YU ISSN 0373 — 3734

BULLETIN

DE

L'OBSERVATOIRE ASTRONOMIQUE DE BELGRADE

№ 129

BEOGRAD
1978

BULLETIN

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Ovaj Bilten štampan je uz pomoć Republičke zajednice nauke Srbije

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Editeur: Observatoire astronomique de Belgrade, Beograd, Volgina 7
Izdavač: Astronomska opservatorija u Beogradu, Beograd, Volgina 7

Imprimérie:
Štampa:
Jugoslovensko udruženje „Nauka i društvo"
11000 Beograd, B. Adžije 11/1, tel. 456–952
Tiraž: 500 primeraka

VOÏSLAV V. MICHKOVITCH

Professor and Academician Voïslav V. Michkovitch, the founder of the Belgrade Astronomical Observatory and of the Department of Astronomy of the Belgrade University, died on 25 November 1976 at the age of 85.

Prof. Michkovitch was born on 18 January 1892 at Fužine, in the district of Delnice, a region of West Yugoslavia at that time under Austro-Hungarian rule. The following year his parents, of Serbian descent, moved to Serbia. He graduated from high school at Novi Sad and took up his studies in Budapest as a Tekelianum scholar just at the time when lecturing of Astronomy as a separate subject was about to be instituted there. However, until this lecturing became regular three years later, he moved, after one year at Budapest University, to Göttingen where, concurrently with other subjects, he attended courses of Astronomy led by J. Hartmann and L. Amron.

Back in Budapest late in 1913, he joined in the activities of a Serbian national youth organization. In Austria-Hungary, based on the oppression of peoples, this was qualified as a seditious activity. In consequence, he was imprisoned for a short time and then kept under police surveillance. To get rid of the hardship he escaped, under dramatic circumstances, to Serbia. Soon the First World War broke out. He immediately volunteered for a fithting detachment, sharing all the hazards of war up to the retreat of the Serbian Army to the Salonika Front in 1915. His health seriously affected by war-time suffering, he was sent to recuperate in France. In 1916 he was back at the Salonika Front and remained in active military service until his demobilization in 1918, when he returned to France to finish his studies.

Michkovitch graduated in Astronomy in 1919 in Marseille after only two semestres, all his previous student's degrees at Budapest and Göttingen having been recognized. Shortly afterwards he was appointed assistent at the Astronomical Obesrvatory of that city. After serving a few months in various divisions of that obesrvatory, he was entrusted the Minor Planets and Comets Service. At the same time he accepted the editorship of the well known "Journal des Observateurs". In 1922 he moved to the Nice Observatory, where he was first preoccupied with the Time Service. In 1923 he was charged with the installation of a new universal instrument and the organization, upon observations with it, of yet another time service in parallel with a new latitude service. In 1924 he received his Ph. D. at Monpeilleux University (his thesis: "Etudes de statistique stellaire") under professors P. Humbert and J. Cabannes. That same year he assumed the direction of, and took a major part in, the expedition to Corsica which was charged with the task of determining accurate geographical coordinates of a number of basic points of that island and connecting them by trianglulation to the French East Alps. In the meantime he mangaged to complete the development of the prototype of his novel instrument – impersonal prismatic astrolabe. Even first observations with this instrument yielded fine results. In 1925 ha was awarded a prize by the French Academy. Next year he was commissioned with the organization of the Minor Planets and Comets Service, due to supercede the one hitherto maintained at the Marseille Observatory.

At this moment Michkovitch was invited, and accepted, to join the Belgrade University as an associated professor of Teoretical and Practical Astronomy. Michkovitch assumed the new position in his native country in October 1926. Simultaneously he was appointed director of the Belgrade Observatory, which administratively belonged to the University.

Some twenty papers, published in the editions of the observatories where he was active, or in those issued by the French Academy, are evidence of the impressive scientific achievements during his brief but fruitful French period.

A somewhat delicate and almost desorganized situation was what Michkovitch met at the Belgrade University as regards the teaching of Astronomy and the state of affairs at the Belgrade Observatory in general. It was, after all, just to rectify this precarious situation that he had been called upon, as an established astronomer, by the University's authorities.

It is pertinent at this juncture to return for a while to the last century, to the year 1887, when whithin the "Grand School", which was subsequently to become, at the turn of the century, Belgrade University, a joint Astronomical and Meteorological Obsevatory was established. Its founder Milan Nedeljkovitch (1857-1950), a professor of the "Grand School", later University, favoured from the outset Meteorology rather than Astronomy, no doubt because of the importance of this discipline for the national economy. Thus the "Observatory" as it came to be called, without specifying which of the two sciences was effectively practicised, became the meteorological centre of the country. The whole astronomical activity of the "Observatory" consisted of sporadic time determination. An additional factor must have played its part in restricting astronomical activity: scarcity of funds, preventing both the purchase of expensive instruments and the empoyment of any full–time, trained assistent for astronomical observations. Even the teaching of Astronomy, which Prof. Nedeljkovitch was in charge of , was to all appearances practicised from time to time only. Astronomy was rated as a secondary subject at the Faculty of Philosophy where it was lectured and no particular interest in it seems to have existed either.

These conditions were to be fundamentally changed after the First World War. Prof. Nedeljkovitch initiated, immediately after the war was over, an energetic action for the compensation of the war damaged equipment of the Observatory through war indemnities from Germany. He came forward with a project of erecting a large observatory for which even more instrumentation was needed than could have been acquired by the indemnities. The project met with approval from the competent authorities. Accordingly he ordered, whithin a short lapse of time, about thirty instruments from the most reputable firms of the time. However, shortly afterward, as the instruments he had ordered were arriving, he retired. In the meanwhile the "Observatory" had been finally divided into two separate observatories: the one astronomical and the other meteorological.

Professor Michkovitch, upon his arrival in Belgrade, was appointed director of the Astronomical Observatory, at the time existing only on paper, in addition to discharging his professorial duties at the Department of Astronomy, which was also, as already stated, far from being in its proper shape.

It seems that the organization of teaching of Astronomy, now a separate subject for the first time at Belgrade University and with equal status to that accorded to the long established mathematics, physics and other disciplines, was the easier task to perform. Incomparable more difficult was the organization of the activity of the Astronomical Observatory. Having assessed the position, Michkovitch directed his energies towards two goals: First, he had to procure the necessary financial means, an unthankful and exhausting task in a poorly developed country just after a terrific war. Second, he had to find out an appropriate location for the observatory. It took a whole ten years before both basic questions were settled satisfactorily. Meanwhile, Prof. Michkovitch, edited, with his wife's help, the "Annuaire pour l'an 1929", the first regular publication of the Observatory - and the very first astronomical publication of the Serbian Academy of Sciences. The main items of the publication were ephemeris of a number of "clock stars", onetime published by the Torin Observatory, but otherwise not found in great astronomical almanacs. "Annuaire" was well received by the astronomical community and it was with that, that the important excange of publications with observatories throughout the world began, thanks to which book stocks of the Observatory's library could be completed with publications otherwise ungettable.

In 1929 Michkovitch undertook another great computing work, made easier by the appointment of two part–time assistents. The calculations bore upon the secular variations of the Earth's orbital elements, conditioning, according to Milankovitch's theory, the variations in the insolation of the Earth, and more particularly, allowing the astronomical chronology of the glacial periods to be established. These very extensive calculations were successfully completed ans their result are built in Milankovitch's theory.

As to the location of the new Observatory, the solution came, after many attempts on the part of Michkovitch to appropriate a suitable ground sufficiently distant from the city (regions of Avala, Fruška Gora or to the south of the city were considered), unexpectedly and had to be accepted such as it was. The city authorities alloted an area of 45000 square metres on the top of the 253 m high Veliki Vračar hill, just at the approaches of Belgrade, rent free for 99 years. In the same year 1929, the State Mortgage Bank accorded a special loan to the University for building the Observatory and construction began the following year, finisching by 1932. Another two years were to pass until various facilities were provided and supplemental works completed.

The profile of the future observatory was predetermined by the already existing, still unmounted, instruments. These were mostly those used in classical positional astrometry. In mounting the instruments it turned out that not all of them were fully equiped, some of them being without their housings. Precedence in mounting was thus accorded to the instruments not requiring additional expenditure. These instruments, with a few mounted after the Second World War, have been and continue to be, the foundation of the observational astronomy in this country.

If the acquirement of the instruments under the peculiar circumstances, described above, is completely to be credited to Prof. M. Nedeljkovitch, the building of the Observatory, the installing and putting in operation of these instruments, as well as the inception of regular teaching of Astronomy according to modern standars, is entirely due to Prof. Michkovitch, whose specific gifts and infatiguable activity and persevearance were equal to this exceptional task.

