Sans changement.
				71.934	315.9	1.56	9.3−9.3	1	DZ	
4823	06079N1016	HO 22		71.778	207.1	0.93	$\Delta m=0.4$	1	OLE	
5016	06178N4236	A 2356		71.810	82.0	0.90	8.8−8.8	1	OLE	
5221	06294N3805	BU 194		71.120	277.6	1.09	—	1	OLE	
5704	06549N5411	A 1575		71.810	282.9	0.68	7.5−8.5	1	OLE	
5958	07122N0929	STT 170		71.934	88.1	1.24	$\Delta m=0.0$	1	GP	En 127 ans θ diminué de 45°.
				71.934	91.9	1.00	7.6−7.9	1	DZ	
6038	07182N2139	STF 1081	AB	71.934	230.8	1.51	—	1	DZ	
				71.934	233.9	1.79	$\Delta m=0.7$	1	GP	En 143 ans θ augmenté de 18°.
6538	07572N2633	STT 186		71.197	76.4	0.99	7.5−8.2	1	DZ	Sans changement depuis 1847.
6668	08082N1556	PHS		71.120	340.1	1.42	$\Delta m=1.2$	1	OLE	
6846	08248N3452	HU 627		71.115	262.3	0.78	$\Delta m=0.3$	1	GP	Changements lents en θ.

ADS 1	IDS 2	Nom. 3	Comp. 4	1900+ 5	θ 6	ρ 7	m 8	n 9	Obs. 10	Orbite et remarques 11
6946	08367N3870	BU 209		71.270	6°2	1″34	8.7−9.2	1	GP	En 96 ans θ augmenté de 11°.
7366	09202N3379	ES 2221		71.287	66.2	5.22	12.0−12.2	1	GP	Le quadrant opposé par rapport au mesure de 1926.
–	09266N3504	GP 56		71.287	215.3	4.99	Δm=0.3	1	OLE	À 0^s et +1′ de BD+35°.2020 (9^m.2).
7694	10097N0013	A 2566		71.271	88.8	1.39	Δm=2.0	1	GP	Le mouvement direct lent.
7704	10108N1774	STT 215		71.364	186.2	1.07	7.0−7.2	1	DZ	Zaera, 57: +2°.7, −0″.29
7724	10145N1981	STF 1424	AB	71.369	123.1	4.43	2.0−3.5	1	Dj	Rabe, 56: +0°.9, +0″.04
7802	10246N2079	STF 1439		71.230	91.6	1.13	8.2−8.6	1	OLE	
7837	10298N0870	STF 1450		71.333	156.8	2.07	6.0−8.7	1	Dj	
7959	10474N0532	A 2773		71.271	2.3	1.20	9.0−11.5	1	GP	En 57 ans θ diminué de 26°.
8017	10554N0290	AG 173		71.230	126.3	1.65	–	1	OLE	
				71.292	126.2	1.79	9.1−9.3	2	DZ	Sans changement depuis 1902.
8119	11128N3166	STF 1523		71.331	121.7	2.75	4.0−4.9	2	DZ	Heintz, 66: −0°.5, −0″.24
8197	11267N6138	STT 235		71.353	111.6	0.58	6.0−7.3	1	DZ	Hable, 54: +6 .8, −0 .11
8225	11299N3558	HU 887		71.320	301.6	1.30	8.2−11.0	1	DZ	
8378	11547N5357	STT 243		71.265	10.4	1.06	7.8−8.8	1	OLE	
8415	12002N5680	A 1358		71.353	228.2	0.86	9.2−9.4	1	DZ	
8561	12232N4481	STF 1645		71.358	158.4	9.82	8.5−8.8	1	Dj	
8575	12255N0976	STF 1647		71.230	240.9	1.30	7.5−7.8	1	OLE	
				71.297	237.6	1.29	7.5−7.8	2	DZ	
8606	12310N1157	STF 1661		71.271	248.0	2.20	Δm=0.5	1	OLE	
				71.342	246.1	2.27	8.5−8.6	2	GP	En 143 ans θ augmenté de 20°.
8625	12358N0883	STF 1668		71.265	191.8	1.26	7.5−8.0	1	OLE	
				71.364	191.9	1.73	7.5−8.0	1	DZ	
8630	12366S0054	STF 1670	AB	71.298	301.9	4.21	Δm=0.0	1	OLE	Strand, 37: −0°.6, −0″.27
				71.309	302.7	4.39	Δm=0.0	2	DZ	: +0 .2, −0 .10
				71.380	302.2	4.26	Δm=−0.1	1	GP	: −0 .3, −0 .22
				71.395	302.2	4.33	3.3−3.7	2	Dj	: −0 .5, −0 .18, Agité.
8695	12484N2147	STF 1687	AB	71.304	156.4	0.91	6.0−8.5	1	GP	Schmeidler, 39: −3°.0, +0″.05
				71.304	152.6	0.94	–	1	OLE	: −6 .8, +0 .08
8708	12513S0025	STT 256		71.287	93.4	0.97	Δm=0.0	1	OLE	
				71.317	91.4	0.87	7.8−7.8	2	GP	En 123 ans θ augmente de 34°.
8887	13189N2945	HO 260		71.353	61.8	1.01	8.3−8.5	1	DZ	Baize, 67: −3°.0, +0″.08.
8914	13236N1574	STT 266		71.279	351.6	1.84	Δm=0.2	2	OLE	
				71.317	352.4	1.99	8.1−8.4	3	GP	En 127 ans θ augmente de 23°.
8949	13292N0012	STF 1757	AB	71.265	107.6	1.95	7.8−8.9	1	DZ	Heintz, 55: −1°.7, −0″.43
				71.284	110.6	2.09	7.8−8.9	2	OLE	: +1 .5, −0 .30
				71.349	108.0	2.39	8.1−9.2	3	GP	: −1 .4, +0 .02
				71.408	111.1	2.34	8.1−9.1	2	Dj	: +1 .9, −0 .04
8950	13290S0806	BU 114		71.271	161.3	1.35	Δm=0.0	1	GP	En 129 ans θ augmenté de 34°.
				71.271	158.0	1.32	Δm=0.0	1	OLE	
8974	13330N3648	STF 1768	AB	71.454	105.9	1.73	5.1−7.1	1	Dj	Jackson, 21: +2°.1, +0″.02, Agité.
9031	13445N2689	STF 1785		71.364	153.9	2.94	7.2−7.5	1	DZ	Strand, 55: +0 .9, −0 .33
				71.443	153.5	3.25	7.8−8.1	1	Dj	: +0 .8, −0 .01
9126	14044N3369	HU 742		71.367	115.7	0.48	8.5−10.0	1	GP	Popović, 72: −1°.6, 0″.00
				71.367	120.1	0.62	8.3−9.6	1	OLE	: +2.8, +0.14
–	14101N3440	ES 2416		71.367	15.0	1.84	11.5−11.8	1	GP	Le mouvement direct.
				71.367	10.3	1.67	Δm=0.4	1	OLE	
9182	14103N0336	STF 1819		71.301	262.1	0.86	Δm=0.1	2	OLE	Hopmann, 45: −4°.0, −0″.15
				71.342	263.9	1.02	7.9−8.0	2	DZ	: +2 .1, +0 .01
				71.368	259.4	0.90	8.1−8.4	3	GP	: −6 .6, +0 .11
9202	14124N2439	STF 1828		71.298	162.1	1.53	9.2−9.2	1	DZ	
				71.298	159.5	1.60	9.2−9.2	1	OLE	
9229	14166N4858	STF 1834		71.364	102.4	1.00	7.1−7.2	1	DZ	Van den Bos, 38: −0°.8, −0″.15.
9254	14193S1113	STF 1837		71.287	283.4	1.26	8.0−8.5	1	GP	En 142 ans θ diminué de 44°.
				71.287	282.9	1.45	Δm=1.2	1	OLE	
9324	14334N4839	A 347		71.364	295.6	0.52	8.2−8.0	1	DZ	Gü-Li, 55: 0°.0, −0″.05

ADS 1	IDS 2	Nom 3	Comp. 4	1900+ 5	θ 6	ρ 7	m 8	n 9	Obs. 10	Orbite et remarques 11
9343	14364N1369	STF 1865	AB	71.358	308°2	0″99	4.6−4.8	1	Dj	Van den Bos, 37: +0°.9, −0″.16, Agité
				71.360	307.2	1.07	4.3−4.3	2	DZ	: −0 .1, −0 .08
9380	14414N0965	STF 1879	AB	71.363	95.0	1.23	7.8−8.6	2	DZ	Wierzbinski, 56: +2°.9, −0″.22
9413	14468N1931	STF 1888	AB	71.421	339.7	7.24	4.8−6.9	1	Dj	Strand, 37: +0°.7, +0″.12.
9425	14487N1567	STT 288		71.370	177.3	1.35	6.4−7.1	1	DZ	Heintz, 55: +2°.9, −0″.05
9578	15140N2672	STF 1932		71.357	243.5	0.96	7.3−7.4	1	DZ	Heintz, 64: −1°.7, −0″.26
9626	15207N3742	STF 1938	BC	71.304	21.8	2.00	Δm=0.5	1	OLE	Baize, 51: +3°.1, −0″.10
				71.344	19.5	1.99	8.0−8.5	2	GP	: +0 .8, −0 .11
				71.390	19.4	1.96	6.7−7.3	2	DZ	: +0 .7, −0 .14
				71.454	18.5	2.07	7.1−7.8	1	Dj	: −0 .3, −0 .03
9716	15325N3968	STT 298	AB	71.361	197.4	0.83	7.5−7.6	2	DZ	Couteau, 65: 0°.0, −0″.26.
9880	15562N1333	STT 303		71.287	165.8	1.38	Δm=0.7	1	OLE	
				71.287	167.6	1.23	Δm=0.0	1	GP	En 125 ans θ augmenté de 57°.
9952	16069N1523	A 1799		71.304	130.1	0.62	Δm=0.1	1	GP	En 63 ans θ diminué de 41°.
				71.304	130.5	0.53	Δm=0.0	1	OLE	
9980	16103N0431	STF 2027		71.452	77.9	1.84	Δm=0.0	1	GP	Sans changement.
				71.452	258.6	1.66	Δm=0.1	1	OLE	
9982	16111N0737	STF 2026		71.298	26.3	—	8.6−9.1	1	DZ	Heintz, 63: +0°.4, —
				71.301	27.1	2.42	Δm=0.2	2	OLE	: +1 .2, −0 .16
				71.304	26.2	2.47	8.8−9.0	1	GP	: +0 .3, −0 .11
10052	16225N6155	STF 2054		71.469	352.4	1.08	Δm=1.2	1	OLE	
10075	16245N1837	STF 2052	AB	71.298	142.7	1.23	Δm=0.0	1	OLE	Siegrist, 52: −0°.3, +0″.05
				71.338	143.7	0.96	7.5−7.5	2	DZ	: +0 .8, −0 .22
10188	16408N4340	D 15		71.298	149.6	1.14	7.7−7.7	1	OLE	Wierzbinski, 55: +1.1, −0.12
				71.328	150.9	1.00	7.7−7.7	2	DZ	: +2.3, −0.26
10279	16559N6511	STF 2118		71.358	70.8	0.98	6.4−6.9	1	DZ	Giannuzzi, 56: +1°.3, −0″.20
10345	17033N5436	STF 2130	AB	71.358	59.1	2.12	5.6−5.6	1	DZ	Heintz, 65: +2°.7, +0″.15
				71.513	57.9	1.88	5.0−5.1	3	OLE	: +1 .7, −0 .09
				71.571	57.8	1.92	Δm=0.0	2	GP	: +1 .7, −0 .05
10460	17154N4925	STF 2153		71.452	253.0	1.68	Δm=0.4	1	GP	En 140 ans θ diminué de 29°.
				71.452	254.5	1.36	Δm=0.9	1	OLE	
10527	17204N3633	STF 2162		71.457	280.2	1.20	—	1	OLE	
10558	17231N3551	STF 2168		71.443	201.0	1.82	7.5−8.2	1	OLE	
				71.714	202.0	2.08	7.5−8.2	3	DZ	
10669	17328N1237	BU 1121		71.304	212.6	0.51	Δm=0.2	1	GP	En 82 ans θ diminué de 27°.
				71.304	219.1	0.64	Δm=0.3	1	OLE	
10690	17372N6711	STF 2207		71.472	119.2	0.99	8.5−8.5	1	OLE	
10765	17411N3110	STF 2213		71.469	329.4	4.68	Δm=0.9	1	OLE	
				71.536	330.0	4.39	Δm=0.5	1	GP	Sans changement.
10769	17413N1745	STF 2205		71.452	333.6	1.57	Δm=−0.2	1	GP	En 140 ans θ augmenté de 42°.
				71.452	332.5	1.28	Δm=0.3	1	OLE	
10874	17498N3607	STF 2243		71.530	222.3	1.28	Δm=0.1	2	OLE	Le mouvement retrograde incertain;
				71.572	42.8	1.29	Δm=0.0	2	GP	ρ décroit.
11074	18033N4021	STF 2282		71.443	86.6	2.37	7.2−8.2	1	OLE	
11141	18069N1712	HU 317		71.457	25.5	1.45	—	1	OLE	
11174	18095N4121	STF 2298	AB	71.457	175.8	1.73	Δm=1.2	1	OLE	
11186	18094N0009	STF 2294		71.472	92.7	1.04	Δm=0.1	1	OLE	Wilson JNR, 35: −1°.6, +0″.05
				71.659	97.7	0.93	8.5−8.8	1	DZ	: +3 .4, −0 .06
11334	18210N2720	STF 2315	AB	71.599	132.2	0.60	Δm=1.0	1	OLE	Heintz, 59: −0°.1, −0″.04
11432	18272N0643	STT 354		71.618	191.9	0.69	Δm=1.1	1	OLE	
11479	18314N2331	STT 359		71.715	13.0	0.59	6.4−6.6	2	DZ	Symms, 64: +1°.3, +0″.04
11483	18314N1654	STT 358	AB	71.503	165.9	1.53	Δm=0.0	1	OLE	Heintz, 54: +0°.7, −0″.15
				71.588	167.4	1.76	—	1	GP	: +2 .3, +0 .08
				71.715	167.9	1.57	6.8−7.2	2	DZ	: +2 .9, −0 .10
11558	18366N5215	STF 2368	AB	71.457	321.4	1.82	Δm=0.1	1	OLE	
11568	18385N6702	STF 2384	AB	71.594	311.9	0.65	Δm=0.5	1	OLE	Baize, 50: +3°.3, −0″.34
				71.670	309.3	0.65	8.0−8.5	3	DZ	: +0 .9, −0 .33
				71.677	309.7	0.80	8.5−8.8	2	GP	: +1 .1, −0 .19

ADS 1	IDS 2	Nom. 3	Comp. 4	1900+ 5	θ 6	ρ 7	*m* 8	*n* 9	Obs 10	Orbite et remarques 11
11635	18410N3934	STF 2382	AB	71.503	352°5	2″46	$\Delta m=1.3$	1	OLE	Gü-Li, 55: −4°.7, −0″.27
			AB	71.588	359.4	2.71	$\Delta m=1.5$	1	GP	: +2 .1, −0 .02
11635	18410N3934	STF 2383	CD	71.503	95.0	2.29	$\Delta m=0.0$	1	OLE	Gü-Li, 55: +7.6, −0.02
			CD	71.588	94.5	2.23	$\Delta m=0.1$	1	GP	: +7.1, −0.08
11811	18505N3715	BU 137	AB	71.443	154.3	1.34	8.2−8.7	1	OLE	
–	18532N3438	GP 41		70.841	352.8	4.91	$\Delta m=1.2$	1	OLE	À −10^s et −1′ de BD+34°.3366 (9^m.0)
11897	18558N5805	STF 2438		71.670	7.9	0.78	7.0−7.6	3	DZ	Jastrzebski, 59: +4°.1, −0″.08
–	19040N1915	HO 443		71.469	118.8	2.99	–	1	OLE	BDS 9071=BD+19°3924=HO 443
				71.720	117.2	2.73	9.5−9.6	3	GP	
12069	19036N1936	STF 2460		71.760	197.9	9.24	$\Delta m=0.4$	1	GP	Sans changement depuis 1829.
12088	19036N1901	HO 442		71.736	94.6	4.47	9.0−11.0	1	GP	Par rapport au ce système le couple BDS 9071, se trouve à la position $\Delta\alpha=-24^s$, $\Delta\delta=-14'$.
–	19051N3412	GP 30		71.452	316.0	2.24	–	1	OLE	Le couple est registré dans le C. I. №52 et Bull. Bgd. № 124.
				71.564	313.5	2.22	$\Delta m=0.4$	2	GP	
12447	19225N2707	STF 2525		71.663	294.5	1.54	7.4−7.6	3	DZ	Finsen 37: −1°.9, −0″.07
12469	19226S1221	SCJ 22		71.472	69.7	0.63	$\Delta m=0.4$	1	OLE	Heintz, 63: +10.3, −0.16
12667	19326N3526	STT 377	AB	71.618	36.2	0.96	–	1	OLE	
				71.698	37.6	0.96	$\Delta m=0.0$	1	GP	En 129 ans θ diminué de 14°.
12889	19418N3322	STF 2576	AB	71.461	4.1	1.70	$\Delta m=0.1$	1	OLE	Rabe, 48: −1°.8, −0″.01
				71.662	8.1	1.60	8.5−8.5	3	DZ	: +2 .4, −0 .12
–	19494N3501	GP 37		71.769	330.9	2.56	9.6−9.9	1	GP	GP 37=BD+34°.3771 (9^m.5).
13030	19472N2316	BU 978		71.815	236.5	0.80	8.3−8.4	1	DZ	
13082	19494N1502	STF 2596		71.469	307.1	1.93	$\Delta m=2.3$	1	OLE	
				71.531	308.8	1.64	8.5−10.0	1	GP	En 140 ans θ diminué de 44°.
13133	19515N3419	ES 200		71.769	228.1	4.03	9.0−9.5	1	GP	Le mouvement retrograde.
13178	19532S0230	AC 12		71.460	303.8	1.04	$\Delta m=1.3$	2	OLE	
				71.492	303.9	1.24	–	2	GP	Il est encor incertain s'il sagit d'un couple optique ou physique.
13171	19538N3438	HLM 35		71.769	268.1	7.47	9.5−9.7	1	GP	
13196	19547N3300	STF 2606		71.618	140.0	0.88	–	1	OLE	
13198	19550N3750	STF 2609		71.766	24.7	1.85	$\Delta m=0.8$	1	OLE	
13235	19563N3407	HU 1308		71.769	21.3	0.56	$\Delta m=0.7$	1	GP	
				71.816	10.8	~0.25	8.5−9.0	1	DZ	
13277	19578N2439	STT 395		71.599	117.4	0.89	$\Delta m=0.2$	1	OLE	
				71.731	117.5	0.86	5.8—6.2	1	DZ	
–	20024N3433	GP 65		71.933	224.9	5.19	12.5−13.5	1	DZ	Suit BD+34°3869 (9^m.3) de 9^s.
13572	20109N4148	STT 403	AB	71.596	170.4	0.89	$\Delta m=0.1$	1	OLE	
13649	20134N2604	BU 984		71.755	241.0	0.63	7.9−8.2	1	DZ	
13750	20173N2327	STF 2672		71.599	321.6	0.67	$\Delta m=0.3$	1	OLE	
13997	20286N0506	STF 2696	AB	71.503	117.2	–	–	1/0	OLE	
14063	20322N1142	STF 2701		71.472	222.8	1.90	$\Delta m=0.3$	1	OLE	
				71.731	218.4	1.96	7.8−8.2	1	DZ	
14073	20328N1415	BU 151	AB	71.599	322.7	0.55	–	1	OLE	Couteau, 62: −10°.7, +0″.10
14233	20402N1157	STF 2723	AB	71.618	121.5	1.10	$\Delta m=2.0$	1	OLE	
14238	20403N1222	BU 64	AB	71.699	338.5	0.53	9.0−8.7	3	DZ	Baize, 57: −0°.6, −0″.01
14296	20435N3607	STT 413	AB	71.586	24.6	0.83	$\Delta m=2.5$	1	GP	Rabe, 48: +4 .9, +0 .01
				71.596	22.9	0.84	$\Delta m=2.2$	2	OLE	: +3 .2, +0 .02
–	20453N3408	GP 51		70.841	348.2	6.06	10.0−10.3	1	OLE	Suit BD+33°4037 (9^m.5) de 16^s, 0′.5 au Sud.
14421	20507N3219	STT 418		71.596	288.8	1.01	$\Delta m=0.0$	1	OLE	
				71.793	287.2	0.95	7.3−7.4	2	DZ	
14499	20541N0355	STT 2737	AB	71.472	286.9	0.88	5.7−6.2	1	OLE	v. d. Bos, 33: +0°.9, −0″.17
				71.694	287.1	0.96	5.8−6.3	3/2	DZ	: +1 .2, −0 .09
–	21021N3435	GP 25		70.614	298.5	3.77	$\Delta m=3.0$	2/1	OLE	Suit BD+34°4278 (9^m.5) de 13^s, 4′.5 au N de BD+34°4304 (9^m.5).
–	21051N3507	GP 26		71.752	243.5	3.68	10.0−12.5	1	GP	
14778	21105N4044	STT 432		71.739	120.5	1.12	6.8−7.2	1	DZ	
14783	21117N6400	H 48		71.708	250.8	0.73	7.0−7.2	2	DZ	Baize, 50: +0°.7, −0″.08
14879	21162N2718	A 295		71.772	242.5	0.48	8.5−8.7	1	DZ	
14889	21166N3202	STT 437	AB	71.528	26.5	1.98	$\Delta m=0.1$	2	OLE	