Framing the work of the Observatory and making the most of it was the chief occupation of Prof. Michkovitch during thirties. The staff was always below the number actually needed and the funding from the national budget imposed many restrictions. Thus, the burden on those already engaged was all the more great, especially on the night observers. The work accomplished is best judged by the numerous publications issued at the time. Michkovitch started editing and took an active part in issuing, up to 1941, of six volumes of "Annuaire", five volumes of "Memoires", five volumes of "Bulletin" and eleven volumes of "Almanac of our Sky" (in Serbo-Croatian). Particular recognition is due to Prof. Michkovitch and his coworkers for the publication of eight volumes of „Nautical Almanac" (in Serbo-Croatian) destined for use in both the national military and merchant navies. Yugoslavia thereby joined the few pre-war countries disposing of their own nautical almanacs, a fact that was beneficially reflected in the teaching in nautical schools of all levels.

In 1929 Prof. Michkovitch was elected a corresponding member and, in 1939, a regular member, of the Serbian Academy of Sciences.

The Second World War brought to a stand-still the activity of the Belgrade University. Mišković was taken hostage and interned in the ill-famed concentration camp Banjica, on the outskirts of Belgrade, like many other University professors. A gloomy lot befell the Observatory: to serve as a lodging for the enemy's armed forces, who even dismounted two instruments and took them away. The work under such circumstances was reduced to the very minimum. The activity of the Academy hardly existed – it was in fact illegal and consisted mainly in the endeavours to preserve its properties (bulidings, archives, library, papers in print ect) from the consequences of the heavy air bombbardment executed by the German Luftwaffe according to their plan "Punishment" in April 1941 as a prelude to the German invasion of this country.

The Observatory suffered once more heavy damages in the course of the liberation fightings in 1944. It was however relatively quickly repaired thanks, in the first place, to the voluntary work of its personnel. Already in 1947 the Observatory had been restored, more or less, to its pre-war shape. In the following year Prof. Michkovitch resigned his post and director of the Observatory.

From 1945 to 1948 Michkovitch performed the duty of the Secretary of the Academy. This period was distinguished by a reorganization as well as setting up of new institutes, both aimed at the expansion and better functioning of the Academy in conformity with new demands set before it. He was an active member of several of Academy's councils and for years editor of many of its publications. In 1950 he organized and directed, until its dissolution in 1961, the Astro-Numerical Institute of the Academy. The chief occupation of the Institute was the study of insufficiently observed minor planets, continuation of the publication of the "Nautical Almanac" (in Serbo-Croatian) -eight volumes in addition to those published before the war–, "Almanac of our Sky" (in Serbo-Croatian) – eight volumes. Scientific papers of the Institute's collaborators are published in "Notes et Travaux" (three volumes). From 1951 to 1954 Michovitch was again director of the Observatory. Among many duties he discharged was that of Secretary of the Section for Natural and Mathematical Sciences of the Academy.

During the whole post-war period, until he retired in 1962, Michkovitch lectured in three astronomical subjects at the Department of Astronomy at the Faculty of Sciences. From 1958 to 1964 he was the mentor of four Ph. D. candidates (Z. Brkić, Lj. Mitić, J. Simovljević and J. Lazović).

Prof. Michkovitch was for many years member of the IAU and several of its Commissions. It was through him that Yugoslavia was admitted to this international professional organization. He was also a member of her first National Committee for Astronomy.

A full bibliography of Prof. Michkovitch's works amounts to over two hundred items. Papers dealing with his original researches number 45. Nearly as many are professional papers and equally as many are popular writings. The rest are historical articles (about 20) textbooks and handbooks (about 20), official and professional reports (about 25) and miscelaneous (about 15). The bulk of his scientific or professional papers relate to the problems connected with the minor planets: quasi–identical oppositions, proximities, statistical features of the asteroid belt etc. The second group of his papers deals with his impersonal astrolabe, observing methods and data treatment. In his last years he turned his interest to the history of Astronomy and the rerults of his original exploration in this field are published in three volumes.

The outstanding accomplishments of Prof. Michkovitch, which are yet to be properly assessed, left a deep mark on the development of Astronomy in Yugoslavia. With him. i.e. with the Belgrade Observatory and the Department of Astronomy, both founded by him – in continuation of what he inherited from his predecessor Prof. Nedeljkovitch in regard to both institutions – this country acquired two key centres, enabling it to take part in contemporary Astronomy. The coming of the cosmic era multiplied the importance of the former fact. This is why the astronomical community and men of science of our country owe Prof. Michkovitch gratitude and will guard his memory with reverance.

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ATMOSPHERIC INFLUENCES IN THE OPTICAL FUNDAMENTAL ASTROMETRY *

G. TELEKI

(Received August 3, 1977)

SUMMARY:

A review is presented of diverse atmospheric influences on the astrometric data, their amount is assessed and the possibility of their elimination is analysed. It is maintained that it is more accurate to account for separate influences according to known physical and meteorological laws then to derive them from the final astrometric results. The importance of taking preventive measures in site selection for the astrometric instruments is emphasised.

1. When one is talking about the influence of the atmosphere on the astrometric measurements, one is led at once to think on astronomical refraction. It is beyond any doubt that the refractional influences are important consequences of the existence of the Earth's atmosphere, at larger zenith distances even dominant, yet they are not the only ones and not always the most essential.

Atmospheric influence – total effect of the atmosphere on the astrometric measurements is thereby undestood – is a composite quantity, the amount of which is unsufficiently known. This is due, firstly, to the lack of sufficient evidence about the state in those parts of the atmosphere, traversed by the light rays and those surrounding the instrument, accessories and the observer, and secondly, to the unsatisfactory knowledge of mechanism and amount of the atmospheric influence on all the elements essential for an astrometric result.

Because we are unable to have an exact knowledge about the integral influence of the atmosphere on our measurements – which of cause would be an ideal case – we are trying to decompose that influence into its components, thus to learn, partly at least, about its totality. For this reason we usually do not speak about atmospheric influence, but influences, assuming their sum total to give what we are seeking for. Such an approach is justified in principle, but in this case the basic problem is in the practice that we, from all possible influences, take into account most often and almost exclusively astronomical refraction, with all its ideal component (see § 3.1.). Consequently, when we are dealing with atmospheric influence as an entirety we do not in the practice get a complete mosaic, with a multitude of harmoniously composed parts, but a rather simplyfied construction. It is quite another question whether it were possible to do more about the more accurate and complete accounting for these influences, but the fact is that simplificiation is imposed upon us.

The most tempting reaction on such a statement

* **Presented to the Seminar des Astronomischen Rechen-Instituts, Heidelberg, 15 April 1977.**

would be the following: to stop the Earth' based astrometric measurements altogether and place the instrument outside the Earth's atmosphere, where they could in principle yield the most accurate results. This is a very simplified and biased solution as it does not take into account the present-day needs of astrometry. Our task is namely to relate those countless astrometric measurements performed in the course of many centuries at various places to the series obtained by new methods. To accomplish this reference of the new to the old observations with maximum possible rigour, as well as to continue the current activity as long as necessary, a more detailed knowledge of the nature of the ground based astrometric results is indispensable. Were we able to do this, then the possibility should be given for a real rising of the accuracy of our data. This is the only correct solution. Mere increase of the number of observations, without an analysis of the factors influencing their accuracy, provides only a fictitious but not a really high accuracy.

Let us return to the atmospheric influences. We would like to treat them here - more especially in the optical fundamental astrometry - in more details and to try to answer the question as to how much we are in error in case some given influence is neglected or poorly accounted for. Clearly, it is impossible to give a completely accurate estimation of the amount of all influences - all parts of the complete mosaic - even less an estimation applying universally to all places and all times. All we aspire at is to give the order of magnitude where such is possible and to initiate a more close study of this complex question.

Evidently we too have to simplify our dealing with the matter. On one hand, we do not take an unique atmospheric field and, on the other, we do not treat the final astrometric result as an ultimate product but only its parts. As regards the atmospheric field it should be emphasised that we are unable to create a model of a unique meteorologic field, not even of a simplified one, of the surface layer in the immediate surroundings of the instruments.

In order to obtain a more complete picture one should analyse the way in which atmospheric elements influence the instrument, the light ray and the observer (registering equipment). There are but few data on the influence of the atmosphere on the human body and by way of it on the astrometric result, accordingly we are not going to consider it here. But the advance brought about by the automatization (Høg, 1974) and elimination of the subjective observer indicates the human factor to be significant. It is difficult to asses to what extent atmospheric influence is hidden in it, but the possibility should not be excluded that higher or lower temperature, humidity or circulation of the air are causing changes in the accuracy obtainable by the buman eye.

2. The instrument

Of the atmospheric factors we take into consideration the influences of the temperature field, air flow and humidity.

The temperature field around instrument is very intricate, so we are compelled to simplify it by decomposing it into two elements: the mean temperature and the temperature gradients (of all kinds). However it should at once be stated that usually the mean temperature is what we rest upon, a full simplification of the phenomenon being the result.

2.1. Let us assume that there are no temperature gradients and the field to be homogeneous. Its influence on the instrument is then manifested by uniform expanding and contracting of its parts, apt to have effects on the mechanical and optical stability of the instrument, thus on the values of its constants.