ADS	IDS	Nom.	Comp.	1900+	θ	ρ	m	n	Obs	Orbite et remarques
1	2	3	4	5	6	7	8	9	10	11
–	21184N3443	GP 50		70.841	16°0	4″94	12.0–13.0	1	OLE	Suit BD+34°4398 (9^m.4) de 9^s.
15007	21240N1039	STF 2799	AB	71.596	272.3	1.47	Δm=0.1	1	OLE	
				71.739	275.4	1.51	7.0–7.0	1	DZ	
15039	21262N3437	HLD 45		71.618	199.7	1.12	Δm=0.1	1	OLE	
				71.816	19.6	1.13	8.0–8.5	1	DZ	
15215	21366N2853	STT 448		71.714	209.2	0.58	Δm=0.8	2	GP	
				71.753	210.4	0.54	Δm=1.0	1	OLE	
15234	21379N1832	HO 165		71.596	64.4	0.60	Δm=0.1	1	OLE	
15270	21397N2817	STF 2822	AB	71.594	291.3	1.88	Δm=1.3	1	OLE	Heintz, 65: −0°.5+0″.02
15295	21415N4328	HO 168	AB	71.599	234.8	0.99	Δm=0.0	1	OLE	
15460	21519N5203	STT 456	AB	71.461	37.0	1.32	Δm=1.1	1	OLE	
15769	22100N2905	STF 2881		71.472	81.6	1.16	Δm=0.4	1	OLE	
–	22146N3442	GP 60		71.736	358.1	3.95	Δm=1.0	1	OLE	À +10^s et −6′ de BD+34°.4650 (9^m.0)
15965	22235N2911	BU 1218		71.499	54.3	1.40	8.6–8.8	4	DZ	Sans changement depuis 1890.
				71.810	55.2	1.30	9.2–9.5	1	OLE	
15971	22237S0032	STF 2909	AB	71.513	243.7	1.73	4.4–4.6	3	OLE	Franz, 58: +5°.5, −0″.03
				71.697	244.8	1.83	4.4–4.6	3	DZ	Rabe, 54: +0 .9, −0 .01
15988	22249N0355	STF 2912		71.594	116.1	0.87	Δm=1.3	1	OLE	Knippe, 59: −1 .4, −0 .21
–	22280N3429	GP 39		71.586	87.3	0.51	Δm=0.0	1	OLE	
				71.626	88.8	0.64	–	2	GP	GP 39=+34°4710 (9^m.3).
16046	22287N4852	HU 1320		71.755	282.8	0.26	8.2–8.2	1	DZ	Muller, 54: −9°.6, 0″.00
16266	22426N4415	A 189	AB	71.684	27.0	0.90	Δm=0.0	2	OLE	
16292	22450N3047	STF 2945		71.810	116.2	3.90	8.5–8.5	1	OLE	
16326	22480N5712	A 632	AB	71.729	176.7	0.94	8.2–9.0	3	DZ	Heintz, 62: +2°.1, 0″.00
16373	22508N1515	HU 987		71.605	95.4	0.66	Δm=0.3	1	OLE	Heintz, 65: −1°.7, +0″.04
16602	23084N2132	STF 2990		71.461	57.9	2.21	–	1	OLE	
–	23158N3548	GP 68		71.813	321.9	0.93	Δm=-0.2	1	OLE	GP 68=BD+35°5010 (9^m.4).
				71.933	324.7	0.87	–	1	DZ	
–	23169N3550	GP 67		71.933	310.5	2.46	9.5–12.5	1	DZ	Precéde BD+35°5015 de 3^s; 12′ au S
–	23223N2953	GP 21		71.586	210.6	–	Δm=0.1	1	OLE	
				71.711	209.3	0.75	Δm=0.0	2	GP	GP 21=BD+29°4929 (9^m.5).
16785	23244N4009	A 1487		71.753	166.4	0.93	Δm=0.2	1	OLE	
				71.767	167.6	1.10	Δm=0.7	2	GP	
16807	23258N0856	STT 497		71.775	221.1	1.22	Δm=0.7	1	OLE	
16869	23320N3423	ES 2208		71.703	86.0	2.69	Δm=1.2	1	GP	Le mouvement direct.
16937	23370N1945	STT 503	AB	71.775	132.8	1.13	Δm=0.3	1	OLE	
16999	23422N0855	A 1245		71.341	29.5	1.58	9.2–9.2	2	DZ	
17036	23455N4630	A 792		71.753	261.5	0.63	–	1	GP	En 67 ans θ augmenté de 13°.
				71.753	264.5	0.67	Δm=0.2	1	OLE	
17050	23465N4132	STT 510	AB	71.652	130.9	0.46	7.5–7.8	1	DZ	
17063	23471N4257	BU 728		71.775	7.4	0.97	Δm=0.2	1	OLE	
17126	23528N5650	STF 3047	AB	71.810	70.5	1.02	Δm=0.4	1	OLE	
17149	23544N3310	STF 3050	AB	71.773	297.2	1.46	6.6–6.6	2	DZ	Franz, : −1°.0, −0″.12
				71.775	296.4	1.47	Δm=0.2	1	OLE	55: −1°.8, −0″.11
17178	23563N3905	HLD 60		71.773	187.2	0.81	9.2–9.6	2	DZ	Heintz, 63: +0 .3, −0 .16
				71.775	186.5	1.02	8.5–9.0	2	GP	: −1 .4, +0 .06
				71.775	186.0	1.26	Δm=0.2	1	OLE	: −1 .0, −0 .29
32	23595N3343	STF 3056	AB	71.737	142.9	0.71	Δm=0.0	1	OLE	
39	23597N4325	A 203		71.343	343.6	1.45	8.3–8.7	2	DZ	
	Supplement:									
–	19263N0808	OLE 3		70.734	67°.7	3″.56	11.5–12.7	1	OLE	À +6^s et −3′ de ADS 12537 (8^m.5).
				70.734	64.1	3.71	12.0–13.5	1	GP	
–	19473N3428	OLE 2		70.592	338.8	2.86	9.6–11.0	2	OLE	À +6^s et 0′ de ADS 13020 (9^m.7).
				70.594	339.4	3.45	–	1	GP	
–	19527N3551	OLE 1		70.580	11.6	3.34	11.2–11.4	1	OLE	À −5^s et 0′ de BD+35°3873 (9^m.5).
				70.580	13.0	3.54	12.0–12.0	1	GP	

THE TRAJECTORY OF THE RECTILINEAR RELATIVE MOTION OF A COMPONENT OF THE VISUAL DOUBLE STAR ADS 9047= 614=IDS 13490N1038, mag. = 8.1—11.8, sp. FO

D. M. OLEVIĆ

From the visual observations of the double star ADS 9047=β 614 given in the Table 1 (position angles θ_t are reduced to the epoch 2000.0) the rectilinear relative motion trajectory is obtained in the polar coordinates:

$$\rho \cos (209^\circ.7-\theta)=0''.254,$$
$$\rho \sin (209^\circ.7-\theta)=0''.009883\ (t-1929.50).$$

Residuals between observed values and those calculated by trajectory equations are given in the Table 2.

Table 3 contains the ephemeris from 1975.5 to 2000.5 for the interval of 5 years.

Table 1

№	t	θ 2000	ρ	n	aut.	Source
1	1878.37	268°.1	0″.60	2	β	BDS
2	1889.40	270 .9	.44	3	β	,,
3	1901.51	252 .0	.39	8	HU3, A5	,,
4	1908.44	250 .0	.40	2	A	ADS
5	1916.26	234 .9	.32	3	Fox1, A2	,,
6	1926.41	227 .7	.30	1	A	,,
7	1947.00	178 .7	.32	3	A	Publ. Yer. 0. 8, 6
8	1962.96	157°.1	0″.34	7	COU (4+3)	Lick. 0. № 579, J. 0. 47. 10, 1964
9	1966.91	146°.6	0″.42	7	Baiz, 4, COU3	J. 0. 50, 1, 1967. J. 0. 50, 4, 1968,

Table 2

№	$(0-C)_\rho$	$(0-C)_\theta$
1	+0″.04	− 4°.9
2	− .02	+ 3 .9
3	+ .01	− 5 .2
4	− .07	+ 1 .0
5	+ .03	− 2 .1
6	+ .04	+11 .3
7	+ .01	+ 3 .3
8	− .06	0 .0
9	+0″.03	− 7°.6

Table 3

EPHEMERIS

t	θ_{2000}	ρ
1975.5	148°.9	0″.52
80.5	146 .5	.56
85.5	144 .3	.61
90.5	142 .5	.65
95.5	141 .0	.70
2000.5	139°.6	0″.75

ORBITE DE L'ÉTOILE DOUBLE ADS 8050=A 1591

par *V. ERCEG*

Pour déduire les éléments de l'orbite de l'étoile, nous avons utilisé la méthode de Thiele-Innes-Van den Boss (1), et nous avons appliqué la relation de G. M. Popović et T. D. Angelov (2) pour la série principale de HR-diagramme, afin d'obtenir la parallaxe dynamique, les magnitudes absolues et les masses des composantes du couple.

Les données générales sur le système sont:

α: $11^h\,02^m.6$, δ: $+55^\circ\,05'$ (1950.0)

Magn.: 9.2—9.2, Classe sp.: GO,

Éléments:

T = 1875.576	A = + 0″.0507
P = 105.18 ans	B = + 0.1633
n = 3°.423	F = + 0.2050
e = 0.49	G = + 0.0540
a = 0.240	C = − 0.1688
i = 122°.10	H = + 0.1152
Ω = 34°.40	$t_{\Omega,\mho}$ = 1881.04, 1902.68
ω = 303°.88	a = 30.0 UA

On a de plus:

Parallaxe dynamique: 0″.008,

les magn. abs. des composantes: $M_A = M_B = 3{,}74$

les masses des composantes: $\mathfrak{M}_A = \mathfrak{M}_B = 1{,}30\odot$

№	t	θ_{2000}	ρ	n	Obs	Références	O—C	
1	1907.26	298°.4	0″.17	3	A	ADS	+0°.3	0″.00
2	1923.20	260.0	0.27	2	A	ADS	−0 .4	+0 .04
3	1927.22	256.7	0.23	2	A	Publ. Y. O. Vol. VIII, Part II.	+2 ,6	—0 .02
4	1943.26	238.2	0.30	7	VBS	Publ. Y. O. Vol. VIII, Part VI.	+2 .8	0 .00
5	1954.09	221.7	0.27	8	VBS 4, BZ 4.	Publ. Y. O. Vol. IX, Part II, J. O. Vol. 40 N. 11−12.	−1 .3	−0 .01
6	1958.024*)	221.3	0.26	2	B	Publ. Y. 0. Vol. IX, Part I.	+2 .8	−0 .01
7	1960.32*)	222.	0.30	3	COU	(P. Muller)	+6 .6	+0 .04
8	1962.210*)	212.7	0.24	7	B 4, WOR 3.	Lick O. Bull. N. 579, Publ. Naval. O. Vol. XVIII, Part VI.	0 .0	0 .00
9	1965.82*)	202.3	0.26	8	B Z 4, WOR 4.	(P. Muller)	−4 .0	+0 .05
10	1966.35*)	199.7	0.2	3	Htz	(P. Muller)	−5 .3	0 .00

*) θ_{obs}. changé de 180°.

ÉPHÉMÉRIDES

1971.0	191°.2	0″.15
1972.0	187 .2	0 .14
1973.0	180 .2	0 .12
1974.0	174 .6	0 .11
1975.0	165 .3	0 .09

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THE NEW DOUBLE STARS DISCOVERED IN BELGRADE WITH THE ZEISS REFRACTOR 65/1055 cm. SUPPLEMENT III

G. M. POPOVIĆ

SUMMARY:

The 55 measurements of 30 newly-discovered double stars with the Zeiss refractor 65/1055 cm of the Belgrade Observatory are shown. For the double stars without BD notification (anonymous), because of easier identification, the values Δα, Δδ are given in relation to BD reference stars.

This series of new systems is the continuation of checking of the duplicity of BD stars published in Suppl. II [2] from the program of checking in the declination zones + 34° and +35° of BD catalogue. The mean value ρ of the series is 4″.4 while the mean values of the magnitudes of the components are 11.0−12.1. The worse structure of pairs in relation to the last series is the result primarily of atmospheric conditions for observations in 1971. While the average image quality in the last series was 1.3 in this series it is worse and comes to 1.1. The structure of pairs by ρ (accepting only the narrower pair in the system) in the previous series [1], [2] and in this one is as follows:

Supp.	ρ < 1″	1″ ⩽ ρ < 3″	ρ > 3″	Σ
I	1	—	13	14
II	5	11	12	28
III	—	7	23	30
Σ	6 (8%)	18 (25%)	48 (67%)	72

In relation to the previous series the tabular review of measurements is slightly changed. The first seven columns do not need a special exlanation. The eighth column, which is marked with the letter W (Weight), includes three columns of previous series (columns 6,7 and 8): the first number in the column is the estimated image quality, the second is the etimated measurement quality and the third is the weight of the measurement (image quality+ measurement quality). The treatment of mean values is identical to the treatment in the previous series. In the ninth column the BD notation of the double star is given (in that case Δα and Δδ are left out) or in the case of an anonymous star the BD notation of reference star together with the values Δα and Δδ is given. In the tenth column the numbers of „Circulaire d'Information, UAI, Commission des étoiles doubles" in which the new pairs are registered are stated.

This series includes the measurements until the epoch 1971.955.

In the Supplement I [1] a mistake in identification is made: the system marked as GP 23 is known as the system Ho 501 = ADS 2395.

Double star	1900 α 1950 δ 2000	t	θ	ρ	m	Mgf.	W	BD Δα Δδ	C. I. UAI. Comm. 26
GP 52	00288N3512	70.835	319°.3	8″.20	—	500	1 1 2	+ 34°.75 (9^m.5)	—
	00314N3529	71.739	321.6	7.92	10.0—11.0	590	1 2 3	0^s + 3′	
	00340N3546	**71.377**	**320.7**	**8.03**	**10.0—11.0**		**2n**		
GP 46	01027N3502	70.745	151.5	3.97	12.5—14.0	590	1 1 2	+ 34°.189 (9^m.3)	52
	01055N3518	71.772	150.4	3.98	10.0—11.5	590	2 2 4	— 3^s — 0′.5	
	01082N3534	**71.430**	**150.8**	**3.98**	**10.8—12.3**		**2n**		
GP 47	01029N3503	70.745	216.8	3.43	12.5—14.0	590	1 1 2	+ 34°.189 (9^m.3)	52
	01057N3519	71.772	215.1	3.77	10.5—12.5	590	1 2 3	+ 10^s + 0′.5	
	01085N3535	**71.361**	**215.8**	**3.63**	**11.5—13.2**		**2n**		
GP 53	01143N3448	70.972	70.2	2.19	Δm=4.0	500	3 2 5	+ 34°.229 (9^m.3)	53
	01171N3504								
	01199N3520								
GP 54	01158N3409	70.972	45.6	1.24	9.0—11.0	500	2 1 3	+ 33°.214 (9^m.5)	53
	01186N3425	71.676	45.4	1.19	Δm=2.0	500	2 2 4		
	01214N3440	**71.374**	**45.5**	**1.21**	**9.0—11.0**		**2n**		
GP 48	01292N3448	70.745	19.4	2.13	13.0—13.5	590	1 1 2	+ 34°.274 (9^m.3)	52
	01320N3503							— + 2′	
	01349N3518								
GP 70	05136N3555	71.849	17.0	1.17	Δm=0.3	590	1 1 2	+ 35°.1056 (9^m.5)	57
	05169N3559	71.934	7.0	—	—	590	1 1 2		
	05202N3603	**71.892**	**12.0**	**1.17**	**Δm=0.3**		**2/1n**		
GP 69	05148N3509	71.849	308.7	3.+	11.5—12.5	590	1 1 2	+ 35°.1072 (9^m.0)	57
	05181N3512	71.934	300.6	3.66	11.0—12.0	590	1 1 2	— 5^s — 3′	
	05215N3515	**71.892**	**304.6**	**3.66**	**11.2—12.2**		**2/1n**		
GP 58	09192N3320	71.366	290°.5	3″.07	13.0—13.0	500	1 2 3	+ 33°.1857 (9^m.0)	55
	09222N3308							— 12^s + 2′	
	09253N3243								
GP 56	09266N3504	71.287	216.0	5.04	12.0—12.3	590	1 1 2	+ 35°.2020 (9^m.2)	—
	09296N3452							0^s + 1′	
	09327N3439								
GP 57	12229N3458	71.361	351.9	8.43	9.7—11.0	500	1 1 2	+ 35°.2339 (9^m.5)	—
	12254N3441	71.366	354.1	9.43	9.5—11.0	590	1 1 2		
	12279N3424	71.378	352.2	9.87	9.5—11.0	500	1 2 3		
		71.380	350.7	9.15	9.5—11.5	590	1 1 2		
		71.372	**352.2**	**9.29**	**9.6—11.1**		**4n**		
GP 45	18389N3426	70.690	278.6	6.41	11.0—11.0	590	1 2 3	+ 34°.3288 (8^m.3)	—
	18407N3428	71.736	279.1	6.24	13.0—13.0	590	1 2 3	+ 9^s — 2′	
	18425N3431	**71.213**	**278.8**	**6.32**	**12.0—12.0**		**2n**		
GP 43	18447N3425	70.769	261.8	2.77	12.0—12.5	590	1 1 2	+ 34°.3323 (8^m.0)	52
	18465N3429							— 17^s + 5′	
	18484N3432								
GP 44	18459N3505	70.636	228.5	9.42	9.0—10.0	590	1 1 2	+ 35°.3368 (9^m.5)	—
	18477N3508	70.690	231.3	9.27	8.5— 9.5	590	1 1 2		
	18495N3511	**70.663**	**229.9**	**9.34**	**8.8— 9.8**		**2n**		
GP 41	18532N3438	70.636	353.3	3.81	13.0—13.6	590	1 1 2	+ 34°.3366 (9^m.0)	52
	18550N3441	70.841	354.7	5.16	Δm=1.0	500	1 1 2	— 10^s — 1′	
	18567N3445	**70.738**	**354.0**	**4.48**	**13.0—13.6**		**2n**		

Double star	1900 α 1950 δ 2000	t	θ	ρ	m	Mgf.	W	BD Δα	BD Δδ	C. I. UAI Comm. 26
GP 42	19285N3402	70.739	286°.9	4″.82	11.0−12.0	590	2 2 4	+ 33.°3492 ($9^m.5$)		—
	19304N3408	71.676	284.9	4.24	Δm=1.0	500	1 2 3	+ 5^s	0′	
	19322N3414	**71.140**	**286.1**	**4.57**	**11.0−12.0**		**2n**			
GP 59	19375N3514	71.698	259.0	5.59	11.0−12.5	590	1 1 2	+ 35°.3748 ($9^m.3$)		—
	19393N3520							− 15^s	− 1′	
	19412N3527									
GP 61	19564N3413	71.769	25.4	6.23	—	590	1 1 2	+ 34°.3831 ($9^m.5$)		—
	19583N3421							− 1^s	− 4′	
	20002N3429									
GP 62	19568N3501	71.777	159	33.07	9.5−12.6	590	1 1 2	+ 34°.3834 ($9^m.5$)		55
A-BC	19587N3509									
	20006N3517									
BC		71.777	70.3	3.62	13.0−14.0	590	1 1 2			55
		71.812	66.2	3.65	12.0−13.5	500	1 1 2			
		71.794	**68.3**	**3.64**	**12.5−13.7**		**2n**			
GP 63	19577N3435	71.812	61.3	4.15	12.5−12.8	500	1 2 3	+ 34°.3841 ($9^m.3$)		—
	19596N3443							− 2^s	− 1′	
	20015N3451									
GP 64	20009N3441	71.777	122.7	4.21	12.0−12.2	590	1 1 2	+ 34°.3862 ($8^m.6$)		—
	20028N3449							+ 11^s	− 2′	
	20047N3458									
GP 65	20024N3433	71.777	221.2	6.43	—	590	1 1 2	+ 34°.3869 ($9^m.3$)		—
	20043N3441	71.933	222.6	6.02	12.3−13.0	590	1 1 2	+ 9^s	0′	
	20062N3450	**71.855**	**221.9**	**6.22**	**12.3−13.0**		**2n**			
GP 66	20025N3437	71.777	5.0	4.	Δm=2.0	590	1 1 2	+ 34°.3874 ($8^m.5$) =		—
	20044N3445	71.933	5.1	4.52	10.0−12.0	590	1 1 2	ADS 13391		
	20063N3454	**71.855**	**5.1**	**4.52**	**10.0−12.0**		**2/1n**	− 22^s	− 0′.5	
GP 51	20453N3408	70.783	350.2	5.86	11.0−12.0	500	2 2 4	+ 33°.4037 ($9^m.5$)		—
	20473N3419	70.841	348.1	6.14	11.0−11.5	500	1 2 3	+ 16^s	− 0′.5	
	20493N3430	**70.808**	**349.3**	**5.98**	**11.0−11.8**		**2n**			
GP 50	21184N3443	70.772	13.9	4.68	12.0−13.5	590	1 1 2	+ 34.4398 (9.4)		—
	21204N3456	70.800	10.6	4.52	11.5−13.0	500	1 1 2	+ 9^s	—	
	21225N3508	70.841	14.4	5.23	12.0−13.0	500	1 2 3			
		70.810	**13.2**	**4.87**	**11.8−13.2**		**3n**			
GP 49	21220N3503	70.800	207.8	6.23	11.5−11.6	500	1 2 3	+ 34.4413 (9.1)		—
	21240N3516	70.821	207.6	6.44	11.8−12.0	500	1 2 3	− 26^s	+ 9′	
	21261N3529	**70.810**	**207.7**	**6.34**	**11.6−11.8**		**2n**			
GP 55	21296N4749	71.845	199.9	4.10	11.5−12.5	500	1 2 3	+ 47.3465 (9.2)		57
	21313N4802	71.854	200.5	3.60	11.5−12.5	590	1 2 3	+ 3^s	+ 1′	
	21331N4816	**71.850**	**200.2**	**3.85**	**11.5−12.5**		**2n**			
GP 60	22146N3442	71.736	1.4	4.27	11.8−12.0	590	1 2 3	+ 34°.4650 ($9^m.0$)		—
	22168N3457	71.813	1.9	4.14	11.0−11.8	500	1 1 2	+ 10^s	− 6′	
	22190N3512	**71.767**	**1.6**	**4.22**	**11.5−11.9**		**2n**			
GP 68	23158N3548	71.813	325.3	1.06	9.5−9.5	590	1 2 3	+ 35°.5010 ($9^m.4$)		55
	23181N3604	71.933	320.6	1.15	Δm=0.0	590	1 1 2			
	23205N3620	**71.861**	**323.4**	**1.10**	**9.5−9.5**		**2n**			
GP 67	23169N3550	71.813	310.7	2.68	9.0−10.5	590	1 2 3	+ 35°.5015 ($8^m.4$)		55
	23193N3607	71.933	304.6	2.36	9.0−13.0	590	1 1 2	− 3^s	− 12′	
	23217N3623	**71.861**	**308.3**	**2.55**	**9.0−11.7**		**2n**			

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LUNAR OCCULTATIONS VISIBLE AT BELGRADE DURING THE PERIOD 1972 - 1974

by H. M. NAUTICAL OFFICE, London

1972

Date		U. T.		Z. C	Mag	Elg. Moon	PH.	P. A.	Az. Moon	Alt.	P. A. C. B. L.	A Min/deg.	B		BD/CD	Double Aitken
1	3	21^h	14^m.3	1405	7.0	218°	R	283°	102°	30°	110°	−0.8	+0.9	+13°	02104	
1	3	23	14.4	1413	6.7	219	R	335	130	48	110	−1.0	−1.8	+13	02117	
1	7	3	29.9	1723	7.1	255	R	236	180	40	115	—	—	−04	03162	
1	10	2	47.8	2027	7.2	287	R	285	140	16	108	−1.2	+0.8	−18	03757	
1	12	7	6.2	2287	3.0	312	D	85	179	19	98	−2.1	+0.1	−25	11228	9862
1	12	8	30.0	2287	3.0	312	R	299	198	17	98	−1.9	−1.1	−25	11228	9862
1	19	17	35.1	3328	7.0	42	D	332	246	15	245	—	—	−05	05843	
1	19	17	38.8	3328	7.0	42	R	325	247	15	245	—	—	−05	05843	
1	20	18	13.3	3477	6.6	55	D	69	248	22	244	−0.7	−0.6	+00	05018	
1	21	17	49.4	51	7.2	68	D	32	237	38	245	−0.8	+1.0	+06	00043	
1	22	20	45.2	207	9.1	83	D	116	268	22	247	−0.4	−2.7	+13	00207	
1	24	18	23.8	470	7.0	109	D	69	207	66	256	−1.7	+0.5	+22	00457	2414
1	25	22	4.9	647	5.5	123	D	100	262	45	263	−0.9	−1.6	+25	00707	3161
1	25	23	17.1	655	7.7	124	D	74	275	33	264	−0.7	−0.9	+25	00710	
1	28	3	16.8	1015	6.4	152	D	166	293	12	278	+1.1	−2.6	+24	01328	
2	2	0	5.9	1577	7.1	211	R	359	166	48	118	−0.1	−3.1	+04	02388	
2	2	22	10.3	1671	7.6	222	R	278	124	27	118	−1.2	+1.1	−00	02447	
2	3	21	38.8	1761	8.0	233	R	238	113	12	117	—	—	−06	03532	8477
2	19	20	40.0	304	8.6	66	D	130	282	13	248	+0.4	−3.1	+16	00237	
2	21	11	34.0	552	3.0	89	D	91	84	29	257	−0.4	+1.3	+23	00541	
2	21	12	31.4	552	3.0	89	R	230	94	39	257	−0.3	+2.1	+23	00541	
2	22	20	12.2	762	6.6	106	D	76	253	54	265	−1.4	−0.6	+26	00783	
2	23	22	18.8	932	7.4	119	D	30	267	42	272	—	—	+26	01117	
2	24	0	16.3	949	7.7	120	D	139	285	21	273	+0.4	−2.2	+25	01180	
2	24	17	35.3	1070	5.2	130	D	113	124	60	278	−1.7	−0.2	+24	01502	
2	24	20	37.9	1080	6.9	131	D	52	221	65	278	−2.7	+1.9	+24	01531	
2	25	0	47.0	1100	7.8	133	D	143	279	24	279	+0.3	−2.2	+23	01647	
3	4	22	51.3	2046	6.9	236	R	244	134	12	113	−2.1	+2.8	−19	03846	
3	6	3	44.9	2174	6.4	248	R	264	193	20	108	−2.1	−0.4	−23	12133	
3	7	1	48.3	2298	5.1	259	R	1	154	15	102	—	—	−25	11295	
3	8	2	35.9	2437	7.8	270	R	210	154	13	96	—	—	−27	11312	10271
3	9	3	3.1	2575	6.8	281	R	277	149	11	90	−1.4	+0.9	−27	12070	
3	17	17	44.6	246	8.9	33	D	70	272	19	240	−0.4	−0.8	+14	00250	
3	18	17	24.8	387	6.9	47	D	14	264	36	247	−1.3	+2.8	+19	00389	
3	19	19	37.2	536	5.4	62	D	35	279	26	254	−1.0	+0.6	+23	00505	
3	19	19	26.9	537	3.8	62	D	78	277	28	254	−0.5	−1.0	+23	00507	
3	19	20	5.8	545	4.2	62	D	119	283	21	255	+0.1	−2.1	+23	00522	
3	19	20	11.2	546	7.0	62	D	52	284	20	255	−0.5	−0.3	+23	00523	
3	19	20	26.3	549	8.1	62	D	85	286	18	255	−0.1	−1.2	+23	00536	
3	19	20	34.9	551	7.1	62	D	133	288	16	255	+0.5	−2.4	+23	00538	2767
3	19	20	29.4	552	3.0	62	D	88	287	17	255	0.0	−1.2	+23	00541	
3	19	21	22.8	552	3.0	62	R	265	295	8	255	+0.2	−1.0	+23	00541	
3	19	20	37.0	553	6.8	62	D	47	288	16	255	−0.4	−0.2	+23	00540	
3	19	21	4.8	557	6.6	62	D	33	293	12	255	−0.6	+0.4	+23	00553	
3	19	21	8.1	560	3.8	62	D	104	293	11	255	+0.3	−1.4	+23	00557	2786

Date		U. T.		Z. C	Mag	Elg. Moon	PH.	P. A.	Az. Moon	Alt.	P. A. C. B. L.	A Min/deg.	B		BD/CD	Double Aitken
3	19	21^h	7^m.9	561	5.2	63°	D	86°	293°	11°	255°	+0.1	−1.1	+23°	00558	
3	20	18	40.1	717	7.5	75	D	67	260	47	261	−1.3	−0.4	+25	00731	
3	21	23	8.8	902	6.6	90	D	54	294	12	270	−0.2	−0.5	+25	01058	
3	22	18	28.6	1041	8.0	100	D	161	219	66	275	−0.6	−4.2	+24	01406	
3	22	21	27.4	1052	6.8	102	D	79	268	38	276	−1.0	−1.1	+24	01451	
3	27	0	4.0	1518	6.3	150	D	96	245	32	287	−1.1	−1.6	+07	02289	
4	1	3	17.6	2027	7.2	207	R	293	226	13	121	−1.3	−1.7	−18	03757	
4	3	1	20.1	2250	7.9	228	R	228	176	20	107	—	—	−25	11070	
4	4	1	30.3	2389	8.4	239	R	254	167	17	101	−2.2	+0.8	−26	11439	
4	6	1	43.0	2676	6.5	262	R	194	147	12	88	—	—	−26	13206	
4	7	3	22.9	2836	5.6	274	R	271	157	18	82	−1.8	+0.8	−24	15307	
4	15	18	25.4	474	9.1	28	D	140	287	14	235	+0.7	−2.9	+21	00432	
4	18	21	34.6	1015	6.4	71	D	44	290	15	273	−0.7	−0.1	+24	01328	
4	18	21	48.0	1019	6.7	71	D	71	291	13	273	−0.1	−0.9	+24	01332	5270
4	21	22	2.7	1386	6.6	108	D	108	259	30	287	−0.6	−1.8	+13	02074	
4	22	23	39.3	1492	8.5	120	D	92	264	17	289	−0.4	−1.6	+08	02327	7672
4	23	22	29.9	1585	8.3	131	D	84	239	31	290	−1.5	−1.3	+03	02429	
5	1	3	36.7	2366	1.2	210	D	78	221	7	106	−1.1	−1.1	−26	11359	10074
5	1	23	8.9	2476	6.9	219	R	290	152	13	99	−1.4	+0.6	−26	12012	
5	4	2	34.8	2790	6.2	243	R	246	175	20	84	−1.8	+0.6	−24	15041	
5	15	20	39.0	Mars	1.9	38	D	155	302	3	—	+1.0	−2.0			
5	17	19	30.9	1227	7.9	64	D	123	269	29	282	−0.2	−1.9	+19	01934	1157
5	18	20	1.9	1346	8.5	77	D	136	261	30	287	−0.2	−2.1	+15	01962	
5	19	21	15.5	1451	8.9	89	D	49	262	22	290	—	—	+10	02065	
5	21	21	44.0	1653	8.9	112	D	114	243	23	292	−0.9	−1.9	−00	02437	
5	22	21	15.4	1745	7.0	123	D	123	225	28	291	−1.2	−1.8	−05	03424	
5	22	22	8.9	1748	8.8	124	D	100	236	21	291	−1.1	−1.7	−06	03509	
6	3	0	41.3	3142	6.8	248	R	305	139	22	71	—	—	−14	06026	
6	15	19	20.0	1409	5.1	57	D	144	266	21	290	0.0	−2.1	+11	02053	
6	21	21	5.5	2027	7.2	126	D	75	215	19	286	−1.7	−0.9	−18	03757	
6	29	1	49.0	2977	6.9	206	R	221	200	23	75	−1.0	+0.5	−19	05809	
6	30	23	1.3	3226	8.0	230	R	266	131	22	67	−1.3	+1.4	−10	05812	
7	7	11	6.5	552	3.0	314	D	75	265	40	82	−1.0	−0.7	+23	00541	
7	7	12	8.4	552	3.0	314	R	278	276	29	82	−0.4	−1.5	+23	00541	
7	13	18	42.9	1468	4.9	37	D	154	271	10	294	+0.1	−2.2	+08	02301	
7	24	21	3.5	2790	6.2	162	D	157	173	20	260	—	—	−24	15041	
7	24	21	14.0	2790	6.2	162	R	171	175	21	260	—	—	−24	15041	
7	27	21	51.0	3188	5.4	199	D	331	144	27	64	—	—	−12	06087	
7	27	21	52.7	3188	5.4	199	R	329	144	27	64	—	—	−12	06087	
7	29	1	43.7	3328	7.0	213	R	209	197	39	63	−0.9	+1.3	−05	05843	
7	30	0	52.6	3462	7.5	225	R	232	164	45	63	−1.3	+1.3	+00	05009	
7	30	20	56.7	29	7.2	237	R	187	93	11	63	+0.2	+2.5	+05	00025	
7	31	1	5.3	45	8.6	239	R	224	150	48	64	−1.1	+1.7	+06	00030	
7	31	23	24.4	177	7.1	251	R	199	106	32	66	0.0	+2.5	+11	00158	
8	1	22	52.3	304	8.6	264	R	305	86	21	70	−0.9	+0.5	+16	00237	
8	3	1	43.9	461	7.8	279	R	200	103	44	75	+0.1	+3.0	+21	00416	
8	18	20	14.0	2435	9.1	108	D	112	214	11	275	−1.7	−1.6	−26	11696	
8	19	18	22.6	2558	6.2	119	D	132	178	18	270	−2.1	−0.8	−26	12367	
8	19	19	15.9	2563	8.1	119	D	98	190	18	270	−2.0	−0.5	−26	12402	
8	22	23	56.1	3017	5.3	156	D	127	221	17	258	—	—	−18	05738	
8	30	21	47.3	556	5.5	260	R	220	73	16	77	+0.4	+1.9	+22	00563	
8	30	22	4.6	559	6.6	261	R	311	75	19	77	−0.7	+0.3	+23	00556	
8	30	22	30.4	564	6.1	261	R	261	79	23	77	−0.2	+1.4	+23	00563	
8	30	22	35.3	567	6.8	261	R	288	80	24	77	−0.5	+1.0	+23	00569	279
8	30	22	55.4	570	6.8	261	R	301	83	28	77	−0.9	+0.6	+23	00570	
8	31	2	0.8	587	6.4	263	R	309	121	59	78	−2.4	−1.3	+24	00599	
8	31	23	10.0	733	7.2	274	R	278	75	21	84	−0.2	+1.1	+25	00746	350
9	2	2	22.9	918	7.0	289	R	339	96	43	91	—	—	+25	01100	
9	4	2	8.6	1205	6.3	315	R	268	80	18	101	−0.1	+1.4	+20	01976	
9	5	3	26.4	1336	5.2	328	R	286	87	20	103	−0.4	+0.9	+15	01945	
9	14	14	46.1	2366	1.2	76	D	129	169	18	280	−1.6	−0.3	−26	11359	1007
9	14	16	4.0	2366	1.2	76	R	248	188	19	280	−2.1	+0.1	−26	11359	1007
9	16	17	33.1	2657	6.7	99	D	120	184	19	268	−2.3	−0.8	−26	13068	
9	17	20	11.8	2819	8.4	111	D	89	209	16	262	−1.6	−0.9	−23	15276	
9	18	18	13.6	2938	7.3	122	D	100	169	24	258	−2.2	+0.2	−21	05629	
9	25	0	34.8	233	6.2	203	R	189	198	59	58	−0.6	+3.2	+13	00240	
9	26	20	28.7	501	6.1	229	R	316	81	24	72	−1.2	−0.1	+22	00495	255
9	27	0	39.8	521	6.7	231	R	247	141	64	73	−1.4	+1.3	+22	00518	
9	27	23	52.0	703	6.3	245	R	294	104	50	80	−1.5	+0.2	+24	00674	
9	29	0	1.7	867	6.9	258	R	312	93	41	88	−1.4	−0.4	+25	00941	

Date		U. T.		Z. C	Mag	Elg. Moon	PH.	P. A.	Az. Moon	Alt.	P. A. C. B. L.	A Min/deg.	B		BD/CD	Double Aitken
9	30	3h	38m.6	1050	5.8	273°	R	280°	138°	64°	95°	−1.7	+0.1	+23°	01518	
10	2	2	48.5	1306	7.8	297	R	283	102	35	104	−0.9	+0.9	+16	01802	
10	16	19	4.1	3022	6.9	102	D	39	203	25	256	−0.9	+0.6	−17	06059	
10	18	17	17.3	3278	5.4	126	D	115	147	32	252	−2.5	+0.2	−08	05855	
10	18	19	37.0	3285	6.1	127	D	98	188	38	252	−2.4	−0.6	−07	05765	
10	19	18	30.2	3407	9.5	140	D	345	152	40	252	—	—	−01	04401	
10	20	1	9.4	3444	6.5	143	D	98	260	10	253	−0.4	−1.8	−00	04509	
10	23	18	9.1	435	5.8	195	R	240	82	22	33	0.0	+1.7	+20	00480	
10	24	20	29.9	611	7.0	211	R	219	92	37	63	−0.1	+2.4	+23	00624	
10	25	3	31.5	649	7.2	214	R	203	253	51	76	—	—	+24	00654	
10	25	18	57.5	775	8.5	224	R	324	66	12	82	−0.6	−0.3	+24	00772	
10	25	23	4.5	795	8.5	226	R	261	109	53	84	−1.2	+1.3	+25	00818	3911
10	26	3	39.9	822	5.9	228	R	260	239	60	85	−1.6	−0.4	+25	00839	4068
10	27	3	27.8	1005	9.0	242	R	292	205	68	93	−1.6	−1.1	+24	01303	
10	27	23	34.0	1125	6.4	253	R	269	94	35	98	−0.7	+1.4	+21	01596	
10	27	23	59.6	1129	5.3	254	R	257	99	40	98	−0.8	+1.8	+21	01602	6089
10	28	2	33.0	1143	6.8	255	R	306	142	63	99	−1.6	−1.0	+21	01630	
10	28	22	42.1	1255	8.2	266	R	215	79	15	103	—	—	+18	01923	
10	30	0	27.3	1378	8.7	279	R	308	92	21	107	−0.6	+0.2	+13	02066	
11	3	3	49.3	1788	6.7	327	R	324	113	10	105	−0.2	−0.3	−07	03409	
11	10	9	56.7	2672	2.9	46	D	153	130	3	268	—	—	−25	13149	
11	10	10	29.5	2672	2.9	46	R	205	137	7	268	—	—	−25	13149	
11	11	16	29.6	2849	9.1	59	D	105	206	19	261	−2.1	−1.4	−22	05127	
11	13	17	24.0	3100	6.4	83	D	72	199	29	253	−1.7	−0.1	−15	05908	
11	14	20	14.8	3233	7.2	96	D	67	232	22	250	−0.9	−0.5	−09	05908	
11	15	16	2.7	3344	6.8	106	D	97	148	36	249	−2.0	+0.7	−04	05757	16270
11	16	22	4.4	3501	5.3	122	D	37	243	29	250	−0.7	+0.6	+02	04709	
11	17	20	0.0	77	7.9	134	D	73	195	53	252	−1.7	+0.3	+08	00080	
11	17	22	59.4	89	6.5	136	D	118	249	33	252	−1.2	−3.1	+08	00094	
11	20	0	45.0	399	5.7	165	D	119	256	41	270	−0.9	−2.5	+19	00403	2062
11	22	18	50.5	880	7.2	205	R	274	77	23	72	−0.2	+1.1	+24	00963	
11	22	19	13.1	882	5.0	205	R	246	81	26	72	−0.1	+1.8	+24	00970	
11	24	0	25.1	1078	5.9	222	R	306	144	64	96	−1.6	−1.0	+22	01566	
11	25	0	2.2	1217	6.1	235	R	258	119	51	102	−1.5	+1.6	+19	01911	
11	27	4	37.3	1465	6.3	262	R	313	191	53	110	−1.3	−1.6	+09	02269	
11	28	1	39.7	1564	6.6	273	R	356	120	31	112	−0.3	−2.9	+04	02375	7896
11	30	3	29.1	1764	8.5	297	R	10	133	26	111	—	—	−06	03538	
12	2	4	32.2	1980	8.8	320	R	333	133	15	105	−0.2	−0.7	−16	03747	
12	13	20	46.4	3453	4.9	90	D	65	251	19	247	−0.6	−0.6	+00	04998	
12	13	20	55.0	3455	6.4	90	D	103	253	18	247	−0.8	−2.1	+00	04999	
12	14	18	45.8	23	8.6	102	D	70	214	47	248	−1.6	0.0	+05	00018	167
12	16	20	20.2	304	8.6	129	D	74	218	58	254	−1.6	0.0	+16	00237	
12	16	21	43.9	311	6.5	130	D	35	245	47	254	−1.2	+1.2	+17	00315	
12	17	15	49.8	435	5.8	141	D	137	96	36	259	—	—	+20	00480	
12	17	16	45.3	440	4.6	142	D	359	106	45	259	—	—	+20	00484	2257
12	18	16	41.9	598	5.7	156	D	26	91	36	268	+0.3	+2.8	+23	00609	2965
12	19	1	43.7	652	6.4	160	D	125	274	32	270	−0.1	−2.2	+23	00684	3179
12	21	18	58.9	1129	5.3	199	R	348	84	25	87		—	+21	01602	6089
12	24	0	5.9	1409	5.1	229	R	348	135	49	111	−0.7	−2.7	+11	02053	
12	24	5	25.4	1428	3.8	231	D	69	247	35	112	−1.6	−0.8	+10	02044	7480
12	25	0	13.3	1519	6.5	241	R	9	128	39	113	—	—	+06	02301	
12	25	2	18.0	1526	8.6	242	R	326	169	50	113	−1.1	−1.6	+05	02331	
12	28	2	6.3	1829	8.3	278	R	318	134	23	112	−0.7	−0.3	−10	03546	