The behaviour of the instrument in the temperature field is a very important question, as yet unfortunately not sufficiently studied and neglected in the astrometric practice. We would like to point out here some of consequences of such a state.

The temperature variations have an impact on the optical system: focal length is being changed along with the position of the plane of sharp vision and the aberational characteristics of the optical system. Bagil'dinskij et al. (1972) have studied this question with the Zverev Photographic Vertical Circle. Their conclusion, in case a suitable compensation for the adverse effects of this kind were missing, is that the focusing of the instrument should be performed not only seasonally but even in the course of a day, otherwise the instruments are considerably affected. The plate scale of this instrument is changed at a rate of 0.''0025 per mm and $1^{o}C$, the change being reduced tenfold with a compensating device. The need should be mentioned here for the good fixing of the parts of objective - mutually and with the tube. This can be achieved, e.g. by the Suharev's (1954) selfcentering system.

Mechanical defects, which usually are magnified by the changes of the temperature field, are causing whole array of additional influences, among others on the flexure of the instrumental parts. Of all these effects the horizontal flexure of the instrumental tube is the only which is usually investigated. From the series of questions connected with this we would like to indicate to these results. According to the investigations of Kosin and Mijatov (1972), the horizontal flexure component of the Pulkovo Vertical Circle is changing by day conditions by 0\."5 – 0\."6. Under the daytime temperature conditions flexure variations might by of the order of 0\."04 per 1°C (Mijatov, 1972/73) and we can expect the same value for night conditions. These results are doubtless affected by the defect of the collimators and thier use.

Collimation variations as function of temperature might also be a significant source of errors. An example of this we find with the Belgrade Large Transit Instrument. A temperature change of 1°C is causing collimation variation of $0^s.005$ (Mitić, Pakvor, 1969).

The accuracy of the level depends upon the quality and cleanliness of the gliding surface (Lauffläche), on the temperature variations, on the length and the diameter of the level-bubble (Teleki, 1968). This meant that the temperature factors are influencing the inclination value. The mean angular value of the level division of the "one second level" can be changed by 0\."003 per 1°C. It should especially be stressed that it is very wrong, as is the habit, not to keep the length of the level bubble very nearly constant and at appropriate size. If this is not observed, the accuracy of the inclination determination is substantially diminished (Alpár, Teleki, 1970).

The angular value variation of the micrometer revolution can be around 0\."001 per 1°C.

2.2. The results given in § 2.1. are empirical, obtained in a temperature field still not exempt of the temperature gradients of all kinds. Unfortunately the instrument as a whole is exposed to diverse temperature effects – having their source either in various part of the building, or emanating from the observer, lamps on and around the instrument, or from other sources, the value of which is changing from minute to minute.

In such a field the instruments needs some time for adaptation, and for taking a stable state. The mere motion of the tube by zenith distance – even the direction in which the motion is made is important – and especially its reversal from one position into other (say from clamp east to clamp west) is already causing a change with its repercussion on the instrumental constants. The investigation of the Belgrade Vertical Circle has shown that 8–10 minutes are required for the instrument to be completely temperature accommodated. If the observation of each star is made in two positions, as is the case with the vertical circle, such a long time for accomodation is not available, this probably being one of the important reasons of the unsatistactory accuracy of the vertical circles in general (Teleki, 1970). The similar problem of the accommodation was also noticed at the Belgrade Large Transit Instrument (Mitić, Pakvor, 1969).

The existence of the gradient field is causing change of all instrumental characteristics – some of them more and others less. The changes of the flexion value are particularly sensitive (see, e.g. Teleki, 1970) and in the inclination determination by level. According to Drobofsky (1956), the level bubble is shifted by 0\."1 towards the warmer end if the temperature differences of both ends of the second level is 0°01 C. Fortunately the level tube is protected to some degree, but even then the errors of the order 0\."1 are occuring. Van Herk (1958) has measured temperature differences in the instrumental tube and has found that a temperature difference of 1°C provoked a change in the flexion of 0\."30 (at z=45°). Usefull information about great sensitivity of the instrument of diverse temperature effects might be found also with Hansson (1963).

The effect of the observer is quite analogous to that of a heat source – it is estimated that his influence is equal to that of a 100 W lamp – which is already a kind of stroke upon the instrument. The sole presence of the observer near the instrument is sufficient to alter the position of the micrometer moving wire by 2 microns (Hansson, 1963), as well as the value of the flexion (Van Herk, 1958). This problem becomes particularly complicated on account of the changeability of the observer's heat effect (variable proximity to the instrument, clothes, etc.).

2.3. Air flow is an important element of the state of the atmosphere. By the air flow we understand the phenomenon characterised not only by the direction and speed, but also by other characteristics such as frequency, temperature, humidity etc. Thus conceived, it becomes understable that the air flow acts through its mechanical force, but it is at the same time the transmitter of the given atmospheric state. The temperature influences are of particular interest – as an example we cite the investigation of Sárdy (1961), who measured, under the field conditions and by windy wheather, the temperature differences at the extremities of the level body and has obtained on the average a difference of 0°.25C, an amount which could affect the value of the latitude by about 0".5.

If the air flow is intensive and the instrument not adequately protected, the strokes on the instrument will be exrecised which sometimes render the work impossible. But even if the protection is proper one, there exists a transmission of a given temperature state, creating in the instrument's body gradients – usually of a variable nature – the consequences of which are set forth in § 2.2.

Hansson (1963) has stated that the air circulation is felt at the instrument pillar as vell: a temperature difference of 0°.01 C casues a drift of 0.2 microns, having its effect on the astronomical results.

2.4. The humidity of the air is also a source of many inconveniences with the instrument. If the vapour is condensed but not everywhere at the same time, a temperature assymetry occurs in the atmospheric field and in the instrument itself. Once again we have to deal with the changes as set out in § 2.2. The water drops as the result of the vapour condensation cause a more extended corosion as well as difficulties in the use of particular instrument's parts, as for instance the micrometer screw. The humidity affects in a considerable measure electric and electronic parts in the instrument.

2.5. From the aforesaid it is evident that the atmospheric elements may – but also may not – have their influence on the instrument's parts, and by that very fact on the astrometric results. Their total effect is difficult to assesed but one may assume that even in the ordinary atmospheric conditions the resulting error is exceding 0".1.

What about the calculation of these influences? Of all possible influences only some of them are being accounted for – even this not as a rule – some temperature corrections of level divisions, of the micrometer revolution, of the collimation and of the flexion. But as it is evident that some average temperature, measured at some arbitrary place, cannot be representative of all temperature field, some observers do not account for these errors, deeming them fictious. It is difficult to decide what solution is the correct one.

This being so, there remain preventive measures only: maximal protection of the instrument against outside atmospheric efects, provided of course, that this is not harmful to precision of the astrometric results. With the classical instruments this is usually achieved by covering the tube, micrometer and the level by aluminium sheets (Teleki, 1970), with useful but still not quite satisfactory results. Instruments of new type are therefore required – of minor size, more simple construction, with as few movable parts and parts in general as possible, with more automatics etc. Examples of the new instruments are: Danjon's astrolabe, Pavlov's transit instrument, Zverev's photographic vertical circle, horizontal meridian circles of Aitkenson's or Suharev's type, as well as projects of Høg (Glass Meridian Circle) and Nemiro (transit instrument with ecker). The perfection of the instruments – especially if principles of their construction are strictly observed and countermeasures against atmospheric factors taken, as proposed by Pavlov (1963) – will surely lessen the atmospheric effects.

How to proceed with the old measures, affected as they are by these effects? Unfortunately, there is little hope to eliminate them, owing to the lack of sufficient information. About the use of old data there will be reference in § 4. In all appearance Pavlov's Transit Instrument (1972) is so far the best protected instrument against atmospheric influences.

3. The light ray

The astronomical refraction is a consequence of the physical laws of bending of the light ray in passing from one medium into another with different densities. These laws give the amount of the bending as a function of the refractive indices of the two mediums and of the light direction. As is known, the refractive index is dependent upon the densities of the mediums and the wave length of the ray.

There is the problem of how to apply these laws in the astronomical practice. Quite a series of difficulties is met (Teleki, 1974 a) some of which only we are going to mention here. The basic question is what kind of the air layer we have to deal with: what is its density, thickness and boundary surfaces. From the meteorological point of view the air layers distribution is not as clear and ideal as postulated by these laws. A somewhat better approximation to the ideal state is attained at altitudes above 1–2 km in the free atmosphere. The planetary (Ekman) boundary layer (altitude 1–2 km) and, especially its lowest part, the surface layer (100–200 m), are dominatly influenced by Eart's surface. This means a great diversity and a rapid changeability of the atmospheric state, which even can compromise the applicability of the foregoing physical laws. One should bear in mind that the lowest portions of the atmosphere exercise about 20% of the pure refraction and the predominant part of the anomalous refraction.