1973

1	8	17	38.5	3281	7.5	46	D	11	242	17	245	0.0	+1.7	−06	05972	
1	10	16	45.4	3524	6.9	71	D	62	214	45	245	−1.4	+0.3	+03	04909	17111
1	11	17	32.0	102	8.8	84	D	118	217	50	246	−2.6	−2.9	+09	00090	
1	11	20	49.2	119	8.8	85	D	73	264	21	247	−0.5	−0.9	+10	00105	
1	12	16	13.4	246	8.9	96	D	64	163	60	249	−1.5	+1.2	+14	00250	
1	12	17	59.6	251	7.6	97	D	64	212	57	249	−1.6	+0.5	+15	00251	
1	14	15	55.6	521	6.7	123	D	37	110	51	259	−0.5	+2.6	+22	00518	
1	14	21	30.9	550	6.8	125	D	28	252	51	260	−1.7	+2.2	+23	00537	
1	14	21	47.3	556	5.5	125	D	123	255	48	260	−0.9	−2.5	+22	00563	
1	14	22	22.5	559	6.6	126	D	18	263	42	260	—	—	+23	00556	
1	14	22	24.1	564	6.1	126	D	65	263	42	260	−1.1	−0.4	+23	00563	
1	14	22	44.8	567	6.8	126	D	29	267	38	260	−1.5	+1.6	+23	00569	2795
1	15	19	47.5	724	8.0	138	D	170	182	70	266	—	—	+24	00689	

Date		U. T.		Z. C.	Mag.	Elg. Moon	PH.	P. A.	Az. Moon	Alt.	P. A. C. B. L.	A Min/deg	B	BD/CD		Double Aitken
1	15	19^h	55^m.9	724	8.0	138°	R	183°	188°	70°	266°	—	—	+24°	00689	
1	15	23	58.4	743	5.6	140	D	69	270	37	267	−0.9	−0.7	+24	00717	3547
1	16	16	5.8	880	7.2	151	D	102	86	32	272	−0.6	+1.0	+24	00963	
1	16	16	41.3	882	5.0	151	D	135	92	38	272	−1.3	−0.4	+24	00970	
1	20	23	14.5	1465	6.3	208	R	317	149	50	117	−1.2	−1.1	+09	02269	
1	21	0	33.3	1468	4.9	209	R	331	179	53	117	−0.9	−1.9	+08	02301	
1	24	23	43.4	1893	7.0	257	R	235	124	12	114	—	—	−13	03665	
1	28	3	24.5	2248	7.7	292	R	310	146	13	102	−0.9	+0.2	−23	12487	
1	28	4	35.9	2251	7.5	292	R	263	162	19	101	−2.1	+0.8	−24	12275	
1	30	4	57.8	2524	6.0	314	R	250	146	11	91	−1.7	+1.6	−26	12152	
2	6	17	46.8	3501	5.3	41	D	77	256	18	241	−0.6	−1.0	+02	04709	
2	9	19	1.7	357	8.0	80	D	138	254	42	250	—	—	+18	00305	
2	10	20	32.5	501	6.1	94	D	55	265	38	256	−1.1	−0.1	+22	00495	2552
2	11	16	42.9	649	7.2	106	D	107	149	67	261	−1.9	−0.3	+24	00654	
2	11	17	13.3	652	6.4	106	D	143	167	69	261	—	—	+23	00684	3179
2	12	17	49.5	822	5.9	120	D	60	151	68	268	−1.7	+1.7	+25	00839	4068
2	12	21	21.1	841	8.4	121	D	117	252	52	269	−0.9	−1.9	+24	00873	
2	13	0	22.2	860	7.8	123	D	171	284	21	269	—	—	+24	00920	
2	13	20	27.4	1017	6.8	135	D	76	209	67	274	−1.9	+0.2	+23	01433	
2	14	0	8.7	1033	6.8	136	D	132	271	33	275	−0.1	−2.1	+22	01456	
2	15	2	51,1	1186	6.1	151	D	85	284	13	279	0.0	−1.2	+19	01854	
2	20	1	2.9	1745	7.0	214	R	0	186	39	121	0.0	−2.8	−05	03424	
2	20	4	5.1	1752	6.5	215	R	249	234	21	121	−1.4	−0.9	−06	03518	
2	21	3	37.8	1861	8.1	227	R	250	215	26	118	−2.1	−0.6	−12	03726	
2	21	23	16.8	1960	6.9	237	R	267	136	17	115	−1.5	+1.4	−15	03715	
2	24	2	42.1	2203	8.7	261	R	306	164	20	105	−1.5	−0.2	−22	03949	
2	25	4	26.2	2349	3.1	273	D	100	177	20	100	−2.0	−0.1	−25	11485	10009
3	12	17	52.2	954	6.1	103	D	104	193	69	272	−1.7	−0.7	+24	01182	
3	12	18	34.1	956	6.3	103	D	151	216	65	272	−1.0	−3.4	+23	01275	
3	12	19	44.2	960	6.6	104	D	163	242	56	272	−0.1	−4.3	+23	01293	
3	12	20	47.7	972	7.7	104	D	85	258	46	272	−1.1	−1.0	+23	01322	
3	12	22	31.5	982	6.8	105	D	102	276	28	273	−0.3	−1.5	+23	01346	
3	12	22	36.7	983	6.0	105	D	125	277	27	273	0.0	−1.9	+23	01347	
3	16	17	0.7	1468	4.9	155	D	120	106	27	283	−0.8	+0.3	+08	02301	
3	20	22	59.4	1918	7.0	206	R	3	162	29	135	—	—	−13	03692	
3	22	23	54.4	2146	8.1	229	R	334	155	19	110	−0.6	−0.8	−21	04015	
3	24	0	11.0	2269	5.4	240	R	266	149	14	104	−1.7	+1.1	−24	12354	
3	24	3	22.3	2286	5.4	241	R	257	193	20	104	−2.0	−0.2	−24	12427	
3	25	3	45.6	2424	6.9	252	R	331	186	20	98	—	—	−25	11743	10232
4	6	18	13.3	578	8.9	46	D	89	274	29	254	−0.5	−1.3	+22	00588	
4	6	19	42.1	584	6.0	47	D	83	288	15	255	0.0	−1.1	+22	00607	
4	7	17	49.6	740	6.3	59	D	57	261	45	262	−1.4	0.0	+24	00709	
4	8	20	47.6	923	6.9	74	D	106	280	25	270	−0.1	−1.6	+23	01192	
4	9	21	48.4	1086	6.5	88	D	120	278	23	277	0.0	−1.8	+21	01528	
4	12	22	19.3	1454	7.1	127	D	116	244	35	287	−0.9	−1.8	+08	02285	
4	12	23	34.7	1457	6.7	127	D	143	259	22	287	−0.2	−2.1	+08	02289	
4	13	23	38.6	1566	6.6	139	D	77	247	25	287	−1.2	−1.2	+03	02408	
4	14	18	44.8	1655	6.7	150	D	194	146	38	286	—	—	−01	02521	
4	14	22	18.9	1670	5.1	151	D	152	213	37	285	−0.9	−2.1	−02	03360	
4	19	0	55.8	2108	6.4	198	R	303	200	22	122	−1.7	−1.2	−20	04087	
4	19	1	44.2	2109	6.1	198	R	286	211	18	122	−1.6	−1.3	−20	04093	
4	20	2	45.2	2237	5.1	210	R	303	213	14	110	−1.7	−1.7	−23	12458	
4	20	23	10.2	2364	6.8	220	D	182	152	15	102	—	—	−25	11513	
4	20	23	25.7	2364	6.8	220	R	203	156	16	102	—	—	−25	11513	
4	21	0	55.1	2371	4.9	220	R	323	176	20	102	−1.7	−1.0	−24	12695	
5	5	18	24.2	853	7.0	42	D	34	278	27	266	−1.5	+1.0	+24	00909	
5	9	18	46.3	1414	8.5	95	D	117	221	49	289	−1.3	−1.5	+10	02026	
5	9	22	8.4	1429	6.8	97	D	134	266	17	289	−0.1	−2.0	+09	02226	
5	11	19	40.0	1629	6.8	120	D	141	203	42	290	−1.1	−1.8	−00	02422	
5	11	22	47.5	1639	7.0	121	D	64	249	18	290	−1.1	−0.9	−00	02428	8131
5	22	0	34.8	2877	8.1	234	R	272	154	20	79	−1.8	+0.9	−21	05479	
5	23	0	5.0	2989	6.8	244	R	266	136	16	75	−1.4	+1.4	−17	05992	
5	24	0	24.8	3112	6.2	256	R	238	128	16	72	−1.1	+1.9	−13	05897	
5	24	1	52.6	3119	6.7	256	R	236	148	26	71	−1.5	+1.6	−13	05904	
6	7	20	53.8	1605	6.2	91	D	62	252	18	293	−1.0	−0.8	+00	02729	
6	13	20	4.5	2269	5.4	159	D	156	166	20	274	−1.0	−1.2	−24	12354	
6	17	23	57.1	2838	5.6	204	R	233	175	23	79	−1.7	+0.9	−22	05105	
6	19	0	49.1	2959	7.2	215	R	218	176	27	74	−1.4	+1.2	−18	05637	
6	24	23	45.5	139	8.2	285	R	237	85	11	69	0.0	+1.8	+10	00115	

Date		U. T.		Z. C.	Mag.	Elg. Moon	PH.	P. A.	Az. Moon	Alt.	P. A. C. B. L.	A Min/deg.	B	BD/CD		Double Aitken
7	7	20^h	26^m.9	1893	7.0	96°	D	89°	235°	13°	292°	−1.0	−1.4	−13°	03665	
7	10	20	13.9	2237	5.1	129	D	75	197	20	281	−2.0	−0.3	−23	12458	
7	11	18	45.0	2371	4.9	140	D	71	165	19	276	−2.2	+1.0	−24	12695	
7	18	1	12.2	3169	6.2	208	R	280	192	34	64	−2.5	−0.8	−11	05640	
7	18	21	43.5	3281	7.5	218	R	288	123	21	63	−1.3	+1.1	−06	05972	
7	20	22	51.3	3524	6.9	242	R	315	111	26	64	—	—	+03	04909	17111
7	22	0	33.4	102	8.8	255	R	288	119	39	66	−1.8	+0.7	+09	00090	
7	23	23	32.7	375	6.8	280	R	265	81	18	73	−0.1	+1.4	+18	00325	
7	26	2	31.7	714	6.2	308	R	293	86	32	84	−0.8	+0.7	+23	00733	
8	6	18	53.0	2194	8.7	99	D	70	208	18	284	−1.7	−0.6	−22	03938	
8	9	19	14.4	2590	8.2	131	D	113	178	20	270	−2.2	−0.4	−25	12544	
8	10	22	5.2	2754	5.9	143	D	101	206	18	265	−2.0	−1.2	−23	14844	
8	15	23	7.0	3370	6.2	200	R	194	163	41	56	−0.6	+2.4	−03	05539	
8	17	0	10.3	3501	5.3	213	R	266	168	48	59	−2.1	+0.4	+02	04709	
8	18	0	51.0	77	7.9	225	R	247	165	53	62	−1.6	+1.1	+08	00080	
8	19	2	21.0	218	8.9	238	R	266	182	59	65	−2.0	+0.1	+13	00222	
8	19	21	47.4	335	8.6	249	R	195	85	20	69	+0.5	+2.6	+16	00266	
8	20	1	5.8	349	8.6	251	R	306	127	54	70	—	—	+17	00353	
8	20	22	32.3	472	5.0	262	R	258	81	21	74	−0.1	+1.5	+20	00527	
8	24	2	18.9	997	6.8	304	R	221	87	30	93	+0.1	+3.1	+22	01352	5129
8	25	1	41.6	1138	7.1	318	R	235	74	12	97	+0.4	+2.2	+20	01822	
9	6	19	5.7	2692	5.7	112	D	136	194	20	267	—	—	−24	14472	
9	8	23	8.3	2966	8.0	135	D	4	229	12	259	+0.6	+2.2	−17	05936	
9	9	21	47.3	3083	7.3	146	D	86	202	29	258	−1.9	−0.6	−14	05936	14638
9	14	20	34.4	163	7.2	206	R	246	109	33	58	−0.7	+1.8	+10	00128	920
9	14	23	55.2	177	7.1	207	R	242	172	57	59	−1.5	+1.1	+11	00158	
9	16	1	43.6	317	9.4	221	R	261	199	61	66	−1.8	+0.1	+16	00247	
9	16	21	23.4	439	8.0	232	R	241	91	30	71	−0.3	+1.8	+19	00400	
9	17	2	52.6	459	6.7	234	R	222	208	64	72	−1.5	+1.7	+20	00514	
9	17	20	41.9	582	5.8	245	R	268	73	15	77	0.0	+1.3	+22	00605	
9	18	2	29.0	612	7.6	247	R	252	162	67	78	−1.7	+0.9	+22	00637	3019
9	19	22	10.5	916	4.3	272	R	310	67	10	90	−0.2	+0.3	+23	01170	
9	20	0	34.4	929	5.8	273	R	269	90	34	91	−0.6	+1.3	+23	01226	4751
9	20	0	52.0	931	6.7	273	R	244	93	37	91	−0.5	+2.1	+23	01232	4768
9	20	1	35.6	942	6.3	274	R	221	102	44	91	−0.5	+3.4	+22	01220	
9	21	2	1.4	1098	8.0	287	R	204	97	37	97	—	—	+20	01743	
10	2	17	55.8	2499	6.6	70	D	83	217	11	274	−1.3	−1.0	−24	13288	
10	5	18	27.7	2908	6.9	102	D	45	194	25	260	−1.3	+0.6	−19	05650	
10	6	19	14.7	3029	6.9	114	D	114	195	28	256	−2.9	−1.6	−16	05690	
10	8	20	0.4	3281	7.5	137	D	84	184	39	254	−2.1	+0.1	−06	05972	
10	8	23	50.0	3290	7.3	139	D	23	244	17	254	−0.2	+1.0	−05	05790	
10	15	1	27.6	563	6.9	216	R	292	201	66	74	−1.9	−1.3	+22	00572	
10	15	1	29.3	566	5.9	216	R	227	202	66	74	−1.6	+1.6	+21	00535	
10	15	21	43.2	716	6.2	228	R	317	92	37	81	−1.6	−0.6	+23	00739	
10	15	23	43.1	727	8.6	229	R	227	119	57	82	−1.0	+2.5	+23	00747	
10	16	23	10.3	887	7.0	242	R	297	97	41	89	−1.2	+0.3	+23	01087	
10	17	4	38.1	916	4.3	245	D	46	232	60	90	−2.3	+1.8	+23	01170	
10	17	23	15.8	1051	6.7	256	R	209	90	31	95	—	—	+21	01426	5553
10	17	23	39.4	1054	6.8	256	R	314	93	35	95	−1.1	−0.3	+21	01428	5564
10	19	0	10.3	1192	7.4	269	R	271	92	28	101	−0.6	+1.3	+18	01778	
10	20	1	26.1	1328	7.0	283	R	326	99	29	105	−0.8	−0.8	+14	01989	
10	21	1	56.1	1440	6.7	296	R	291	100	22	107	−0.6	+0.7	+09	02239	
11	3	19	24.1	3103	7.7	94	D	25	219	24	253	−0.5	+1.0	−13	05881	
11	4	16	34.6	3216	6.6	104	D	68	160	35	251	−1.7	+1.1	−09	05876	
11	4	21	19.7	3230	8.4	106	D	35	238	19	251	−0.4	+0.5	−08	05789	
11	5	19	50.1	3340	7.5	117	D	340	208	39	250	—	—	−03	05505	
11	5	20	8.4	3340	7.5	117	R	313	213	37	250	—	—	−03	05505	
11	7	19	22.0	51	7.2	142	D	68	167	52	253	−1.6	+1.0	+06	00043	
11	8	16	24.7	177	7.1	153	D	350	100	27	259	—	—	+11	00158	
11	12	0	12.3	664	5.4	197	R	212	200	67	47	−1.7	+3.0	+22	00699	
11	12	4	43.1	693	6.0	199	R	300	277	27	76	−0.1	−2.0	+23	00715	
11	13	4	47.3	859	6.5	213	R	310	267	38	87	−0.3	−2.2	+23	01007	
11	13	21	38.7	1001	7.2	224	R	299	94	37	94	−1.0	+0.3	+22	01364	
11	14	1	9.4	1021	6.3	226	R	309	160	66	94	−1.6	−1.4	+22	01416	
11	14	23	27.0	1151	6.8	239	R	252	107	43	100	−1.0	+1.9	+19	01784	
11	15	4	12.4	1175	5.0	241	R	310	222	58	101	−1.1	−1.9	+18	01733	
11	16	2	18.9	1301	8.0	253	R	263	145	55	106	−1.9	+0.9	+14	01946	
11	17	0	30.1	1410	5.3	266	R	256	106	29	109	−0.9	+2.0	+10	02014	7416
11	19	1	29.3	1629	6.8	292	R	259	107	15	111	−0.7	+2.0	−00	02422	
11	19	4	17.2	1639	7.0	293	R	322	145	38	111	−1.0	−0.9	−00	02428	8131
11	20	3	33,8	1745	7.0	305	R	332	126	23	110	−0.4	−0.9	−05	03424	