Accordingly, one must be aware of the fact that the values of the astronomical refraction can be given only approximately – what is its true value depends not only or the real state of the atmopshere but also or our ability to calculate them.

Astronomical refraction is usually divided into the pure and anomalous refraction (Teleki, 1974b).

3.1. By the pure refraction is meant the component of the astronomical refraction in the vertical plan of the observer's place, in the case that the atmosphere is a medium with characteristics of an ideal gas in a hydrostatic equilibrium, in a Newtonian gravitational field and with the spherically symmetric density distribution.

As evident, this is a really ideal representation of an intricate phenomenon.

The pure refraction depends on the accepted law of the density variation with the altitude, on the refractive index in the surface layer and on the zenith distance. If we wish to estimate the accuracy of the computation of this value, then the following picture is presented: the various atmospheric models may vary the results obtained for the pure refraction at $z=45^{\circ}$ by about $0''.01-0''.02$ and at $z=60^{\circ}$ by about $0''.1$ (Teleki, 1969); on account of the uncertainty of the calculation of the refractive index in the surface layer we cannot expect an accuracy higher then $\pm 0''.02$ tg z accidentally, while in respect to systematic errors these may be somewhat larger (Teleki, 1974b). One has to point out that this is an error of computation and not an estimation of the real state.

In the practice tables are being used, constructed upon the foregoing principles – such as are, say, Pulkovo Refraction Tables – or computations are made according to some given formulae (usually as function of tg z). The pure refraction – according to definition (Teleki, 1974b) – bears no local character, so the calculated values do not depend on the season (in the sense of the change of the atmospheric model), nor on the azimuth of the observed body nor on the immediate surrounding, etc. Nevertheless the estimation can be made – naturally with unsufficient certainty – that the pure refraction, strictly calculated, makes still 98% of the true values of the astronomical refraction.

3.2. The difference between the true and the pure refraction is termed anomalous refraction. This is another ideal definition of one influence giving integral amount of the correction for the pure refraction. We are not able to find it out by calculation, so we speak of diverse anomalies (Teleki, 1969b), maintaining that their sum total yields the value wanted.

Theoretically it may be ascertained that the largest anomalies are originating from the perturbed state in the atmosphere in the surface layers, in the portions immediately surrounding the instrument in particular. But what are these values it is hard to say. It depends not only on the general state of the atmosphere, but also on what the instrument is surrounded with – the shape and particulars of the pavilion, internal disposition, thermal sources within it and around it, on the surroundings in the broader sens etc. – as well as on the laws of their effects on the field of the meteorological elements. If separate influences of this kind were to be calculated, then values up to $0''.1$ would be obtained even for the zenith zone, but there remains the question of their reality. How uncertain these values are might be judged by the fact that they are not taken into account in the reduction of the astrometric measurements.

All attempts made so far to calculate the anomalous refraction on the ground of measured temperature gradients in the pavilion and its surrounding have failed. The reason for this is to be sought not only in our lacking a suitable model of influence but in the first place in our neglecting of the pressure and humidity variations, and in particular the elements of the air flow.

Neither there was any success in the determination of the refractional anomalies directly from the astrometric data. The explanation of this should be sought alike in instrumental imperfections and in the nonexistence of corresponding mathematical model of influences (Teleki, Ševarlić, 1971).

3.3. The use of the aerological data, especially if they originate from the surroundings of the astronomical observing station for the computation of the values of astronomical refraction constitutes an advance relative to the previous situation, because real state of the atmosphere is employed instead of a fictious theoretical atmosphere. Such a computing of refractional influences procedure is recommendable to observatories in whose proximity aerological measurements are being carried out. The disadvantage of computing the refraction in this way comes from the fact that the time of aerological soundings does not correspond to the time of astrometric observations and, which is of particular importance, the data of one sole station are used, thus vertical section is obtained but not spacious characteristics of the atmosphere above the observing site.

The deriving of vertical section only means that air layers are assumed spherical and symmetrical with reference to the plumb line. It follows therefore that values of some kind of pure refraction are still obtained.

Difficulties are felt in computing values of refraction for larger zenith distances. Kolchinskij (1976) has found, by using geodetic method for the computation of the terrestrial refraction, the refractional influence at $z=90^{o}$, at 288.2 K and 1013.25 mb in the surface level, to be 33' 5".5. This value is less by about 25–26" then that which follows from the Pulkovo Tables or from theories of Radau, Grafinkel and Bessel, which may be explained by the different atmosphere model used and by the neglecting of temperature gradients respectively.

Referring to aerological data one should stress that they do not offer the possibility of improving the computation for the planetary boundary layer, consequently in so far as the most important refractional anomalies is concerned, no progress has been achieved.

In the more recent time an aid is presented by the meteorological satellites (Teleki, 1977b), but no steps have been taken to make use in the astrometric praxis.

3.4. Summing up what has been said about astronomical refraction one is led to conclude that the internal accuracy of its determination in the zenith zone is of order of 0".01 but that it is diminishing with the growing zenith distance. The real error is probably substantially larger than the mathematical one.

What could be done to improve the present state? A certain progress could be achieved, on one hand, by the more rigorous computation of this value according to the existing formulae, and on the other hand, by prevention through proper site selection for the astrometric instruments. Here are some general considerations.

Direct meteorological and aerological data or those obtained with satellites, giving instantaneous information on the atmosphere at the time of astronmetric measurements, should be used wherever possible. Because these data cannot always be used, the need appears for the construction of refraction tables for some average atmosphere. But quite irrespective of what procedure is applied it is imperative to take into account all the factors whose influence is not negligable. These have been carefully analyzed in connection with the construction of new refraction tables (Teleki, 1977a).

What innovations are brought forth by the new tables? Above all an up–to–date model of the atmosphere is used, unique for the entire Earth, by means of which it is possible to pass from the spherically symmetric distribution of density to a more real state. Second, a new method is introduced of the computation of the chromatic refraction by way of spectrophotometric gradients (so called "black body gradients"). Third, the procedure itself of the direct calculation of the refractional influences will be changed (refractive index has been introduced instead of separate temperature, pressure and humidity; logarithmic quantities have disappeared; the use of computers made possibel, etc.). These tables are intented to be standard in all astrometric measurements.

It is not easy to estimate to what extent all these innovations would improve the present state but it is certain that they will be a contribution and a step forward. This only in the case we fully apply the instructions for their use. Thus, for instance, chromatic characteristics of the instrument will be necessary as well as characteristics of the local atmosphere and the registering equipment (the eye).

At this point we might also, as in § 2.5., put the question: how to clean the astrometric results of earlier times from the refractional influences not accounted for? There is little hope to achieve this as sufficient elements related are lacking. Provided the instrument is adequately isolated from the atmospheric influence – as is the case with the Pavlov's Transit Instrument – and the instrument itself is highly precise, then a possibility is presented to obtain information about the refractional anomalies right from the astrometric measurements (Teleki, Ševarlić, 1971).

Since we are confronted with difficulties in our getting information on the atmospheric influences and will never, in all likelyhood, be able, to find out this value and to apply it, the need becomes apparent to carefully select the site for the astrometric instruments (Teleki, 1974b). It is thereby essential to have the meteorological field around instrument as simple as possible. The same criteria should be applied in placing the astrometric instruments, or at least approximately the same, as in the site selection for astrophysical instruments.

3.5. In talking about the influence of the atmosphere on the light ray, we surely have to think also on the phenomena of the terrestrial refraction, occuring in the determination of separate constans. We have, first of all, in view the collimation and flexion – by means of horizontal collimators – and the azimuth, by way of meridian marks. In the determination of the flexion the terrestrial refractional influence might even amount to 0".2 (Mijatov, 1972/73). By inserting vacuum tubes between the instrument and meridian marks the accuracy of the azimuth determination rises actually to the optimal accuracy of reading with the instrument, and does not depend upon the atmospheric variations (Mitić, Pakvor, 1977). Thus we have to deal with influences which by no means can be neglected.

4. The elimination of the atmosperic influences

In § 2.5. and 3.4 we have dealt with the possibility of the elimination of the atmospheric influence separately on the instrument and on the light ray. But the atmospheric influence being a unique phenomenon, the question should be posed in this way: are we able to completely free the results from this influence? Here also we are led to reiterate what we already have stated: real possibility for complete accounting for is ruled out; the possibility for some improvement of this state is given – by introduction of new corrections but the greatest effect can be achieved by the preventive measures.

As many observers are aware that it is not real to expect our being able to determine with high accuracy the amount of the atmospheric influence and to apply it in deriving the astrometric results, they do not take into account even what is possible, but are striving to determine the amount of this influence from the direct astrometric measurements. So we arrive at a vicious circle leading to the distortion of our results.