Date		U. T.		Z. C.	Mag.	Elg. Moon	PH.	P. A.	Az. Moon	Alt.	P. A. C. B. L.	A Min/deg,	B	BD/CD		Double Aitken
11	20	4^h	4^m7	1748	8.8	305°	R	4°	133°	27°	110°	—	—	−06°	03509	
11	21	4	38.5	1858	6.5	317	R	287	133	21	107	−1.1	+0.7	−11	03398	
12	2	16	20.4	3290	7.3	85	D	50	181	40	248	−1.5	+1.1	−05	05790	
12	3	17	0.5	3410	7.7	96	D	50	180	45	248	−1.4	+1.2	−00	04483	
12	3	21	3,9	3426	8.8	98	D	145	248	21	248	—	—	−00	04498	
12	3	21	12.3	3426	8.8	98	R	159	250	20	248	—	—	−00	04498	
12	5	16	16.1	102	8.8	120	D	343	130	45	250	—	—	+09	00090	
12	5	16	34.0	102	8.8	120	R	315	136	48	250	—	—	+09	00090	
12	5	17	8.7	108	8.6	121	D	37	147	51	250	−1.0	+2.1	+09	00097	
12	5	18	9.1	114	8.4	121	D	45	170	55	250	−1.3	+1.6	+09	00099	709
12	6	18	3.0	260	9.1	134	D	117	145	56	254	−2.6	−0.8	+14	00270	
12	7	16	35.0	397	7.5	147	D	101	102	38	258	−1.1	+1.0	+18	00337	2042
12	7	20	3.3	411	7.3	148	D	108	172	64	259	−2.1	−0.7	+18	00347	2122
12	8	19	54.7	566	5.9	162	D	84	136	62	266	−1.5	+0.8	+21	00535	
12	8	23	33.1	582	5.8	164	D	92	241	55	267	−1.4	−0.9	+22	00605	
12	11	1	58.6	946	3.2	193	D	94	246	53	93	−1.2	−1.1	+22	01241	4841
12	11	3	3.2	946	3.2	193	R	294	261	42	93	−0.6	−1.7	+22	01241	4841
12	11	18	25.5	1077	3.7	204	D	114	76	15	99	−0.2	+0.7	+20	01687	5742
12	11	19	18.6	1077	3.7	204	R	257	85	25	99	−0.2	+1.6	+20	01687	5742
12	12	3	4.4	1109	7.3	208	R	220	244	50	101	—	—	+19	01685	
12	12	22	29.6	1238	6.1	220	R	267	113	44	106	−1.2	+1.2	+16	01662	
12	13	1	51.0	1247	6.8	221	R	306	191	61	106	−1.4	−1.4	+16	01687	
12	15	0	18.7	1489	6.8	248	R	356	122	36	112	−0.4	−3.0	+06	02265	
12	16	2	38.9	1605	6.2	262	R	328	152	42	113	−0.9	−1.3	+00	02729	
12	17	1	28.1	1713	5.8	274	R	285	124	23	113	−1.0	+0.8	−04	03152	
12	18	4	44.4	1829	8.3	288	R	315	165	33	111	−1.2	−0.8	−10	03546	
12	19	3	47.7	1944	5.6	299	R	289	141	21	109	−1.2	+0.6	−14	03739	
12	29	16	40.6	3259	7.4	54	D	58	222	29	246	−1.1	0.0	−07	05727	
12	30	17	13.5	3371	6.4	66	D	47	223	35	245	−1.1	+0.5	−02	05858	
12	31	19	51.8	3504	8.2	78	D	29	252	23	245	−0.5	+0.9	+03	04895	
								1974								
1	4	17	16.8	472	5.0	127	D	38	131	59		−0.9	+2.5	+20	00527	
1	4	20	38.0	486	5.2	128	D	103	228	59		−1.6	−1.3	+20	00543	
1	5	22	14.1	664	5.4	143	D	129	242	55		−1.1	−2.6	+22	00699	
1	6	2	24.8	693	6.0	145	D	16	289	14		—	—	+23	00715	
1	12	23	2.9	1670	5.1	241	R	284	119	23		−0.9	+0.8	−02	03360	
1	26	17	22.5	3340	7.5	36	D	61	250	15		−0.5	−0.5	−03	05505	
1	27	17	14.3	3464	7.1	47	D	344	244	27		—	—	+01	04731	
1	27	17	29.6	3464	7.1	47	R	319	247	24		—	—	+01	04731	
1	29	20	13.7	177	7.1	72	D	99	268	19		−0.4	−1.8	+11	00158	
2	1	16	32.0	573	6.8	108	D	119	142	63		−2.1	−0.8	+21	00539	
2	1	19	29.7	582	5.8	109	D	67	232	59		−1.6	+0.2	+22	00605	
2	2	16	19.5	734	6.6	121	D	91	115	54		−1.4	+0.9	+23	00757	
2	2	22	50.2	761	6.7	124	D	149	267	37		+0.1	−3.3	+22	00818	
2	3	17	38.7	907	6.9	136	D	90	120	57		−1.4	+0.8	+22	01135	
2	4	1	3.9	946	3.2	139	D	22	278	25		—	—	+22	01241	4841
2	4	1	12.1	946	3.2	139	R	5	279	23		—	—	+22	01241	4841
2	4	17	25.5	1077	3.7	150	D	133	104	43		−1.2	−0.5	+20	01687	5742
2	8	21	3.5	1605	6.2	208	R	269	120	27		−1.1	+1.4	+00	02729	
2	11	0	23.3	1852	6.0	235	R	304	150	29		−1.2	−0.2	−10	03570	
2	11	2	22.6	1858	6.5	236	R	305	184	33		−1.5	−0.9	−11	03398	
2	11	23	19.1	1967	5.7	248	R	248	127	12		−1.5	+2.4	−15	03731	
2	27	18	7.0	397	7.5	66	D	84	254	41		−1.1	−1.0	+18	00337	2042
3	1	20	27.9	709	4.3	92	D	90	264	39		−0.8	−1.3	+22	00739	
3	2	19	58.2	861	6.5	105	D	164	244	54		—	—	+22	00996	
3	3	0	0.6	4006	0.2	107	D	80	289	13		0.0	−1.0	Saturn		
3	3	0	48.7	4006	0.2	107	R	300	297	5		+0.5	−1.5	Saturn		
3	11	23	12.5	2039	5.6	228	R	280	144	19		−1.3	+0.8	−17	04046	
3	12	0	1.5	2045	6.4	228	R	221	155	23		—	—	−17	04053	
3	12	1	12.7	2051	5.7	228	R	240	173	26		−2.8	+1.3	−18	03789	
3	14	0	42.5	2305	5.9	252	R	227	144	13		−2.4	+2.8	−23	12700	
3	14	2	29.9	2314	5.8	252	R	247	168	21		−2.2	+1.0	−23	12731	
3	27	17	27.4	487	5.2	48	D	66	262	38		−1.0	−0.5	+20	00551	
3	27	18	18.0	492	5.9	48	D	60	271	29		−0.8	−0.4	+20	00556	
3	27	20	10.4	503	7.2	49	D	115	289	10		+0.3	−1.8	+20	00573	
3	28	19	11.5	656	4.4	62	D	120	272	31		−0.2	−2.2	+21	00642	
3	28	19	23.0	657	5.4	62	D	147	274	29		+0.3	−3.4	+21	00643	

Date		U. T.		Z. C.	Mag.	Elg. Moon	Ph.	P. A.	Az. Moon	Alt.	A Min/deg.	B Min/deg.	BD/CD		Double Aitken
3	29	21^h	15^m.4	828	6.5	76°	D	119°	282°	20°	+0.1	−1.8	+22°	00925	
3	30	18	22.9	984	6.6	87	D	106	234	57	−1.4	−1.3	+21	01232	
3	31	19	25.8	1130	7.2	101	D	86	233	55	−1.6	−0.7	+19	01734	
4	24	17	35.1	599	4.5	30	D	19	277	25	—	—	+21	00585	
4	26	19	3.0	939	7.0	58	D	58	271	30	−1.0	−0.4	+21	01146	
4	30	22	30.9	1482	6.3	112	D	85	256	21	−0.7	−1.3	+06	02259	
5	1	18	17.6	1582	6.3	124	D	112	168	46	−1.6	−0.4	+01	02495	
5	1	20	59.6	1590	6.9	125	D	105	221	38	−1.4	−1.3	+01	02502	
5	2	23	12.3	1713	5.8	139	D	68	238	22	−1.3	−0.9	−04	03152	
5	25	20	24.7	1198	6.2	55	D	88	282	11	0.0	−1.2	+16	01598	
6	26	19	53.6	1752	6.5	90	D	144	236	20	−0.8	−2.1	−06	03518	
7	2	22	36.0	2523	4.9	162	D	138	197	20	—	—	−23	13412	
7	4	19	56.5	2797	3.0	183	R	241	137	13	−1.4	+1.8	−21	05275	
7	17	10	52.0	4002	−3.4	330	D	78	242	55	−1.7	−0.5	Venus		
7	17	12	1.7	4002	−3.4	330	R	304	259	43	−0.6	−2.3	Venus		
8	6	21	32.1	3482	5.6	220	R	251	115	25	−0.9	+1.8	+01	04744	
8	24	18	36.3	2290	2.5	89	R	303	211	17	−1.7	−1.6	−22	04068	
9	10	1	50.0	851	6.3	276	D	164	104	45	—	—.	+21	00918	
9	10	2	7.0	851	6.3	276	R	191	108	48	—	—	+21	00918	
9	12	2	2.7	1158	5.2	302	R	247	89	25	−0.3	+2.1	+18	01701	
9	27	16	59.3	3163	7.3	136	D	89	134	23	−1.5	+1.3	−10	05714	
9	27	23	15.1	3184	7.1	138	D	97	233	20	−1.1	−1.2	−09	05827	
9	27	23	18.6	3185	5.3	138	D	84	234	19	−1.3	−1.8	−09	05829	
10	5	22	38.6	631	5.6	231	R	310	103	43	−1.7	−0.4	+21	00618	
10	6	23	46.6	792	5.1	244	R	312	105	45	−1.7	−0.6	+21	00816	
10	20	16	41.7	2604	6.6	61	D	136	208	17	—	—	−22	04516	
10	21	17	48.3	2757	5.1	73	D	57	213	18	−1.1	−0.2	−20	05339	
10	21	18	47.0	2760	6.7	73	D	10	225	12	—	—	−20	05344	11872
10	26	22	38.1	3371	6.4	130	D	64	239	26	−0.9	−0.4	−02	05858	
10	27	16	48.5	3482	5.6	139	D	64	123	31	−1.1	+1.8	+01	04744	
10	28	0	14.9	3501	5.3	141	D	75	253	21	−0.7	−0.9	+02	04709	
11	2	23	10.4	752	4.7	214	R	202	129	59	—	—	+21	00751	
11	3	2	15.4	766	6.0	215	R	236	222	62	−1.9	+1.0	+21	00766	
11	5	21	44.0	1198	6.2	253	D	13	79	13	—	—	+16	01598	
11	5	21	47.3	1198	6.2	253	R	6	80	14	—	—	+16	01598	
11	6	23	10.7	1341	4.3	267	D	114	88	15	−0.3	+0.6	+12	01948	7115
11	7	0	11.6	1341	4.3	267	R	280	99	26	−0.7	+1.0	+12	01948	7115
11	9	3	37.1	1582	6.3	295	R	288	129	34	−1.2	+0.5	+01	02495	
12	7	2	47.1	1670	5.1	278	R	281	137	33	−1.4	+0.6	−02	03360	
12	18	16	21.7	3154	7.4	54	D	357	215	29	—	—	−10	05696	
12	19	16	49.4	3272	5.8	65	D	3	213	34	0.0	+2.9	−06	05960	
12	20	20	46.5	3397	7.4	78	D	62	259	11	−0.3	−0.5	−01	04393	
12	21	16	29.6	3501	5.3	88	D	45	182	49	−1.4	+1.4	+02	04709	
12	24	23	47.6	348	6.8	125	D	27	272	22	−0.9	+1.2	+16	00281	
12	25	19	14.8	460	7.0	136	D	25	171	64	−1.1	+3.3	+18	00418	
12	27	1	9.1	633	5.4	151	D	118	271	30	−0.3	−2.1	+20	00733	
12	27	3	5.5	651	5.9	152	D	156	290	10	+1.0	−3.3	+20	00751	
12	27	16	5.2	752	4.7	160	D	96	82	23	—0.3	+1.2	+21	00751	
12	31	2	49.0	1271	5.9	206	R	344	236	47	−0.2	—3.0	+14	01899	

PHOTOELECTRIC OBSERVATIONS OF SOME FLARE STARS

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During the period 1967—1970 photoelectric observations of UV Ceti stars were carried out with the 65 cm refractor of Belgrade Astronomical Observatory.

The photometric channel of the stellar polarimeter (Oskanjan, et al., 1969) has been used. During the reported interval the following modifications of the photometer have taken place:

1) The photometer has been convertea into a pure D. C. set containing: the photomultiplier, a Keithley micro-microammeter and the recorder.

2) On 9. II. 1968 the photomultiplier EMI 9558 B has been replaced by EMI 9502 S.

3) From 23. VI. 1967 to 5. XI. 1969 the observations were done without any filter. Before and after this interval 2 mm GG-11 and 1 mm BG-12+

+2 mm GG-13 filters were used for V and B regions respectively.

The total monitoring time was distributed as follows:

Star	Total duration
UV Ceti	858^m
V 371 Ori	269
BD +1°1522	368
YZ CMi	342
AD Leo	5825
SZ UMa	100
BD +55°1823	3023
BD −8°4352	2506
DO Cep	1930
EV Lac	2730
EQ Peg	1499

In all 19450^m or $324^h\,10^m$ of effective patrol observations were realized. Nine flare-like phenomena are pointed out in Table I. The most completely observed flares are listed in Table II.

The observations partly cover some of the intervals of the international cooperative campaigns.

In Table I the detailed coverage is presented. The moments of the beginning and the end of the monitoring time are shown without an interruption at midnight. The column F shows the photometric region. In the column σ^m the error of the observation according to formula

$$\sigma^m = \pm\, 2{,}5 \;\log \frac{I_0+\sigma}{I_0}$$

is given. Here I_0 denotes the mean intensity deflection of the undisturbed star and σ is the standard deviation of random noise fluctuations measured at one-minute integration intervals along the averaged deflection of the star signal. Δm_{lim} is given by

$$\Delta m_{lim} = -2{,}5 \;\log \frac{3\sigma}{I_0}.$$

In Table II the flare data are given. According to the recommendation of the IAU Working Group on Flare Stars (Andrews, et al., 1969) Δt_1 and Δt_2 are the durations of the flare before maximum and after maximum respectively. Δm_f is the magnitude difference of the star introduced by the flare, found from

$$\Delta m_f = -2{,}5 \;\log \frac{I_{0+f}}{I_0}.$$

Here I_{0+f} represents the deflection of star signal at the maximum phase of the flare. The column P contains the integrated intensity of the flare expressed in minutes. X is the air mass at the time of the flare. The definition of σ^m is the same as in Table I.

Figures 1 and 2 represent the light curves of the observed flares in the relative intensity units. The time scales are shown in minutes after the brightness maxima.

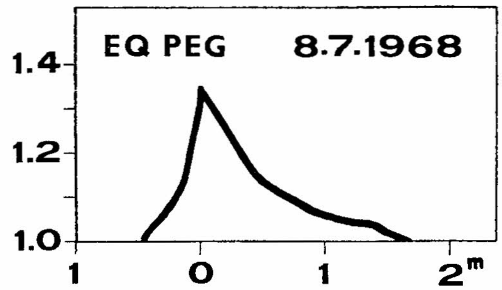

Fig. 1

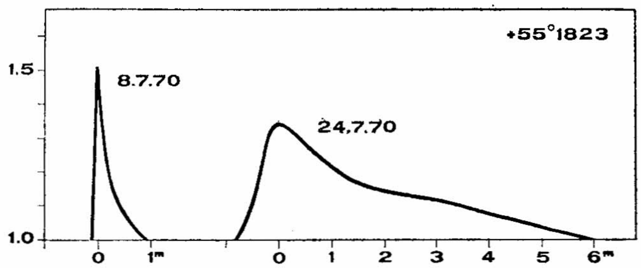

Fig. 2

Table I

Date	Begin. of observ. UT	End UT	Duration of obs.	F	σ^m	Δm_{lim}	Remarks
UV Ceti							
1967 IX 30	24^h20^m	25^h20^m	60	—	0.256	+2.0	1
X 2	22 31	22 52	21	—	—	—	
	22 54	22 58	4	—	—	—	
4	23 18	23 38	20	—	—	—	
	23 46	24 27	41	—	—	—	
12	22 32	24 25	113	—	—	—	
XI 2	21 34	23 27	113	—	—	—	
4	21 19	21 45	26	—	—	—	
24	19 34	21 10	96	—	—	—	
1969 X 4	22 28	22 33	5	—	0.066	+1.8	
	22 35	22 39	4	—	0.066	+1.8	
	22 45	23 12	27	—	0.066	+1.8	
	23 21	23 51	30	—	0.066	+1.8	
	24 02	24 31	29	—	0.066	+1.8	
	24 39	24 56	17	—	0.066	+1.8	
6	22 39	22 42	3	—	0.060	+1.9	
	22 47	23 04	17	—	0.060	+1.9	
	23 10	23 39	29	—	0.060	+1.9	
	23 44	24 19	35	—	0.060	+1.9	
8	22 06	22 28	22	—	—	—	
	22 33	22 41	7	—	—	—	
16	22 29	22 46	17	—	0.056	+2.0	
	22 56	23 42	46	—	0.056	+2.0	
	23 47	24 03	16	—	0.056	+2.0	
18	22 19	22 32	13	—	—	—	
	22 35	23 13	38	—	—	—	
	23 31	23 40	9	—	—	—	

Date	Begin. of observ. UT	End UT	Duration of obs.	F	σm	Δm_{lim}	Remarks
V 371 Ori							
1967 X 6	25 28	26 36	68	—	—	—	
12	24 59	26 50	111	—	—	—	
1968 II 22	18 35	20 05	90	—	—	—	
BD+1°1522							
1967 II 24	17 40	21 10	210	V	—	—	
1968 XI 26	23 30	24 00	30	—	—	—	
1970 XI 6	23 36	23 48	12	V	—	—	
XII 30	22 22	22 39	17	V	—	—	
	22 44	23 16	32	V	—	—	
	23 19	24 26	67	V	—	—	
YZ CMi							
1967 I 4	21 10	25 30	260	V	—	—	
1970 XII 20	23 28	24 30	62	V	0.038	+2.4	
	24 33	24 53	20	V	0.038	+2.4	
AD Leo							
1967 I 14	22 20	25 20	180	V	—	—	
16	21 45	24 45	180	V	—	—	
	24 58	25 18	20	V	—	—	
18	22 35	23 00	25	V	—	—	
	23 05	24 35	90	V	—	—	
20	21 55	25 30	215	V	—	—	
	25 42	26 00	18	V	—	—	
II 6	19 30	21 00	90	V	—	—	
10	19 00	23 30	210	V	—	—	
12	21 23	21 48	25	V	—	—	2
14	21 35	24 32	177	V	—		
	25 06	25 46	40	V	—	—	
16	23 47	24 07	20	V	—	—	
III 2	21 12	23 12	120	V	—	—	
6	18 15	18 55	40	V	—	—	
	19 30	20 30	60	V	—	—	
	20 36	20 56	20	V	—	—	
	21 18	24 15	177	V	—	—	
	24 31	25 20	49	V	—	—	
26	18 41	19 21	40	V			
IV 2	18 50	23 24	274	V	—	—	3,4
	23 32	23 58	26	V	—	—	
3	19 04	20 27	83	V	—	—	
5	19 37	21 45	128	V	—	—	
	22 36	24 40	124	V	—	—	
7	23 00	23 30	30	V	—	—	
8	18 40	19 05	25	V	—	—	
	22 37	22 57	20	V	—	—	
12	19 32	20 45	73	V	—	—	
	20 48	21 30	42	V	—	—	
	22 00	23 54	114	V	—	—	
18	18 53	20 20	87	V	—	—	
20	21 05	21 35	30	V	—	—	
24	19 00	21 40	160	V	—	—	
30	18 55	22 25	210	V	—	—	
V 1	19 05	19 15	10	V	—	—	
28	19 29	21 25	116	V	—	—	
VI 2	19 50	19 56	6	V	—	—	
6	19 38	20 38	60	V	—	—	
16	19 45	20 07	22	V	—	—	
XI 2	26 17	27 03	46	—	—	—	
4	26 03	27 03	60	—	—	—	
1968 II 18	22 16	25 16	180	—	—	—	
22	20 45	21 36	51	—	—	—	
	22 03	24 00	117	—	—	—	
28	21 35	21 50	15	—	—	—	
	21 55	22 20	25	—	—	—	
	22 23	23 08	45	V	—	—	
III 8	19 36	20 53	77	—	—	—	
	22 05	23 35	90	—	—	—	
20	19 00	20 08	68	—	—	—	
	20 18	21 00	42	—	—	—	
24	19 15	19 50	35	—	—	—	
	21 11	22 11	60	—	—	—	
	22 25	23 12	47	—	—	—	
26	20 50	22 00	70	—	—	—	
	22 36	22 45	9	—	—	—	
	22 50	23 45	55	—	—	—	
28	20 20	20 43	23	—	—	—	
	21 43	22 30	47	—	—	—	
	22 53	24 19	86	—	—	—	
30	21 15	23 35	140	—	—	—	
IV 14	19 40	21 00	80	—	—	—	
18	19 18	20 13	55	—	—	—	
	20 35	21 10	35	—	—	—	
	21 20	21 46	26	—	—	—	
22	20 28	21 30	62	—	—	—	
24	19 52	20 02	10	—	—	—	
	21 00	22 10	70	—	—	—	
V 8	20 15	21 23	68	—	—	—	
1969 XI 16	24 06	24 25	19	V	0.036	+2.5	
	24 37	25 15	38	V	0.036	+2.5	
	25 26	26 20	54	V	0.036	+2.5	
	26 35	26 47	12	V	0.036	+2.5	
	26 53	27 43	50	V	0.036	+2.5	
	27 55	28 17	22	V	0.036	+2.5	
1970 III 8	20 27	20 32	5	V	0.038	+2.4	
	20 42	20 49	7	V	0.038	+2.4	
	21 20	21 37	17	V	0.038	+2.4	
30	19 40	19 47	7	V	0.015	+3.4	
	19 53	20 46	53	V	0.015	+3.4	
	21 01	22 21	80	V	0.015	+3.4	
IV 4	22 22	22 33	11	V	—	—	
	22 58	23 16	18	V	—	—	
6	20 11	20 24	13	V	0.020	+3.2	
	20 32	21 00	28	V	0.020	+3.2	
	21 25	21 55	30	V	0.020	+3.2	
	21 58	22 16	18	V	0.020	+3.2	
V 6	20 56	21 36	40	V	0.040	+2.4	
	21 42	21 49	7	V	0.040	+2.4	
26	20 12	20 18	6	V	—	—	
	20 21	21 09	48	V	—	—	
XII 30	24 55	25 07	12	V	—	—	
SZ UMa							
1970 VII 8	21 02	21 19	17	B	0.043	+2.3	
	21 23	22 12	49	B	0.043	+2.3	
10	21 24	21 58	34	V	0.040	+2.4	