Let us take, for instance, the question of the so called correction to the refraction constant. No doubt this value cannot be considered as the correction to the refraction constant (Teleki, 1977a), but it is certain that there are considerable refractional influences in it, not accounted for. The values of declination obtained in the upper and lower culminations, in different atmospheric states, should rather serve for the determination of the correction to the integral atmospheric influence, and not only of one of its portions (of the refractional value). The question is, hower, according to what law to pick out something like this from the astrometric data. It is sure that the law expressed as a function of tg z is not suitable.

The assertion might be considered real that momentarily, in the strugle against atmospheric influences, it is more correct to rigorously apply our physical and meteorological knowledge and possible corrections that follow from it, then to manipulate with the astrometric results themselves. It is therefore strongly recommended to thoroughly investigate the instrument, accessories and the atmosphere, their known influences to eliminate, striving at the same time to have the instrument placed in the best possible conditions, at high altitudes whenever possible. That the atmospheric influences are worthy of paying particular attention to follows from the estimation of the order of their integral effect: 0".1.

It cannot be doubted that the observing site, with its atmospheric characteristics, may to a considerable degree affect the astrometric results. An analysis of ours (Teleki, 1976) offers an confirmation of this. We have studied the results of the International Latitude Service, obtained at its 5 stations in the period 1949.0–1962.0. At all these stations the observation program is one and the same. It came out that in Kitab and Ukiah, the latitude variations during night were the largest, but with opposite tendencies (increase resp. decrease). In seeking the cause of this phenomenon we found that in the regions of these two stations an anomalous field of meteorological elements was to be presumed, whereby with just opposite characteristics. Accordingly, the cause of these pronounced, non polar latitude variations, should be sought in the influence of the existing atmosphere. The analysis of this kind may be useful in connecting the observed date, gathered at different places, into one whole, for the possibility is thereby given to let local anomalies of the atmospheric state spring up. We are convinced that such a procedure should be used in the analyse of the stellar catalogues entered into a general calalogue, and especially in the constructions of the fundamental system.

In seeking a better solution an essential part should be played by a more rapid introduction of new instruments, but of substantially higher accuracy, and instead of simple multiplication of the number of observations it is better to orient oneself toward possibly lesser number in return for their higher quality. This of course holds true not only in connection with the atmospheric influences, but in general.

REFERENCES:

Alpár, G. and Teleki, G.: 1970, Bull. Geodes. 93, 375.

Bagil'dinskij, B.K., Belorossova, T.S. and Merman, N.U.: 1972, Trudy 18. Astr. Konf. SSSR, 330.

Drodofsky, M.: 1956, Veröffentl.DGK, C, 17, 1.

Hansson, N.: 1963, Arkiv Astron., 3, 137.

Høg, E.: 1974, New Problems in Astrometry, IAU Symposium No. 61, D. Reidel Publ. Comp., 243.

Kolchinskij, I.G.: 1976, Astrometrija i astrofizika, Kiev, 28, 52.

Kosin, G.S. and Mijatov, M.: 1972, Trudy 18. Astr. Konf. SSSR, 198.

Mijatov, M.: 1972/73, Bull. Obs. Astron. Belgrade, 125, 24.

Mitić, Lj. and Pakvor, I.: 1969, Publ. Obs. Astron. Belgrade, 16, 27.

Mitić, L.A. and Pakvor, I.: 1977, Bull. Obs. Astron. Belgrade, 128, 11.

Pavlov, N.N.: 1963, Trudy 15. Astr. Konf. SSSR, 246.

Pavlov, N.N.: 1972, Trudy 18. Astr. Konf. SSSR, 151.

Sárdy, A.: 1961, Épitöipari és Közl. Müszaki Egyetem Tud. Közl., Budapest, 7, 2, 37.

Suharev, L.A.: 1954, Uspehi astr. nauk, 6, 163.

Teleki, G.: 1968, Publ. Obs. Astron. Belgrade, 14, 19.

Teleki, G.: 1969a, Studii Cerc. Astr. Bucarest, 14, 3.

Teleki, G.: 1969b, Proc. Int. Latit. Obs. Mizusawa, 9, 222.

Teleki, G.: 1970, Bull. Obs. Astron. Belgrade, 123, 31.

Teleki, G.: 1974a, Publ. Obs. Astron. Belgrade 18, 213.

Teleki, G.: 1974b, ibid, 9.

Teleki, G.: 1976, Mitt. Lohrmann Obs. Dresden, 33, 913.

Teleki, G.: 1977a, Bull. Obs. Astron. Belgrade, 128, 7.

Teleki, G.: 1977b, Proc. Int. Symp. Terr. EDM and Atm. Effects on Angular Meas., Stockholm, 5, 1.

Teleki, G. and Ševarlić, B.: 1971, Publ. Dept. Astron. Belgrade, 3, 5.

van Herk, G.: 1958, Bull. Astron. Inst. Neth., 14, 115.

Bull. Obs. Astron. Belgrade, N^o 129

ORBITAL ELEMENTS, PARALLAXES AND MASSES OF THE VISUAL BINARY SYSTEMS A 556 = ADS 7854 and Hu 1324 = ADS 16880

G. M. Popović

SUMMARY:

Orbital elements, orbital parallaxes and masses presented of the components of visual binaries A 556 = ADS 7854 and Hu 1324 = ADS 16880

Binary system A 556 = ADS 7854, α, δ, (1950): $10^h34^m.5, -8^o35'$

The system was discovered by R. Aitken in 1903. Until 1972 the position angle has changed by 61^o. A considerable difference in brightness of the components ($\Delta m = 3^m.2$) as well as their separation ρ less than 1".6 (according to the ephemeris) are, in all probability, responsible for the late discovery of the pair. It was discovered at the time of maximum relative distance. Apparent magnitudes of the components, according to the estimate of their first observer, are $6^m.8$ and $10^m.0$ respectively, while the IDS catalogue gives them as $7^m.2$ and $10^m.4$. Physical connection of the pair's components is pointed out in the IDS catalogue by the remark: "The proper motion common to the two stars is 0".116 in 284°.3, (Nyrén).

In Table I all observations of this pair are presented according to the double stars card file of the Nice Observatory along with the 0–C values. On the basis of Table I four normal places have been formed (mean weight values of θ and ρ, the number of measurements n being taken for weight) Table II, which served in the determination of the apparent elipse. These normal places are drawn by circlets in Fig. 1. In the same Figure 1 indivdual observations are indicated by black circlets. The elements have been determined by Thiele–Innes–Van den Bos's method (1926). The precessional effect on θ has been neglected. In calculation of the orbital elements, ephemeris and other quantities WANG 2200 computer has been used.

Table III gives the standard quantities, charactersising the orbital motion. Table IV presents ephemeris from 1977 to 2000.

The derivation of the orbital elements, as presented in Table III, was preceded by a variant giving the following system of orbital and astro–physical elements: P = 164.6, T = 2021.2, e = 0.54, a = 1".219, i = 43°.6, ω = 229°.8, Ω = 45°.2, $M_A = +4^m.8$, $M_B = +8^m.0$, $\mathfrak{M}_A = 1.10\ \mathfrak{M}_\odot$, $\mathfrak{M}_B = 0.69\ \mathfrak{M}_\odot$, π = 0".033. According to this variant the A component belongs to the main HR sequence, that is the spectrum Sp_A = GO is in good aggreement with the absolute brightness of M_A of the main sequence. The paralaxe of this variant is also in accord with the paralaxe $d\pi$ = 0".034 (1954) as given by G.van Biesbroeck. Nevertheless this variant of elements falls behind in satisfying the observations with respect to that presented in Table III.

Our trying to derive the components' masses, parallaxes and absolute magnitude by using the empirical mass–brightness relation(Popović, Angelov, (1970) for the main HR sequence, on the base of elements in Table III, showed the pair as not belonging to the main sequence. The following values have been obtained: π = 0".015, $M_A = -1^m.93$, $M_B = 1^m.27$, $\mathfrak{M}_A = 6.41\ \mathfrak{M}_\odot$, $\mathfrak{M}_B = 2.14\ \mathfrak{M}_\odot$. It is evident that the values of the absolute brightness and the mass of the A component cannot be reconciled with its GO spectrum of the main HR sequence. By the elements in Table III this system, or at least its A component, is placed in the region considerable above the main HR sequence, thus in the region of the giant stars.

Table I

Individual measurements of the pair ADS 7854 and O–C

t	θ_t	ρ	n	Observer	O–C	
	o	"			o	"
1903.04	54.0	1.34	2	A	−4.0	−0.22
1909.32	65.1	1.69	3	MCO	+2.7	+ .13
1911.58	63.3	1.62	7	Doo4, Fox3	−0.7	+ .06
1921.36	73.1	1.61	1	A	+2.2	+ .06
1922.78	81.8	1.98	2	Gcb	+9.9	+ .43
1925.80	76.9	1.62	4	A	+2.8	+ .08
1928.16	81.3	1.52	3	VBs	+5.7	− .01
1929.573	75.3	1.54	4	Ol	−1.5	+ .01
1933.277	78.0	1.56	4	B	−1.6	+ .05
1933.969	76.5	1.33	3	Brt	−3.6	− .18
1935.63	82.8	1.62	3	Bz	+1.5	+ .12
1936.247	81.4	1.35	5	Sim	−0.4	− .15
1939.304	81.5	1.52	1	φ	−2.7	+ .04
1944.01	86.4	1.45	4	V	−1.5	±0.00
1944.29	92.4	1.40	2	VBs	+4.2	− .05
1947.933	89.0	1.28	3	B	−2.2	− .14
1956.34	97.6	1.28	2	Chur	−1.2	− .07
1957.76	106.2	1.52	3	VBs	+ 6.2	+ .19
1958.00	97.0	1.42	1	B	−3.3	+ .09
1958.04	103.1	1.38	1	B	+ 2.8	+ .05
1959.161	110.8	1.60	1	Dick	+ 9.4	+ .28
1959.30	97.7	1.14	4	B	−3.8	− .18
1959.31	103.2	1.53	2	H	+ 1.6	+ .21
1960.29	101.6	1.30	3	Wor	−0.9	− .01
1961.22	106.0	1.38	3	Hz	+ 2.5	+ .08
1962.502	110.3	1.18	4	B	+ 5.5	− .10
1966.05	108.6	1.42	4	Hz	±0.0	+ .18
1966.38	108.4	1.20	3	B	−0.6	− .04
1972.112	116.5	1.14	1	Wor	+ 0.7	− .02
1972.12	113.1	0.92	2	VBs	−2.7	− 0.24

Table II

Normal places

t	θ_t	ρ	n	Observer
1909.59	62.2	1.59	12	A2,MCO3,Doo4,Fox3
1931.78	78.7	1.51	28	A5,Gcb2,VBs3,O14, B4,Brt3,Bz3,Sim5, φ_1
1954.09	97.1	1.36	26	V4,VBs5,B9,Chur2, Dick1,H2,Wor3.
1965.49	109.5	1.24	17	Hz7,B7,Wor1,VBs2.

Table III

Orbital elements of the ADS 7854 pair

P = $283^{y}.11$	A = − 0".900
n = $1^{\circ}.2716$	B = − 0.712
T = 2017.61	F = + 0.590
e = 0.304	G = − 1.108
a = 1".317	C = ± 0.648
i = $35^{\circ}.22$	H = ∓ 0.397
ω = $121^{\circ}.48$	t (☊) = 1948.18
Ω = $91^{\circ}.09$	t (☋) = 2051.05

Table IV

Ephemeris of the pair ADS 7854

t	θ_t	ρ	t	θ_t	ρ
	o	"		o	"
1977.0	122.4	1.09	1989.0	142.8	0.92
1978.0	123.9	1.08	1990.0	144.8	0.91
1979.0	125.4	1.07	1991.0	146.9	0.90
1980.0	126.9	1.05	1992.0	149.0	0.89
1981.0	128.5	1.04	1993.0	151.3	0.87
1982.0	130.1	1.02	1994.0	153.5	0.86
1983.0	131.8	1.01	1995.0	155.9	0.85
1984.0	133.5	1.00	1996.0	158.3	0.84
1985.0	135.2	0.98	1997.0	160.7	0.83
1986.0	137.0	0.97	1998.0	163.2	0.82
1987.0	138.9	0.95	1999.0	165.8	0.81
1988.0	140.0	0.94	2000.0	168.5	0.80

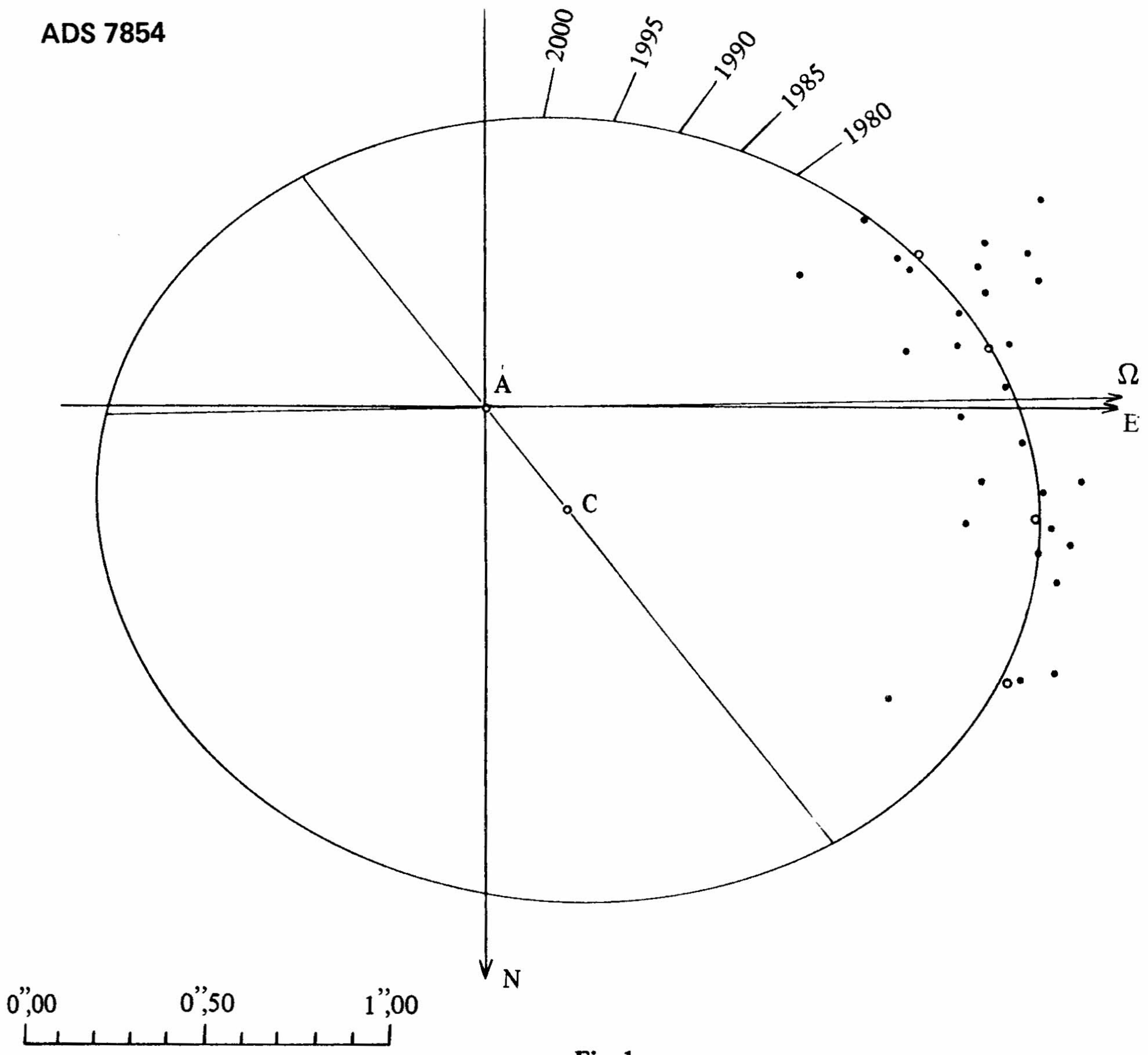

Fig. 1

Binary system Hu 1324 = ADS 16880, α, δ (1950): $23^h35^m.5$ $+65^{\circ}44'$

First measurement of this W. J. Hussey's close faint pair is owed to R. Aitken and dates from 1906. Until 1975 the position θ angle has increased by 91°, a sufficient amount for a preliminary orbit to be derived. The measurements of θ are reduced to the epoch 1950.0 by means of the relation $\theta_{1950} - \theta_t = -0^{\circ}.00141\ (1950 - t)$. The reduction caused only one correction of W for the year 1906.33 of $-0^{\circ}.1$.

In Table V individual measurements of this pair are given and the corresponding values of O–C. Normal places are given in Table VI and are represented in Fig. 2 by circlets. Table VII comprises orbital and astrophysical elements of the pair, and Table VIII ephemeris from 1976 to 1985. In the ADS catalogue dynamical parallax, according to G. van Biesbroeck is found of 0".008. Here is obtained its value as 0".006.