BD+55°1823

Date	Begin. of observ. UT	End UT	Duration of obs.	F	σm	Δm_{lim}	Remarks
1967 VI 12	25 05	25 50	45	V	—	—	
16	25 01	25 35	34	V	—	—	
20	24 25	25 10	45	V	—	—	
	25 38	25 53	15	V	—	—	
22	22 10	25 50	220	V	—	—	
24	23 41	25 14	93	—	—	—	
26	23 09	25 30	141	—	—	—	
VII 6	23 35	25 00	85	—		—	
13	23 07	24 00	53	—	—	—	
	24 08	25 04	56		—	—	
IX 8	19 50	21 05	75	—	—	—	
26	19 02	20 51	109	—	—	—	
28	20 00	20 50	50	—	—	—	
30	19 06	19 57	51	—	—	—	
X 2	18 13	19 23	70	—	—	—	
22	17 54	19 44	110	—	—	—	
24	17 25	18 30	65	—	—	—	
	18 33	19 45	72	—	—	—	
26	17 20	18 35	75	—	—	—	
	19 17	19 32	15	—	—	—	
1968 VI 8	22 54	24 16	82	—	—	—	
1970 VI 30	22 24	22 37	13	B	0.028	+2.8	
	22 42	22 49	7	B	0.028	+2.8	
	22 57	25 00	123	B	0.028	+2.8	
VII 2	20 43	21 12	29	B	0.040	+2.4	
	21 20	21 31	11	B	0.040	+2.4	
8	22 44	23 06	22	B	0.055	+2.0	
	23 14	23 42	28	B	0.055	+2.0	5
	23 51	24 00	9	B	0.055	+2.0	
	24 04	24 17	13	B	0.055	+2.0	
10	22 35	23 55	80	B	0.248	+1.1	
12	21 37	22 15	38	B	0.058	+2.0	
	22 19	23 03	44	B	0.058	+2.0	
	23 14	24 26	72	B	0.058	+2.0	
22	20 12	20 53	41	B	0.045	+2.1	
24	20 15	21 38	83	V	0.043	+3.0	6
	21 46	21 54	8	V	0.043	+3.0	
	21 59	22 21	22	V	0.043	+3.0	
	22 29	22 47	18	V	0.043	+3.0	
26	20 05	20 20	15	V	0.020	+3.1	
	20 26	20 38	12	V	0.020	+3.1	
	20 41	21 47	66	V	0.020	+3.1	
	21 54	22 27	33	V	0.020	+3.1	
	22 39	23 19	40	V	0.020	+3.1	
	23 28	23 33	5	V	0.020	+3.1	
	23 55	24 30	35	V	0.020	+3.1	
28	20 37	22 18	101	V	0.017	+3.2	
VIII 4	20 42	22 15	93	V	0.017	+3.3	
	22 19	23 22	63	V	0.017	+3.3	
6	21 18	21 51	33	V	0.030	+3.0	
	21 55	22 07	12	V	0.030	+3.0	
	22 14	22 41	27	V	0.030	+3.0	
10	21 11	21 32	21	V	—	—	
	21 43	22 11	28	V	—	—	
12	20 08	20 24	16	V	0.022	+3.0	
	20 28	21 50	82	V	0.022	+3.0	
14	21 14	21 56	42	V	0.045	+2.3	
	22 00	22 56	56	V	0.045	+2.3	
	23 00	23 21	21	V	0.045	+2.3	

BD−8°4352B

Date	Begin. of observ. UT	End UT	Duration of obs.	F	σm	Δm_{lim}	Remarks
1967 IV 12	24 11	25 44	93	V	—	—	
20	22 05	26 50	285	V	—	—	
30	22 37	25 10	153	V	—	—	
	25 30	26 00	30	V	—	—	7
V 1	23 35	24 05	30	V	—	—	
	24 52	25 35	43	V	—	—	
28	21 45	25 05	200	V	—	—	
31	21 05	21 13	8	V	—	—	
VI 2	22 00	25 20	200	V	—	—	
4	21 55	22 05	10	V	—	—	
	23 16	24 23	67	V	—	—	
6	20 00	21 10	70	V	—	—	
	24 25	25 30	65	V	—	—	
16	20 50	24 48	238	V	—	—	
24	20 06	21 35	89	—	—	—	
	21 43	23 40	117	—	—	—	
26	20 17	21 50	93	—	—	—	
	21 58	22 15	17	—	—	—	
VII 6	19 50	20 15	25	—	—	—	
13	19 50	21 43	113	—	—	—	
	21 48	22 54	66	—	—	—	
26	21 30	22 04	34	—	—	—	
1968 VI 14	21 17	22 12	55	—	0.012	+3.7	8
	22 21	22 45	24	—	0.012	+3.7	
18	20 27	20 46	19	—	—	—	
	21 04	21 24	20	—	—	—	
	21 29	22 03	34	—	—	—	
22	20 15	20 29	14	—	—	—	
	20 38	21 12	34	—	—	—	
26	21 02	21 25	23	—	—	—	
	21 46	21 56	10	—	—	—	
28	19 45	20 10	25	—	—	—	
	20 23	21 00	37	—	—	—	
	22 21	22 42	21	—	—	—	
30	21 26	21 50	24	—	—	—	
1970 VI 24	20 46	20 51	5	B	—	—	
	20 57	21 20	23	B	—	—	
28	20 06	20 14	8	B	0.040	+2.4	
	20 20	21 22	62	B	0.040	+2.4	
	21 30	21 52	22	B	0.040	+2.4	

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Date	Begin. of observ. UT	End UT	Duration of obs.	F	σm	Δm_{lim}	Remarks
1967 I 4	18 02	20 25	143	V	—	—	
16	19 30	20 34	64	V	—	—	
26	18 08	18 55	47	V	—	—	
	19 08	19 33	25	V	—	—	
VIII 16	21 30	22 50	80	—	—	—	
	23 25	25 05	100	—	—	—	
IX 4	22 20	23 00	40	—	—	—	
6	25 06	26 20	74	—	—	—	
8	22 35	24 55	140	—	—	—	
24	22 30	23 30	60	—	—	—	
	23 38	25 00	82	—	—	—	
26	22 35	26 05	210	—	—	—	
28	23 48	24 11	23	—	—	—	
30	21 34	23 10	96	—	—	—	
X 26	23 20	24 43	83	—	—	—	

Date	Begin. of observ. UT	End of observ. UT	Duration of obs.	F	σm	Δm_{lim}	Remarks
XI 4	23 25	23 40	15	–	–	–	
20	17 20	18 25	65	–	–	–	
22	17 14	18 09	55	–	–	–	
	18 15	18 30	15	–	–	–	
1969 X 6	21 00	21 22	22	–	0.038	+2.4	
	21 27	21 51	24	–	0.038	+2.4	
	22 01	22 15	14	–	0.038	+2.4	
8	22 56	23 00	4	–	0.040	+2.4	
	23 05	23 42	37	–	0.040	+2.4	
	23 53	24 45	52	–	0.040	+2.4	
16	20 46	20 51	5	–	0.023	+3.0	
	21 01	22 12	71	–	0.023	+3.0	
17	19 41	20 06	25	–	–	–	
	20 11	20 24	13	–	–	–	
	20 31	20 53	22	–	–	–	
18	21 02	21 33	31	–	–	–	
20	20 19	20 58	39	–	0.009	+4.0	
	21 08	21 35	27	–	0.009	+4.0	
	21 41	21 49	8	–	0.009	+4.0	
XI 4	19 47	20 03	16	–	0.010	+3.8	
	20 15	20 54	39	–	0.010	+3.8	
	21 00	21 18	18	–	0.010	+3.8	
	21 25	21 50	25	–	0.010	+3.8	
	22 02	22 17	15	–	0.010	+3.8	
	22 23	22 29	6	–	0.010	+3.8	

EV Lac

Date	Begin. of observ. UT	End of observ. UT	Duration of obs.	F	σm	Δm_{lim}	Remarks
1967 VII 19	24 00	25 05	65	–	–	–	
26	23 15	23 22	7	–	–	–	
	23 45	24 00	15	–	–	–	
	24 03	24 43	40	–	–	–	
VIII 2	25 25	26 03	38	–	–	–	
10	24 45	26 00	75	–	–	–	
XII 20	19 25	21 00	95	–	–	–	
1968 X 20	20 50	22 15	85	–	–	–	
22	21 26	22 36	70	–	–	–	
24	20 26	21 56	90	–	–	–	
28	21 20	21 35	15	–	–	–	
XI 8	19 56	21 00	64	–	–	–	
1969 IX 18	19 48	19 56	8	–	0.080	+1.6	
	19 59	20 02	3	–	0.080	+1.6	
	20 05	20 14	9	–	0.080	+1.6	
	20 19	20 27	8	–	0.080	+1.6	
	20 28	20 35	7	–	0.080	+1.6	
1970 VII 10	24 28	25 03	35	B	0.080	+1.6	
	25 07	25 18	11	B	0.080	+1.6	
20	23 04	25 06	122	V	0.035	+2.8	
VIII 12	22 24	22 47	23	B	0.028	+2.8	
	22 49	23 23	34	V	0.028	+2.8	
	23 29	23 58	29	V	0.028	+2.8	
	24 20	25 00	40	V	0.028	+2.8	
14	23 43	24 07	24	V	0.015	+3.6	
	24 17	25 12	55	V	0.015	+3.6	
IX 4	23 17	23 28	11	V	0.037	+2.4	
	23 39	23 42	3	V	0.037	+2.4	
	24 13	24 35	22	V	0.037	+2.4	
	24 41	26 13	92	V	0.037	+2.4	
8	19 30	19 59	29	B	0.027	+2.8	
	20 05	20 21	16	B	0.027	+2.8	
	20 27	22 05	98	B	0.027	+2.8	
	22 18	23 48	90	B	0.027	+2.8	
	23 56	26 25	149	B	0.027	+2.8	
10	24 46	25 46	60	B	–	–	
24	21 12	22 05	53	B	–	–	
	22 05	22 22	17	V	0.025	+3.0	
	22 26	23 15	49	V	0.025	+3.0	
	23 20	23 26	6	V	0.025	+3.0	
	23 47	24 25	38	V	0.025	+3.0	
28	22 25	23 11	46	B	–	–	
	23 20	24 06	46	B	–	–	
	24 14	26 01	107	B	–	–	
30	21 52	22 23	31	V	0.017	+3.4	
	22 26	23 22	56	V	0.017	+3.4	
	23 30	23 47	17	V	0.017	+3.4	
X 6	19 59	20 24	25	V	0.010	+3.8	
	20 35	20 56	21	V	0.010	+3.8	
	21 04	21 30	26	V	0.010	+3.8	
	22 30	23 26	56	V	0.010	+3.8	
	23 32	23 53	21	V	0.010	+3.8	
X 8	20 00	20 38	38	B	0.050	+2.2	
	20 50	21 55	65	B	0.050	+2.2	
	21 55	22 34	39	V	–	–	
	22 43	23 06	23	V	–	–	
	23 21	24 48	87	V	–	–	
10	22 50	23 08	18	B	0.030	+2.7	
	23 17	24 20	63	B	0.030	+2.7	
26	21 43	23 38	115	V	0.010	+3.8	
	22 54	23 01	7	V	0.010	+3.8	
	23 11	23 21	10	V	0.010	+3.8	
28	21 41	21 54	13	B	–	–	

EQ Peg

Date	Begin. of observ. UT	End of observ. UT	Duration of obs.	F	σm	Δm_{lim}	Remarks
1967 IX 6	20 20	22 32	132	–	–	–	
	23 00	24 06	66	–	–	–	
24	19 15	20 15	60	–	–	–	
X 2	20 06	20 40	34	–	–	–	
4	20 45	20 50	5	–	–	–	
	21 06	22 47	101	–	–	–	
6	18 49	24 36	347	–	–	–	
8	21 40	22 16	36	–	–	–	
1968 VII 8	24 22	25 07	45	–	0.018	+3.2	9
X 22	21 00	21 20	20	–	–	–	
1969 XI 2	17 25	18 45	80	–	0.013	+3.6	
	19 39	20 00	21	–	0.013	+3.6	
	20 11	21 12	61	–	0.013	+3.6	
	21 19	21 45	26	–	0.013	+3.6	
	21 51	22 06	15	–	0.013	+3.6	
	22 18	23 12	54	–	0.013	+3.6	
	23 18	23 23	5	–	0.013	+3.6	
1970 VII 28	23 11	24 11	60	V	0.045	+2.2	
30	23 12	23 44	32	V	0.078	+1.7	
	23 48	24 17	29	V	0.078	+1.7	
VIII 4	23 36	23 50	14	V	0.030	+2.7	
	23 54	25 05	71	V	0.030	+2.7	
6	23 01	23 20	19	V	0.040	+2.4	
	23 25	25 11	106	V	0.040	+2.4	

Remarks:

1) At 24^h36^m an uncompletely recorded brightness enhancement of about 0.5 magnitude lasting nearly 1^m.
2) At 21^h26^m an enhancement of about 0.2 magnitude lasting nearly 3^m.
3) At 21^h06^m an uncertain enhancement of about 0.1 magnitude
4) At 22^h48^m an enhacement of about 0.2 magnitide
5) At $23^h35^m.3$ an enhancement (Table II)
6) At $21^h23^m.6$ an enhancement (Table II)
7) At 23^h17^m an uncertain enhancement
8) At 22^h01^m an uncertain enhancement
9) At $22^h46^m.1$ an enhancement (Table II)

Table II

Star	Date	UT_{max}	F	Δt_1	Δt_2	Δmf	σ^m	P	X
$-55°1823$	1970 VII 8	$23^h35^m.5$	B	0.1	0.9	−0.45	0.055	0.16	1.253
	24	21 23 .6	V	0.8	5.9	−0.32	0.043	0.94	1.126
EQ Peg	1968 VII 8	24 46 .1	–	0.5	1.7	−0.33	0.018	0.23	1.256

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Oskanjan V., Kubičela A., Arsenijević J., 1969, Bull. A. O. Beograd, XXVII, № 2, 1.

PHOTOELECTRIC FLARE STARS OBSERVATIONS IN 1971.

J. ARSENIJEVIĆ, A. KUBIČELA

During 1971. regular flare stars observations have been carried out at Belgrade Observatory. The 65 cm refractor and Belgrade photoelectric polarimeter (V. Oskanjan, A. Kubičela and J. Arsenijević, 1969) were used.

The monitoring time intervals are given in Table I. In addition, Table I contains data concerning the spectral region of observation in the column F, the error of the observation according to formula

$$\sigma^m = \pm 2{,}5 \log \frac{I_0 + \sigma}{I_0}$$

in the column σ^m and the limiting magnitude difference in the column Δm_{lim} calculated from

$$\Delta m_{lim} = -2{,}5 \log \frac{3\sigma}{I_0}.$$

In the quoted expressions I_0 is the mean intensity deflection of the quiet star and δ is the standard deviation of random noise fluctuation measured at one-minute intervals along the averaged deflection of the star signal.

Some of the obsevation of AD Leo and EV Lac that correspond to International Patrol Intervals have been published elsewhere (Arsenijević J. and Kubičela A., 1972).

The total monitoring time for the observed stars is given in Table II.

Table I

Date	Begin. of observ.	End of observ.	Duration of obser	F	σ^m	Δm_{lim}
V 371 Ori						
1971 XI 11	23^h02^m	23^h37^m	35	V	0.036	+2.5
	23 40	23 42	2	V	0.036	+2.5
XII 17	21 45	23 22	97	V	0.044	+2.3
AD Leo						
1971 I 28	24 55	25 15	20	V	0.018	+3.3
	25 19	25 36	17	V	0.018	+3.3
	25 43	26 21	38	B	0.024	+3.0
II 12	22 25	23 46	81	V	0.015	+3.5
18	20 35	20 40	5	V	0.017	+3.3
	20 42	21 15	33	V	0.017	+3.3
III 18	19 10	19 52	42	V	0.015	+3.5
	19 57	20 05	8	V	0.015	+3.5
	20 12	21 52	100	V	0.015	+3.5
	21 57	23 17	80	V	0.015	+3.5
20	19 28	19 50	22	V	0.011	+3.8
	20 05	21 06	61	V	0.011	+3.8
	21 17	22 38	81	V	0.011	+3.8
22	20 30	20 50	20	V	—	—
26	19 39	20 33	54	V	0.028	+2.8
	20 39	23 19	160	V	0.028	+2.8
IV 8	20 12	21 12	60	V	0.033	+2.6
14	19 40	20 27	47	V	0.028	+2.8
	20 33	21 36	63	V	0.028	+2.8
	21 40	22 01	21	V	0.028	+2.8

Date	Begin. of observ.	End of observ.	Duration of obs.	F	σ^m	Δm_{lim}
16	19 00	19 17	17	V	0.012	+3.7
	19 22	20 41	79	V	0.012	+3.7
	20 45	21 35	50	V	0.012	+3.7
18	19 05	19 25	20	V	0.021	+3.1
	19 30	19 50	20	V	0.021	+3.1
	20 00	21 20	80	V	0.018	+3.1
XII 22	19 53	21 23	90	V	0.018	+3.2
15	23 36	24 56	80	V	0.022	+3.0
16	23 45	24 36	51	V	0.020	+3.2
17	24 00	24 30	30	V	—	—
	24 32	24 45	13	B	0.018	+3.2

SZ UMa

Date	Begin. of observ.	End of observ.	Duration of obs.	F	σ^m	Δm_{lim}
1971 III 20	23 22	23 34	12	V	0.018	+3.3
	23 38	23 54	16	V	0.018	+3.3
	24 06	24 18	12	V	0.018	+3.3
IV 8	21 34	21 58	24	V	0.019	+3.2
	22 00	22 36	36	B	0.025	+2.1

BD+13°2618

Date	Begin. of observ.	End of observ.	Duration of obs.	F	σ^m	Δm_{lim}
1971 IV 14	22 28	23 08	40	V	0.038	+2.4
16	22 02	23 25	83	V	0.028	+2.8
18	22 07	23 28	81	V	0.030	+2.7
20	21 10	24 10	180	V	0.014	+3.5
22	21 35	23 45	130	V	0.031	+2.7
V 20	20 17	21 55	98	V	0.017	+3.3
25	19 40	20 44	64	V	0.023	+3.0

BD+16°2708

Date	Begin. of observ.	End of observ.	Duration of obs.	F	σ^m	Δm_{lim}
1971 IV 22	23 53	26 13	140	V	0.023	+3.0
V 20	22 08	22 24	16	V	—	—
26	21 25	22 25	60	V	0.016	+3.4
VI 23	21 28	21 56	28	V	0.039	+2.4

BD+55°1823

Date	Begin. of observ.	End of observ.	Duration of obs.	F	σ^m	Δm_{lim}
1971 V 28	23 51	24 40	49	V	—	—
VII 17	21 10	22 51	101	V	0.027	+2.8
23	20 40	22 30	110	V	0.019	+3.2
	22 40	23 05	25	V	0.019	+3.2
25	20 00	23 00	180	V	0.014	+3.6
26	22 08	23 08	60	V	0.019	+3.2
27	19 53	20 42	49	V	0.016	+3.4
	21 00	22 58	118	V	0.016	+3.4
VIII 19	20 00	20 34	34	V	0.025	+2.9
	20 38	21 25	47	V	0.025	+2.9
	21 28	22 10	42	V	0.025	+2.9
20	20 44	21 31	47	V	0.018	+3.2
	21 36	22 35	59	V	0.018	+3.2
21	19 47	20 38	51	V	0.012	+3.7
	20 42	21 48	66	V	0.012	+3.7
	22 02	22 47	45	V	0.012	+3.7

BD−8°4352

Date	Begin. of observ.	End of observ.	Duration of obs.	F	σ^m	Δm_{lim}
1971 V 28	23 01	23 31	30	V	—	—
VI 24	20 57	22 19	82	V	0.036	+2.5

EV Lac

Date	Begin. of observ.	End of observ.	Duration of obs.	F	σ^m	Δm_{lim}
1971 VIII 19	24 06	24 45	39	V	0.016	+3.3
	24 56	25 46	50	V	0.016	+3.3
	25 53	26 14	21	V	0.016	+3.3
20	24 37	26 07	90	B	0.030	+2.7
21	24 09	25 02	53	B	0.032	+2.6
	25 08	26 08	60	V	0.017	+3.2
25	24 28	25 58	90	V	0.019	+3.2
IX 18	21 38	21 58	20	V	—	—
21	23 17	23 23	6	V	0.021	+3.1
	23 28	24 22	54	B	0.026	+2.8
	24 22	25 40	78	V	0.021	+3.1
22	21 13	21 47	34	V	0.014	+3.5
	22 00	22 52	52	V	0.014	+3.5
	23 19	24 04	45	V	0.014	+3.5
	24 16	24 52	36	V	0.014	+3.5
	25 03	25 13	10	V	0.014	+3.5
23	21 11	22 30	79	V	0.011	+3.8
	22 44	23 58	74	V	0.011	+3.8
	24 43	25 17	34	V	0.011	+3.8
X 12	19 41	19 51	10	B	0.051	+2.1
	20 20	21 28	68	B	0.051	+2.1
	22 12	23 12	60	V	0.017	+3.3
	23 25	25 00	95	V	0.017	+3.3
13	20 10	21 14	64	V	0.019	+3.2
	21 50	22 07	17	V	0.019	+3.2
	22 10	22 16	6	V	0.019	+3.2
	22 18	22 25	7	V	0.019	+3.2
14	19 58	21 09	71	V	0.013	+3.6
	21 18	21 38	20	V	0.013	+3.6
	21 50	22 04	14	V	0.013	+3.6
19	21 07	23 28	141	V	0.011	+3.8
20	19 55	21 20	85	V	0.027	+2.8
	21 47	22 35	48	V	0.027	+2.8
	22 38	23 19	41	V	0.027	+2.8
XI 11	19 10	19 30	20	V	0.024	+3.0
	19 37	21 00	83	V	0.024	+3.0
	21 15	22 10	55	V	0.024	+3.0

EQ Peg

Date	Begin. of observ.	End of observ.	Duration of obs.	F	σ^m	Δm_{lim}
VI 23	24 45	25 16	31	V	0.031	+2.7
VII 17	24 14	25 14	60	V	0.020	+3.1
23	23 33	25 30	117	V	0.033	+2.6
25	23 57	25 30	93	V	0.015	+3.4
26	23 24	25 54	150	V	0.026	+2.8
27	23 14	24 45	91	V	0.029	+2.7
VIII 15	21 48	22 25	37	V	0.026	+2.9
	22 32	23 33	61	V	0.026	+2.9
	23 46	25 46	120	V	0.026	+2.9
IX 18	20 40	20 55	15	V	—	—
	21 03	21 08	5	V	—	—
	21 14	21 28	14	V	—	—
21	19 36	20 35	59	V	0.026	+2.9
	20 41	21 40	59	V	0.026	+2.9
23	19 53	20 02	9	V	0.032	+2.6
	20 13	20 47	34	V	0.032	+2.6

Table II

Star	Total duration
V 371 Ori	134^m
AD Leo	1543
SZ U Ma	100
BD+13°2618	676
BD+16°2708	244
BD+55°1823	1083
BD-8°4352	112
EV Lac	1830
EQ Peg	955

Certain flare activity has been noticed only in the case of EV Lac. The data of the observed flares are given in Table III and the light curves in relative intensity units are shown in Figure 1.

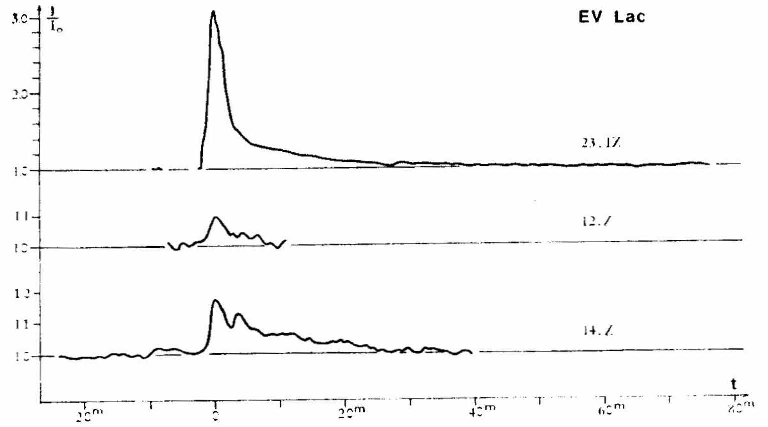

Fig. 1

Table III

Star	Date	UT_{max}	F	Δt_1	Δt_2	Δm_f	σm	P	X
EV Lac	1971 IX 23	$21^h13^m.0$	V	2.0	52	1.22	0.011	11.28	1.000
	X 12	22 31 .1	V	1.4	7.5	0.12	0.017	0.39	1.120
	14	20 28 .1	V	1.5	31.0	0.18	0.013	1.76	1.006

In Table III, Δt_1 and Δt_2 are durations of the flare before and after maximum. In the column Δm_f the magnitude difference of the maximum phase of the flare and the quiet star has been calculated from $\Delta m_f = -2 \cdot 5 \log \frac{I_{0+f}}{I_0}$

Here I_{0+f} represents the deflection of star signal at maximum phase of the flare. The integrated intensity of the flare is given in the column P. The air mass is given in the column X.

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LAGRANGE-KOEFICIENTOJ f, g, h POR LA PERTURBATA MOVIĜO

BOŽ. POPOVIĆ

Se, anstataŭ simpla problemo de du korpoj, oni pritraktas la perturbatan moviĝon de la koncerna korpo, la ekvacion de ĝia moviĝo oni povas skribi en sufiĉe ĝenerala formo

$$(0,1) \qquad d^2\mathbf{r}/(dt)^2 = -\mu r^{-3}\mathbf{r} + \delta.\mathbf{F},$$

kie $\delta \cdot \mathbf{F}$ prezentas la sumon de ĉiuj fortoj, agantaj ekster la „neperturbata problemo de du korpoj“ (ekz. ĉe moviĝo de artefarita satelito kiel perturba forto povas esti prenataj: efiko de altirforto de aliaj korpoj, influo de la nesfereco de la planedo, influo de la atmosfero k. t. s.). Per la malgranda koeficiento δ oni esprimas ke la neperturbata moviĝo estas la ĉefa kaj ke ĉiuj aliaj influoj estas multe malpli grandaj ol la altirforto de la ĉefa korpo. Pro tio amleksega klaso de moviĝoj povas esti esprimata per ĉi tiu ĝenerala formo de la moviĝekvacio.

La solvo de la neperturbata moviĝo prezentiĝas plej ofte kiel la keplera moviĝo (la komponantoj en la direkto de la perihelia vektoro kaj orte al ĝi), aŭ per la L a g r a n g e-koeficijentoj f, g (komponentoj en la direktoj de la pozicivektoro kaj de la rapido, en difinita momento t_0). En la unua kazo, la transiro de la neperturbata al la perturbata moviĝo estas atingata kutime per variigo de la orbitelementoj, konstantaj en la neperturbata moviĝo kaj iom ŝanĝiĝaj en la perturbata moviĝo. En la Lagrange-formo de la solvo oni povas same apliki la metodon de variigo de la konstantoj (kiam la vektorojn de la ekira pozicio kaj rapido oni prenas kiel la orbitelementojn kaj oni serĉas la variaĵojn de tiaj elementoj pro la perturboj) — v. ekz. P o p o v i ć (1959).

Sed aliflanke eblas solvi la problemon pere de la koeficientoj de Lagrange, variante la koeficientojn mem, ne la orbitelementojn. Tio ja estas la celo de ĉi tiu artikolo. En la unua parto oni esprimas la solvo-„integralojn" de la moviĝo kaj el ili sekvantajn rilatojn inter la koeficientoj de Lagrange. El tiuj rilatoj sekvas, en la dua parto, esprimoj por la koeficientoj. En la tria parto troviĝas la ĝeneraligita Kepler-ekvacio kaj en la kvara parto estas donita la superrigardo de ĉiuj formuloj.

1) LA MOVIĜINTEGRALOJ KAJ LA RILATOJ INTER LA KOEFICIENTOJ DE LAGRANGE

Uzinte la signaĵojn

$$(1,1)\qquad d\mathbf{r}/(dt) = \mathbf{v},\quad \mathbf{r}x\mathbf{v} = \mathbf{c},\quad \int_{t_0}^{t}(\mathbf{r}\times\mathbf{F})dt = \mathbf{c}_1,$$

la vektora multipliko de la moviĝekvacio per $\mathbf{r}$ donas la „integralon"

$$(1,2)\qquad \mathbf{c} = \mathbf{c}_0 + \delta\cdot\mathbf{c}_1,\quad \mathbf{c}_0 = \mathbf{r}_0\times\mathbf{v}_0.$$

Kaj la vektora multipliko per $\mathbf{c}$, kun tuja integrigo, donas

$$\frac{d}{dt}(\mathbf{v}\times\mathbf{c}) - \mathbf{v}\times\frac{d\mathbf{c}}{dt} = -\frac{\mu}{r^3}\left(r\cdot\frac{dr}{dt}\right)\mathbf{r} + \frac{\mu}{r}\frac{d\mathbf{r}}{dt} + \delta\mathbf{F}\times\mathbf{c}$$

$$\frac{d}{dt}\left(\mathbf{v}\times\mathbf{c} - \frac{\mu}{r}\mathbf{r}\right) = \delta\,[\mathbf{F}\times\mathbf{C} + \mathbf{v}\times(\mathbf{r}\times\mathbf{F})]$$

$$(1,3)\qquad \mathbf{v}\times\mathbf{c} - \frac{\mu}{r} = \mathbf{e} = \mathbf{e}_0 + \delta\mathbf{e}_1,\quad \mathbf{e}_0 = \mathbf{v}_0\times\mathbf{c}_0 - \frac{\mu}{r_0}\mathbf{r}_0,$$

$$\mathbf{e}_1 = \int_{t_0}^{t}[\mathbf{F}x\mathbf{c} + \mathbf{v}x(\mathbf{r}x\mathbf{F})]dt$$

Por trovi la nekonatajn vektorojn $\mathbf{r}$, $\mathbf{v}$ el la „integraloj" (1,2) kaj (1,3), diskomponu la pozicivektoron kaj la rapidvektoron al la direktoj $\mathbf{r}_0$, $\mathbf{v}_0$, $\mathbf{c}_0$:

$$(1,4)\qquad \begin{cases}\mathbf{r} = f\mathbf{r}_0 + g\mathbf{v}_0 + h\mathbf{c}_0\\ \mathbf{v} = f'\mathbf{r}_0 + g'\mathbf{v}_0 + h'\mathbf{c}_0.\end{cases}$$

Per ĉi tio oni fakte havas plilarĝigon de la moviĝebleco el la ebeno ($\mathbf{r}_0$, $\mathbf{v}_0$) al spaco ekster la ebeno, kio esprimiĝas per aldono de la variabla komponanto en la direkto $\mathbf{c}_0$, kun la koncerna nova Lagrange-koeficiento h (kaj ĝia derivaĵo h').

Enigu la esprimojn (1,4) en (1,2) kaj post tio multipliku skalare, per $\mathbf{c}_0$, $\mathbf{r}_0$, $\mathbf{v}_0$, unu post la alia. El tio sekvas la unuaj ligaĵoj inter la koeficientoj

$$(1,5)\begin{cases}fg' - f'g = c_0^{-2}(\mathbf{c}\cdot\mathbf{c}_0) = 1 + \delta\cdot c_0^{-2}(\mathbf{c}_0\cdot\mathbf{c}_1)\\ gh' - g'h = c_0^{-2}(\mathbf{c}\cdot\mathbf{r}_0) = \delta\cdot c_0^{-2}(\mathbf{r}_0\cdot\mathbf{c}_1)\\ hf' - h'f = c_0^{-2}(\mathbf{c}\cdot\mathbf{v}_0) = \delta\cdot c_0^{-2}(\mathbf{v}_0\cdot\mathbf{c}_1).\end{cases}$$

La elimino de h' el du lastaj ekvacioj, kun utiligo de la unua ekvacio, donos

$$h(f'g - fg') = c_0^{-2}\mathbf{c}\cdot(f\mathbf{r}_0 + g\mathbf{v}_0) = \delta\cdot c_0^{-2}(f\mathbf{r}_0 + g\mathbf{v}_0)\cdot\mathbf{c}_1$$

$$h = -\frac{\mathbf{c}\cdot(f\mathbf{r}_0 + g\mathbf{v}_0)}{\mathbf{c}\cdot\mathbf{c}_0} = -\delta\cdot\frac{(f\mathbf{r}_0 + g\mathbf{v}_0)\cdot\mathbf{c}_1}{\mathbf{c}\cdot\mathbf{c}_0} =$$

$$= -\delta\cdot\frac{\mathbf{r}\cdot\mathbf{c}_1 - h\mathbf{c}_0\cdot\mathbf{c}_1}{\mathbf{c}\cdot\mathbf{c}_0}$$

$$h\left(1 - \delta\cdot\frac{\mathbf{c}_0\cdot\mathbf{c}_1}{\mathbf{c}\cdot\mathbf{c}_0}\right) = -\delta\cdot\frac{\mathbf{r}\cdot\mathbf{c}_1}{\mathbf{c}\cdot\mathbf{c}_0}$$

do du utilajn esprimojn

$$(1,6)\quad h = -\delta\cdot\frac{\mathbf{r}\cdot\mathbf{c}_1}{c_0^2},\quad h = -\delta\cdot\frac{(f\mathbf{r}_0 + g\mathbf{v}_0)\cdot\mathbf{c}_1}{\mathbf{c}\cdot\mathbf{c}_0}$$

La simila elimino de la koeficiento h donos

$$h'(f'g - fg') = c_0^{-2}\mathbf{c}\cdot(f'\mathbf{r}_0 + g'\mathbf{v}_0) =$$
$$= \delta c_0^{-2}(f'\mathbf{r}_0 + g'\mathbf{v}_0)\cdot\mathbf{c}_1$$

$$(1,7)\quad h' = -\delta c_0^{-2}(\mathbf{v}\cdot\mathbf{c}_1) = -\delta\cdot(f'\mathbf{r}_0 + g'\mathbf{v}_0)\cdot\mathbf{c}_1/(\mathbf{c}\cdot\mathbf{c}_0)$$

Per la esprimoj (1,6), (1,7) la tasko pri kalkulado de la „aldonaj" Lagrange-koeficientoj h, h' estas dependigita de f, g, f', g', do estas nenia bezono trakti ilin plu. Sed per tio ankaŭ la nombro de la ekvacioj (1,5) reduktiĝis je nur unu — la unua.

La „integralo" (1,3), multiplikita per $\mathbf{c}_0$, donas nenion novan, ĉar ni jam havas h'. Sed la multipliko per $\mathbf{v}_0$, post tio per $\mathbf{r}_0$, konsiderante la komponantojn (1,4) de la vektoro $\mathbf{v}$, la „integralon" (1,2) kaj la esprimon (1,3) por $\mathbf{e}_0$, donas

$$(1,8)\begin{cases}c_0^2f' + \mathbf{R}\cdot\mathbf{v}_0 = \delta\cdot(\mathbf{v}\times\mathbf{c}_1 - \mathbf{e}_1)\cdot\mathbf{v}_0\\ \qquad\qquad \mathbf{R} = \mu\left(\frac{\mathbf{r}}{r} - \frac{\mathbf{r}_0}{r_0}\right)\\ c_0^2(1 - g') + \mathbf{R}\cdot\mathbf{r}_0 = \delta\cdot(\mathbf{v}\times\mathbf{c}_1 - \mathbf{e}_1)\cdot\mathbf{r}_0\end{cases}$$

Per tio ankaŭ la kalkulado de f', g', fakte en sinsekvaj alproksimiĝoj, reduktiĝas je kalkulado de la koeficientoj f, g.

2) ESPRIMOJ POR LA PERTURBATAJ *f*, *g*

Kiam oni enigas *f'*, *g'*, el (1,8) en la restintan (la unuan) ekvacion (1,5), kun la signaĵoj

(2,1) $$\mathbf{d}_1 = \mathbf{v} \times \mathbf{c}_1 - \mathbf{e}_1, \quad (\mathbf{r}_0 \cdot \mathbf{v}_0) : r_0 = s_0,$$

ĝi fariĝas

$$c^2 f - f(\mathbf{r}_0 \cdot \mathbf{d}_1 \delta - \mu \frac{\mathbf{r}}{r} \cdot \mathbf{r}_0 - \mu r_0) - g(\mathbf{v}_0 \cdot \mathbf{d}_1 \delta -$$

$$- \mu \frac{\mathbf{r}}{r} \cdot \mathbf{v}_0 + \mu s_0) = \mathbf{c}_0 \cdot \mathbf{c}$$

$$f(c_o^2 - \mu r_o) + \mu(\mathbf{r} - h\mathbf{c}_o)\mathbf{r}/r - \mu s_o g = c_o^2 + \delta \mathbf{c}_o \cdot \mathbf{c}_1 + \delta(f\mathbf{r}_o + g\mathbf{v}_o) \cdot \mathbf{d}_1$$

$$\mu r = c_o^2 - f(c_o^2 - \mu r_o) + \mu s_o g + \mu h^2 c_o^2 / r + \delta \mathbf{c}_o \cdot \mathbf{c}_1 + \delta(f\mathbf{r}_o + g\mathbf{v}_o) \cdot \mathbf{d}_1$$

(2,2) $$\begin{cases} \mu r = \tau + \delta \cdot d, \ \tau = c_{o2}(1-f) + \mu(f r_o + g s_o) = \\ c_o^2(1-f) + \mu \mathbf{r} \cdot \mathbf{r}_o / r_o = c_o^2 - (\mathbf{r} \cdot \mathbf{e}_o) \\ d = \mathbf{c}_o \cdot \mathbf{c}_1 + (f\mathbf{r}_o + g\mathbf{v}_o) \cdot \mathbf{d}_1 + \mu h^2 c_o^2 / (r\delta) \end{cases}$$

Ĉi tio estas kunligo de koeficientoj *f*, *g*, el kiu — same kiel en la neperturbata moviĝo — oni povas la kalkuladon de la du koeficijentoj redukti je unu helpa variablo. Sed ĉar ambaŭ koeficientoj troviĝas ankaŭ maldekstre (en *r*), oni povas esprimi unu koeficijenton per la alia. La kvadratumo de esprimoj (2,2) kondukas al

$$\mu^2(f^2 r_o^2 + 2fg r_o s_o + g^2 \mathbf{v}_o^2) + \mu^2 h^2 c_o^2 = c_o^4 - 2c_o^2 \cdot (c_o^2 - \mu r_o) f + f^2(c_o^2 - \mu r_o)^2 + 2\mu s_o c_o^2 g - 2\mu s_o (c_o^2 - \mu r_o) fg + \mu^2 s_o^2 g^2 + 2\delta d\tau + \delta^2 d^2$$

$$\mu^2 g^2 c_o^2 r_o^{-2} + 2\mu s_o g(\mu r_o f - c_{o2} + c_o^2 f - \mu r_o f) - f^2 c_o^2 (c_o^2 - 2\mu r_o) - c_o^4 + 2c_o^2(c_o^2 - \mu r_o) f - 2\delta d\tau - \delta^2 d^2 - \mu^2 h^2 c_o^2 = 0$$

$$\mu^2 g^2 r_o^{-2} - 2\mu g s_o (1-f) - c_o^2 (1-f)^2 - 2\mu r_o f(1-f) - r_o^{-2} \delta d(2\tau + \delta d) - \mu^2 h^2 = 0$$

$$\mu g / ro = (\mathbf{ro} \cdot \mathbf{vo})(1-f) \pm \sqrt{[r_o^2 \mathbf{v}_o^2 (1-f)^2 + 2\mu r_o f(1-f) + \delta d(2\tau + \delta d) c_o^{-2} + \mu^2 h^2]}$$