By applying the empirical mass-luminosity relation ($\mathfrak{M}$, M) for the HR main sequence (Popović-Angelov, 1970) to this pair absolute luminosity $M_A = +3^m.53$ and $M_B = +3^m.73$ and masses $\mathfrak{M}_A$ =

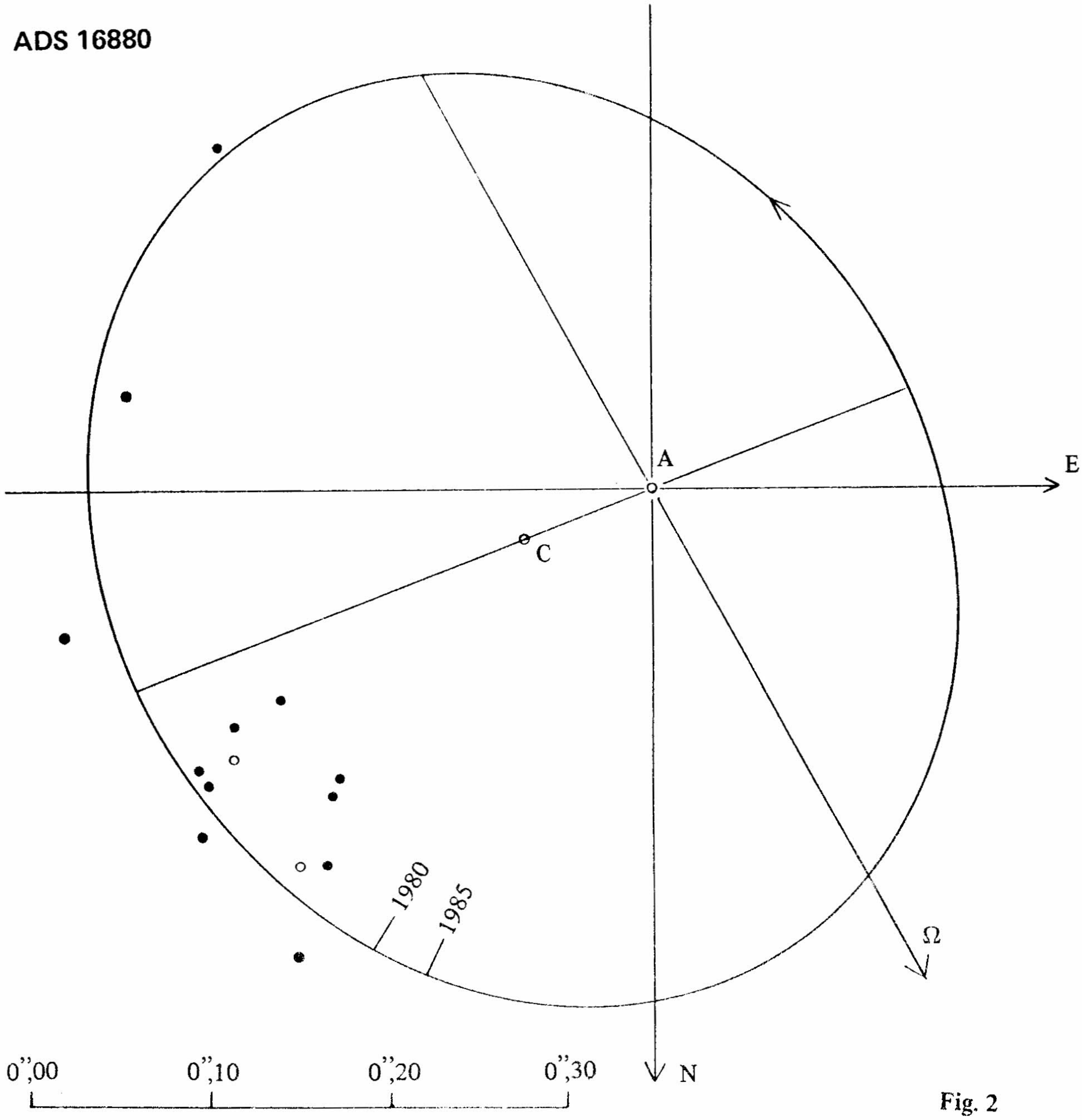

Fig. 2

$=1,34\ \mathfrak{M}_\odot$ and $\mathfrak{M}_B = 1,30\ \mathfrak{M}_\odot$ respectively are obtained, amounts not acceptable for the main sequence with regard to the spectrum GO. A better agreement is obtained by the acceptance of the empirical mass-luminosity relation valid for stars above the main sequence of HR diagram (Popović-Angelov, 1970). In deriving of $\mathfrak{M}$, M, π apparent magnitudes $m_A = 9^m.5$ and $m_B = 9^m.7$ of respective components have been used.

Data processing was again carried out on WANG 2200 computer of the Belgrade Observatory.

Table V

Individual measurements of the ADS 16880 pair and O–C

t	θ_t	ρ	n	Obs.	O–C	
	°	"			°	"
1906.33	231.3	0.31	2	A	–4.3	±0.00
1923.65	259.7	0.30	4	VBs	+2.6	– .02
1943.79	283.9	0.34	3	VBs	+2.1	+ .03

Table V (continued)

t	θ_t	ρ	n	Obs.	O–C	
1956.81	301.6	0.30	2	C	+3.4	– .01
1957.62	299.6	0.24	2	VBs	+0.3	– .07
1958.65	299.5	0.27	2	B	–1.1	– .03
1961.811	307.6	0.32	3	Wor	+2.9	+ .01
1962.714	303.6	0.30	4	B	–2.2	– .01
1962.932	simple		1	C		
1964.096	ronde		1	Bz		
1966.865	312.7	0.26	2	Wal	+1.5	– .05
1968.941	313.7	0.25	1	VBs	–0.2	– .06
1974.75	318.9	0.28	3	Hz	–2.6	– .02
1975.72	322.7	0.33	1	DZ	–0.1	+0.03

Table VI:
Normal places of the pair ADS 16880

t	θ	ρ	n	Observer
	o	"		
1906.33	231.3	0.31	2	A
1923.65	259.7	0.30	4	VBs
1943.79	283.9	0.34	3	VBs
1960.19	303.0	0.29	13	C2, VBs2, B6, Wor3
1971 81	316 9	28	7	Wal2, Hz3, VBs1, DZ1

Table VII:

Elements of the orbital motion and astrophysical quantities of the ADS 16880 pair

P = $187^{J}.210$	A = – 0".0846	M_A = +$3^m.46$
n = $1^{\circ}.92297$	B = + 0.2166	M_B = +3.66
T = 2044.995	F = – 0.2654	
e = 0.336	G = – 0.1180	$\mathfrak{M}_A$ = 1.49 $\mathfrak{M}_\odot$
a = 0".29	C = $\pm$ 0.1744	$\mathfrak{M}_B$ = 1.45 $\mathfrak{M}_\odot$
i = $37^{\circ}.18$	H = $\pm$ 0.0177	
ω = $84^{\circ}.2$	t(☊) = 2020.268	
Ω = 28.6	t(☋) = 2074.767	π = 0".006

Table VIII:

Ephemeris of the binary ADS 16880

1976.0	$323^{\circ}.2$	0".30	1981.0	$329^{\circ}.8$	0".30
1977.0	324.5	0.30	1982.0	331.1	0.30
1978.0	325.8	0.30	1983.0	332.4	0.30
1979.0	327.1	0.30	1984.0	333.8	0.30
1980.0	328.4	0.30	1985.0	335.1	0.30

REFERENCES:

W.H.van den Bos, 1926: Union Observatory Circular,No 68.
G.M.Popović,
T.D.Angelov, 1970: Bull. Obs. Astron., Belgrade, No 124.
G.van Biesbroeck, 1954: Pub.Yerkes Obs.,Vol VIII.P.VI.

Bull. Obs. Astron. Belgrade, N° 129

LES ORBITES NOUVELLES DE DEUX ETOILES DOUBLES VISUELLES (ADS 3465 = A 2621 et ADS 4604 = A 1315)

V. Erceg

(Reçu le 27 mai 1977)

RESUME:

On a donné les éléments des orbites, les masses, les magnitudes absolues et les parallaxes dynamiques orbitalles de deux étoiles doubles visuelles, les éléments étant déterminés en utilisant la méthode de Thiele–Innes Van den Bos.

ORBITE DE ADS 3465 = A 2621

Pos. (1950) : $04^h47^m.0$; + $02^o07'$
Mgns.: 8.4 – 8.4.

Tableau I.

Les éléments orbitaux, les quantités astrophysiques et les constantes

P=225.84 ans		
n=$1^\circ.5940$		
T=1830.87	A =$-0''.1250$	
e=0.27	B =-0.0517	π dyn.orb.=$0''.003$
a=$0''.178$	F = +0,0872	$M_B=M_C$ = 0.5
i =$41^\circ.8$	G =-0.1533	$\mathfrak{M}_B=\mathfrak{M}_C$ = 3.19 $\odot$
Ω=$129^\circ.0$	C =± 0.1159	a = 68.5 U.A.
ω=$77^\circ.6$	H =± 0.0256	
$T_{\Omega \mho}$= 1800.17,1875.56.		

Tableau II.

Les éphémérides

t	θ^o	ρ''
1978.0	66.8	0.17
1979.0	68.1	0.17
1980.0	69.4	0.17
1981.0	70.7	0.17
1982.0	72.0	0.17
1983.0	73.3	0.17
1984.0	74.6	0.17
1985.0	75.8	0.17
1986.0	77.1	0.17
1987.0	78.4	0.17

Tableau III.