Por liberiĝi de la radiko, kaj konkorde kun la analoga derivado en la negerturbata moviĝo (v. ekz. Popović, 1959 a), signu

(2,3) $$r_0((1 - f) = a_0(1 - \cos \xi) - \delta r_o f_1$$

ĉe kio

(2,4) $$\mu / a_0 = 2\mu / r_0 - \mathbf{v}_0^2$$

La subradikaĵo, konsidere s_0 el (2,1) kaj a_0 el (2,4), fariĝas

$$\mathbf{v}_o^2[a_o^2(1-\cos\xi) - 2\delta r_o f_1 a_o (1 - \cos\xi) + \delta^2 r_o^2 f_1^2] + 2\mu[a_o(1-\cos\xi) - \delta r_o f_1] \cdot [1 - a_o(1-\cos\xi)/ro + \delta f_1] + \delta d(\delta d + 2\tau) c_o^{-2} - \mu^2 h^2 = a_o^2 (1 - \cos\xi)^2 (2\mu / r_o - \mu/a_o - 2\mu/r_o) + 2\mu a_o (1-\cos\xi) - 2\delta f_1 [\mathbf{v}_o^2 a_o r_o (1 - \cos\xi) + \mu r_o - a_o(1-\cos\xi) \cdot 2\mu] + 2\delta d\tau c_o^{-2} + \delta^2 d^2 c_o^{-2} - \mu^2 h^2 + \delta^2 r_o f_1^2 (r_o \mathbf{v}_o^2 - 2\mu).$$

La parto libera de δ povas esti esprimita kiel $\mu a_0 \cdot (1-\cos\xi)(1+\cos\xi) = \mu a_0 \sin^2\xi$, pro kio oni povas difini novan kvanton T_1 tiel ke la tuta esprimo estu kvadrato de $(\sin\xi \sqrt{\mu a_0} + \delta T_1)$, t. e.

$$\sqrt{\mu a_o} T_1 \sin\xi = -\mu f_1 r_o(-1 + \cos\xi + 1) + d\tau c_o^{-2}$$

$$T_1^2 = d^2 c_o^{-2} - (\mu h / \delta)^2 - \mu r_o^2 f_1^2 / a_o$$

Post eltrovo de f_1 kaj T_1, la supra esprimo por μg donos

(2,5) $$\mu g = \mathbf{r}_0 \cdot \mathbf{v}_0 [a_0(1 - \cos\xi) - \delta r_o f_1] \pm \pm r_0 (\sin\xi \cdot \sqrt{\mu a_0} + \delta T_1)$$

Kaj por f_1, unue, oni havos

$$f_1^2 \mu r_o^2 \cos^2\xi - 2 f_1 r_o c_o^{-2} \cos\xi \cdot \tau d + \tau^2 d^2 / (\mu c_o^4) = [d^2 c_o^{-2} - (\mu h/\delta)^2 a_o \sin^2\xi - \mu r_o^2 f_1^2 \sin^2\xi$$

$$f_1^2 - 2 f_1 \tau_1 \cos\xi + \tau_1^2 - \frac{a_o \sin^2\xi}{\mu r_o^2} \left[\frac{d^2}{c_o^2} - \left(\frac{\mu h}{\delta}\right)^2 \right] = 0$$

(2,6) $$\tau_1 = \frac{\tau d}{\mu r_o c_o^2}$$

De tie senpere

$$f_1 = \tau_1 \cos\xi \pm \sqrt{\{\tau_1^2 \cos^2\xi - \tau_1^2 + a_o \sin^2\xi [d^2 c_o^{-2} - (\mu h/\delta)^2] : (\mu r_o^2)\}}$$

(2,7) $$f_1 = \tau_1 \cos\xi \pm \tau_2 \sqrt{a_o / r_o} \sin\xi$$

(2,8) $$\tau_2^2 = [d_2 c_o^{-2} - (\mu h/\delta)^2] : (\mu r_o) - \tau_1^2 r_o / a_o$$

Tuj post tio por T_1 oni trovos

$$\frac{1}{\mu r_o} \sqrt{\mu a_o} T_1 \sin\xi = -\cos\xi(\tau_1 \cos\xi + \tau_2 \sqrt{a_o/r_o} \sin\xi) + \tau_1$$

(2,9) $$T_1 = \sqrt{\mu r_o} (\tau_1 \sqrt{a_o / r_o} \sin\xi - \tau_2 \cos\xi)$$

La espirimoj (2,3) kaj (2,5), kun utiligo de (2,7) kaj (2,9), donas la jɛnɔjn perturbatajn koeficijentojn *f*, *g*:

(2,10) $$\begin{cases} f = 1 - (1 - \cos\xi) a_o / r_o + \delta(\tau_1 \cos\xi + \tau_2 \sqrt{a_o / r_o} \sin\xi) \\ \mu g = a_o (\mathbf{r}_o \mathbf{v}_o)(1 - \cos\xi) + r_o \sqrt{\mu a_o} \sin\xi + \\ + \delta r_o \sqrt{ro} (\tau_1 \sqrt{a_o / r_o} \sin\xi - \tau_2 \cos\xi) - \\ - \delta r_o (\mathbf{r}_o \mathbf{v}_o)(\tau_1 \cos\xi + \tau_2 \sqrt{a_o : r_o} \sin\xi) \end{cases}$$

Oni povas nur plisimpligi la esprimon por *d* el (2,3), pere de (2,1) kaj (1,6), poste ankaŭ de (1,2) kaj (1,3), nome

$$d = \mathbf{c}_o \cdot \mathbf{c}_1 + (\mathbf{r} - h\mathbf{c}_o)(\mathbf{v} \times \mathbf{c}_1 - \mathbf{e}_1) - \frac{\mu}{r} \frac{h}{\delta} \delta(\mathbf{r} \cdot \mathbf{c}_1) =$$

$$= \mathbf{c}_o \cdot \mathbf{c}_1 + \mathbf{c} \cdot \mathbf{c}_1 - \mathbf{r} \cdot \mathbf{e}_1 - \frac{h}{\delta} \mathbf{c}_o \cdot (\mathbf{v} \times \mathbf{c} - \mathbf{v} \times \mathbf{c}_o - \mathbf{e} + \mathbf{e}_o + \frac{\mu}{r} \mathbf{r}).$$

La lasta parentezo nuliĝas pro (1,3), do fine

(2,11) $$d = (\mathbf{c}_0 + \mathbf{c}) \cdot \mathbf{c}_1 - (\mathbf{r} \cdot \mathbf{e}_1)$$

3) *LA ĜENERALIGITA KEPLER-EKVACIO*

La ĝisnunaj esprimoj reduktis kalkuladon de la koeficientoj al eltrovo de la helpa variablo ξ, enkondukita ĉi tien per (2,3) kaj tre ligita kun la ĝenerala anomalio (aŭ „anomalio de komenco“, v. ekz. K. Stumpff 1947, B. Popović 1959a, aŭ P. Kustaanheimo 1960). Pro tio ni bezonas trovi ankoraŭ unu „integralon“, similan al (1,2) kaj (1,3). Ni trovos ĝin, analoge al la neperturbata moviĝo, nome el (1,3) sekvas

$$c^2\mathbf{v}^2-\frac{2\mu}{r}c^2+\mu^2=e^2$$

(3.1) $$\mathbf{v}^2=\frac{2\mu}{r}+H,\ H_0+\delta H_1=H=(e^2-\mu^2)c^{-2},$$

$$H_0=(e_0{}^2-\mu^2)c_0{}^{-2}=-\mu/a_0$$

(La kutima *h* estas ĉi tie anstataŭigita per H, pro nekonfuzo kun la Lagrange-koeficiento *h*). Enportinte ĉi tion en c^2, ĝi fariĝas

$$c^2=r^2\cdot\mathbf{v}^2-(\mathbf{r}\cdot\mathbf{v})^2=2\mu r+Hr^2-r^2\left(\frac{dr}{dt}\right)^2$$

(3,2) $$r.dr=\sqrt{(2\mu r+Hr^2-c^2)}dt$$

La esprimoj (2,2), kune kun (2,11) kaj (2,10), poste kun (2,6) donas

$$\mu r=\mu r_o+(c_o{}^2-\mu r_o)[(1-\cos\xi)a_o/r_o-\delta(\tau_1\cos\xi+\tau_2\cdot$$
$$\cdot\sqrt{a_o/r_o}\sin\xi)]+(\mathbf{r}_o\mathbf{v}_o)^2(1-\cos\xi)a_o/r_o+\mu(\mathbf{r}_o\mathbf{v}_o)\cdot$$
$$\cdot\sqrt{a_o/\mu}\sin\xi+\delta\sqrt{\mu r_o}(\mathbf{r}_o\mathbf{v}_o)(\tau_1\sqrt{a_o/r_o}\sin\xi-$$
$$-\tau_2\cos\xi)-\delta(\mathbf{r}_o\mathbf{v}_o)^2(\tau_1\cos\xi+\tau_2\sqrt{a_o/r_o}\sin\xi)+d\delta=$$
$$=\mu r_o+(r_o\mathbf{v}_o{}^2-\mu)a_o(1-\cos\xi)+\mu(\mathbf{r}_o\mathbf{v}_o)\sqrt{a_o/\mu}\sin\xi-$$
$$-\delta(r_o\mathbf{v}_o{}^2-\mu r_o)(\tau_1\cos\xi+\tau_2\sqrt{a_o/r_o}\sin\xi)+\delta\sqrt{ro}\cdot$$
$$\cdot(\mathbf{r}_o\mathbf{v}_o)(\tau_1\sqrt{a_o/r_o}\sin\xi-\tau_2\cos\xi)+d\delta$$

(3,3) $$r=r_0(L+\delta\rho),$$
$$L=1+\zeta(1-\cos\xi)a_0/r_0+\eta\sqrt{a_0/r_0}\sin\xi$$

(3,4) $$\eta=\frac{\mathbf{r}_o\cdot\mathbf{v}_o}{\sqrt{\mu r_o}},\ \zeta=\frac{r_o}{\mu}\mathbf{v}_o{}^2-1=1-\frac{r_o}{a_o}$$

(3,5) $$\rho=-\zeta(\tau_1\cos\xi+\tau\ \sqrt{a_0/r_0}\sin\xi)+$$
$$+\eta(\tau_1\sqrt{a_0/r_0}\sin\xi-\tau_2\cos\xi)+d/(\mu r_0)$$

Enigu ĉi tiun esprimon por r en la ekvacion (3,2). Sub la radiko estos

$$2\mu r_o(L+\delta\rho)+H_or_o{}^2(L+\delta\rho)^2+\delta H_1r^2-c^2=\mu r_oL\cdot$$
$$\cdot(2-Lr_o/a_o)-r_o{}^2\mathbf{v}_o{}^2+(\mathbf{r}_o\mathbf{v}_o)^2+(\mathbf{c}+\mathbf{c}_o)\cdot\delta\mathbf{c}_1+$$
$$+2\delta\mu r_o\rho(1-Lr_o/a_o)+\delta H_1r^2-\delta^2\mu\rho^2r_o{}^2/a_o=\mu r_o[(1-$$
$$-r_o/a_o)^2(a_o/r_o)\cdot\sin^2\xi+\eta^2\cos^2\xi+2(1-r_o/a_o)\eta\cdot$$
$$\cdot\sqrt{a_o/r_o}\sin\xi\cos\xi]+\delta(\mathbf{c}+\mathbf{c}_o)\mathbf{c}_1+2\delta\mu r_o\rho(\zeta\cos\xi-$$
$$-\eta\sqrt{a_o/r_o}\sin\xi-\frac{1}{2}\delta\rho r_o/a_o)+\delta H_1r^2.$$

Prezentu ĉi tiun esprimon kiel kvadraton de

$$\sqrt{\mu r_0}(\zeta\sqrt{a_0/r_0}\sin\xi+\eta\cos\xi+\delta T),$$

kio plene eblas, kondiĉe ke *T* estu kalkulata el

$$2\rho(\zeta\cos\xi-\eta\sqrt{a_0/r_0}\sin\xi-\tfrac{1}{2}\delta\rho r_0/a_0)+H_1r^2/(\mu r_0)=$$
$$=2(\zeta\sqrt{a_0/r_0}\sin\xi+\eta\cos\xi)T+\delta T^2$$

do

(3,6) $$T=\frac{2\rho(\varsigma\cos\xi-\eta\sqrt{a_0/r_0}\sin\xi)+H_1r^2/(\mu r_0)-}{2L'}$$
$$\frac{-\delta\rho^2r_o/a_o-\delta T^2}{2L'}$$

(3,7) $$L'=\sqrt{r_o/a_o}\cdot\frac{\partial L}{\delta\xi}=\zeta\sqrt{a_o/r_o}\sin\xi+\eta\cos\xi$$

Per tio la ekvacio (3,2) fariĝas

$$\frac{rr_o\left(\sqrt{\frac{a_o}{r_o}}L'+\delta\cdot\frac{d\rho}{d\xi}\right)}{\sqrt{\mu r_o}(L'+\delta T)}d\xi=dt$$

$$(L+\delta\rho)r_o\sqrt{a_o/\mu}\left[1+\delta\cdot\left(\sqrt{\frac{r_o}{a_o}}\frac{d\rho}{d\xi}-T\right):\left((L'+\delta T\right)\right].$$
$$\cdot d\xi=dt$$

$$t-t_o=r_o\sqrt{a_o/\mu}\,[\xi+(a_o/r_o)\zeta(\xi-\sin\xi)+\eta\sqrt{a_o/r_o}\cdot$$
$$\cdot(1-\cos\xi)+\delta\int_{to}^{t}\rho\cdot d\xi]+\delta\sqrt{r_o/\mu}\int_{to}^{t}\frac{r}{L'+\delta T}(d\rho-$$
$$-\sqrt{a_o/r_o}Td\xi)$$

Post enkonduko de jenaj signaĵoj kaj funkcioj:

(3,8) $$\sqrt{\mu r_o{}^{-3}}=n,\ \xi\sqrt{a_o/r_o}=y,\ \frac{\sin\xi}{\xi}=c_1,$$
$$\frac{1-\cos\xi}{\xi^2}=c_2,\ \frac{\xi-\sin\xi}{\xi^3}=c_3,$$

la „integralo“ fariĝas

$$y(1+\eta yc_2+\varsigma y^2c_3)=n(t-t_o)+$$
$$+\delta\cdot\int_{to}^{t}\frac{\sqrt{\frac{a_o}{r_o}}\left(\frac{r}{r_o}T-\rho L'-\delta\rho T\right)d\xi-\frac{r}{r_o}d\xi}{L'+\delta T}$$

(3,9) $$y=\frac{n(t-t_o)+\delta J}{1+\eta yc_2+\zeta y^2c_3},$$

$$J=\int_{to}^{t}\frac{(LT-L'\rho)\sqrt{a_o/r_o}d\xi-r/(r^o)d\rho}{L'+\delta T}$$

El ĉi tiu ekvacio oni povas trovi la „anomalion de la komenco“ *y*, kun unu ŝtupo de proksimumigo pli ol oni havas proksimumigitan *J*.

4) SUPERRIGARDO DE LA FORMULOJ

El la ekiraj valoroj ($\mathbf{r}_0$, $\mathbf{v}_0$) oni povas facile kalkuli

(4,1) $r_0 = |\mathbf{r}_0|$, $n = \sqrt{\mu r_0} : r_0^2$, $\eta = \mathbf{r}_0 \cdot \mathbf{v}_0 : \sqrt{\mu r_0}$,

$$\zeta = r_0(\mathbf{v}_0^2 : \mu)^{-1}, a_0 = r_0 : (1-\zeta)$$

$$\mathbf{c}_0 = \mathbf{r}_0 \times \mathbf{v}_0, \quad c_0^2 = \mu r_0 (1 + \zeta - \eta^2)$$

Tiam la ekvacio

(4,2) $$y = \frac{n(t-t_0)}{1 + \eta y c_2 + \zeta y^2 c_3}, \quad \xi^2 = y^2(r_0/a_0) = y^2(1-\zeta)$$

$$\begin{cases} c_1 = \dfrac{\sin\xi}{\xi} = 1 - \dfrac{\xi^2}{2!} + \dfrac{\xi^4}{4!} - \dfrac{\xi 6}{6!} + \ldots, \\ c_2 = \dfrac{1-\cos\xi}{\xi^2} = \dfrac{1}{2!} - \dfrac{\xi^2}{4!} + \dfrac{\xi^4}{6!} - \dfrac{\xi^6}{8!} + \ldots \\ c_3 = \dfrac{\xi - \sin\xi}{\xi^3} = \dfrac{1}{3!} - \dfrac{\xi^2}{5!} + \dfrac{\xi^4}{7!} - \dfrac{\xi^6}{9!} + \end{cases}$$

donas la anomalion y en la nula proksimumigo, post kio (2,10) donas

(4,4) $$\begin{cases} f = 1 - y^2 c_2, \quad ng = y c_1 + \eta y^2 c_2, \\ \mathbf{r} = f\mathbf{r}_0 + g\mathbf{v}_0, \; |\mathbf{r}| = r = r_0 L, \; L = 1 + \eta y c_1 + \zeta y^2 c_2 \\ \mathbf{v} = \mathbf{v}_0 + \mathbf{c}_0 \times S, \; S = \mu c_0^{-2} \left(\dfrac{\mathbf{r}}{r} - \dfrac{\mathbf{r}_0}{r_0}\right) \end{cases}$$

Post tio oni povas transiri al la unua proksimumigo (pro la perturboj). Elkalkulu $\mathbf{c}_1$, $\mathbf{e}_1$, el (1,1) kaj (1,3), post kio (3,1) donas

$$\delta \cdot H_1 = (e^2 - \mu^2)c^{-2} - (e_0^2 - \mu^2)\, c_0^{-2} = c^{-2}(\mathbf{e} + \mathbf{e}_0)\, \delta \mathbf{e}_1 + + (\mu/a_0)\, c^{-2}(\mathbf{c} + \mathbf{c}_0)\, \delta \mathbf{c}_1$$

(4,5) $$c^2 H_1 = (\mathbf{e} + \mathbf{e}_0) \cdot \mathbf{e}_1 + (\mu/a_0)(\mathbf{c} + \mathbf{c}_0) \cdot \mathbf{c}_1$$

Tiam (2,11) ebligas kalkuli d, post kio (2,6), (2,8), kun (2,2) kaj (1,6), donas

(4,6) $$\begin{cases} \tau_1 = \dfrac{d}{r_0}\left(1 - \dfrac{\mathbf{r} \cdot \mathbf{e}_0}{c_0^2}\right) \\ \tau_2^2 = \dfrac{1}{\mu r_0}[d^2 c_0^{-2} - (\mu c_0^{-2} \mathbf{r} \cdot \mathbf{c}_1)^2] - \tau_1^2 (1-\zeta) \end{cases}$$

El (3,5), (3,3) kaj (3,7) estas kalkulotaj

$$\rho = d : (\mu r_0) + \eta[\tau_1 y c_1 - \tau_2(1 - \xi^2 c_2)] - -\zeta[\tau_2 y c_1 + \tau_1(1 - \xi^2 c_2)]$$

(4,7) $$L = 1 + \eta y c_1 + \zeta y^2 c_2, \quad L' = \zeta y c_1 + \eta(1 - \xi^2 c_2).$$

Oni kalkulu tiam T el (3,6), do

(4,8) $$2L' \cdot T = 2\rho\,[\zeta(1 - \xi^2 c_2) - \eta y c_1] + H_1 r^2 : : (\mu r_0) - \delta\rho^2 (1-\zeta) - \delta T^2$$

Ĉiuj ĉi kvantoj, elkalkulitaj en la nula proksimumigo, donas en (3,9) $\mathcal{J}$ en la nula proksimumigo kaj y en la unua proksimumigo. Fine (2,10) kaj (1,6) fariĝas

(4,9) $$\begin{cases} f = 1 - y^2 c_2 + \delta\,[\tau_2 y c_1 + \tau_1 (1 - \xi^2 c_2)] \\ ng = y c_1 + \eta y^2 c_2 + \dfrac{\delta}{\sqrt{\mu}}\left[\tau_1 y c_1 - \tau_2 (1 - \xi^2 c_2)\right] - \\ \quad - \delta\eta\left[\tau_2 y c_1 + \tau_1 (1 - \xi^2 c_2)\right] \\ h = -\delta \cdot c_0^{-2}(\mathbf{r} \cdot \mathbf{c}_1) \end{cases}$$

Ripeto de la formuloj (4,5)—(4,8) en la trovita proksimumigo donas (4,9) kun unu plua grado de proksimumigo ktp.

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