Les observations et les residus

t	θ_o^o	ρ_o''	Obs.	n	Références	$(0-C)_\theta^o$	$(0-c)_\rho''$
1913.72	339.2	0.19	A	3	ADS	− 9.4	0.00
1920.75	354.4	18	A	3	ADS	− 1.6	0
1930.99	7.3	16	A	2	Lick Obs. Bull. N. 451.	0.0	− 2
1937.827	23.5	20	V	4	Ann. Bosscha Lemb., 1934, N. VI.	+ 8.3	+ 3
1941.066	22.0	17	B	1	U.O.C. N. 111, 1951.	+ 2.9	0
1944.063	24.7	18	B	1	"	+ 1.9	+ 1
1944.91	24.9	16	VBS	2	Pub. Yerkes Obs., Vol.VIII, Part VI.	+ 1.1	− 1
1948.099	35.2	17	B	1	U.O.C.N. 111, 1951.	+ 7.4	0
1948.72	33.8	14	VBS	2	Pub. Yerkes Obs. Vol. VIII, Part. VI.	+ 5.2	− 3
1951.057	32.9	16	B	1	U.O.C. N. 111, 1951.	+ 1.3	− 1
1951.80	29.6	12	VBS	3	Pub. Yerkes Obs., Vol. IX, Part II.	− 2.9	− 5
1953.020	28.5	12	VBS	3	"	− 5.6	− 5
1953.78	36.4	16	MUL	1	Lick Obs. Bull. N. 530.	+ 1.3	− 1
1954.78	32.7	13	VBS	2	Pub. Yerkes Obs. Vol. IX, Part II.	− 3.7	− 5
1957.78	39.2	18	MUL	2	J.O.Vol. 41, N. 7, 1958.	− 1.0	+ 1
1961.08	31.	21	COU	3	J.O.Vol. 45, N. 3, 1962.	−13.	+ 4
1961.871	48.6	18	B	4	Astr. J.Vol. 67, N.8., 1962, N. 1303.	+ 3.0	+ 1
1966.88	52.2	0.12	WOR	2	Pub. Naval Obs. Sec. Ser., Vol. XXII, Part IV.	0.0	− 0.04

ORBITE DE ADS 4604 = A 1315

Pos. (1950) : $05^h58^m.8$; + 58°13'
Mgns. : 10.0–10.0: Type sp. G5

Tableau I.

Les éléments orbitaux, les quantites astrophysiques et les constantes

p =276.923 ans		
n =1°.3000		
T(θ = 0.0)=1912.69	A=+0".2900	π dyn orb.=0".005
e =0.0	B= 0.0000	M_A=M_B=3.4
a =0".290	F= 0.0000	$\mathfrak{M}_A$=$\mathfrak{M}_B$=1.45 ⊙
i =0.0	G=+0.2900	a =58.0 U.A.
Ω =0.0		
ω =0.0		

Tableau II.

Les éphémérides

t	θ°	ρ"
1978.0	84.9	0.29
1979.0	86,2	0.29
1980.0	87.5	0.29
1981.0	88.8	0.29
1982.0	90.1	0.29
1983.0	91.4	0.29
1984.0	92.7	0.29
1985.0	94.0	0.29
1986.0	95.3	0.29

Tableau III.

Les observations et les residus

t	θ_o^o	ρ_o''	Obs.	n	Références	$(0-C)_\theta^o$	$(0-C)_\rho''$
1906.90	350.0	0.28	A	2	ADS	– 2.5	– 0.01
1916.26	1.6	29	A	2	"	– 3.0	0
1919.77	9.8	26	A	1	"	+ 0.6	– 3
1921.85	12.6	30	A	2	"	+ 0.7	+ 1
1929.88	23.8	30	A	2	Lick Obs. Bull. N. 451	+ 1.5	+ 1
1945.03	39.8	28	VBS	4	Pub. Yerkes Obs., Vol. VIII, Part VI.	– 2.2	– 1
1958.003	59.2	30	B	1	Pub. Yerkes Obs., Vol IX, Part I.	+ 0.3	+ 1
1958.192	58.7	0.28	B	1	"	– 0.5	– 0.01

LITTÉRATURE:

Bos, W.H., 1926, U.O.C., 68.
Parenago, P., P., 1938, Kurs zvezdnoj astronomiji.

Bull. Obs. Astron. Belgrade, N° 129

LES ORBITES NOUVELLES DE DEUX ETOILES DOUBLES VISUELLES (ADS 2849 BC = A 1831 BC et ADS 3438 = A 1544)

V. Erceg

(Reçu le 27 mai 1977)

RESUME:

On a donné les éléments des orbites, les masses, les magnitudes absolues et les parallaxes dynamiques orbitalles de deux etoiles doubles, les elements étant determinés en utilisant la méthode de Thiele–Innes–Van den Bos.

ORBITE DE ADS 2849 BC = A 1831 BC

Pos. (1950) $3^h\ 51^m.8$; $+05^\circ\ 03'$
Mgns. 10.0–10.0, Type sp.–

Tableau I.

Les éléments orbitaux, les quantites astrophysiques et les constantes

$P = 117.74$ ans		
$n = 3^\circ.0577$		
$T = 1988.91$	$A = -0''.0746$	
$e = 0.21$	$B = -0''.1534$	
$a = 0''.173$	$F = +0''.1330$	π dyn.orb. $= 0''.005$
$i = 37^\circ.68$	$G = -0''.0448$	$M_B = M_C = 3.5$
$\Omega = 50^\circ.88$	$C = \mp 0''.0300$	$\mathfrak{M}_B = \mathfrak{M}_C = 1.41\odot$
$\omega = 196^\circ.49$	$H = \mp 0''.1014$	$a = 34.6$ U.A.
$T_{\Omega\mho} = 1922.0,\ 1985.4$		

Tableau II.

Les éphémérides

t	θ°	ρ''
1977.0	199.4	0.14
1978.0	203.2	0.14
1979.0	207.0	0.14
1980.0	210.0	0.14
1981.0	214.0	0.14
1982.0	218.0	0.14
1983.0	221.0	0.14
1984.0	225.0	0.14
1985.0	229.0	0.14
1986.0	232.0	0.14

Tableau III

Les observations et les residus

t	θ^o_o	ρ''_o	Obs.	n	Réferences	$(0-C)^o_\theta$	$(0-C)''_\rho$
1908.78	35.0	0.20	A	3	ADS	+ 8.0	+ 0.01
1919.66	49.6	0.20	A	4	"	+ 2.7	– 1
1935.706	66.9	0.19	V	4	La corr. pers. Obs. de Nice.	– 6.9	– 1
1938.932	71.2	0.20	B	2	"	– 8.5	+ 1
1944.76	84.2	0.18	V	4	J. O. Vol. XXXVIII, N.6.	– 7.3	0
1958.695	322.1*	0.16	B	3	Pub. Yerkes Obs., Vol. IX, Part I.	+12.6	+ 0.01
1961.743	too close		B	1	La corr. pers. Obs. de Nice.	–	–
1963.984	simple < 0.2		C	–	"	–	–

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* Quadrant changé

ORBITE DE ADS 3438 = A 1544

Pos. (1950) : $4^h\ 43^m.9$; $+ 43^o 19'$
Mgns. 9.5 – 9.5 ; Typ. sp. Fo

Tableau I.

Les éléments orbitaux, les quantites astrophysiques et les constantes

P=66.31 ans		
$n=5^o.4287$		
T=1962.93	$A=+0''.1574$	
e=0.32	$B=+0''.0240$	π dyn.orb.$=0''.009$
$a=0''.178$	$F=+0''.0152$	$M_A=M_B=4.3$
$i=152^o.1$	$G=-0''.1760$	$\mathfrak{M}_A=\mathfrak{M}_B=0.87\odot$
$\Omega=80^o.7$	$C=\pm 0''.0799$	a =19.8U.A.
$\omega=74^o.0$	$H=\pm 0''.0229$	
$T_{\Omega\mho}=1955.3$; 1975.6		

Tableau II.

Les éphémérides

t	θ^o	ρ''
1977.0	254.5	0.18
1978.0	250.3	0.19
1979.0	246.2	0.19
1980.0	242.4	0.19
1981.0	238.6	0.20
1982.0	235.0	0.20
1983.0	231.0	0.20
1984.0	228.0	0.21
1985.0	224.0	0.21
1986.0	221.0	0.21

Tableau III

Les observations et les résidus

t	θ_o^o	ρ_o''	Obs.	n	Références	$(0-C)_\theta^o$	$(0-C)_\rho''$
1907.82	255.8	016	A	2	ADS	−12.3	− 0.01
1919.35	219.7	0.20	A	3	”	− 2.8	− 1
1921.83	212.0	0.22	A	2	”	− 2.5	+ 1
1931.86	187.2	0.16	A	1	La corr. pers. Obs. de Nice.	+ 5.2	− 5
1934.39	184.2	0.19	A	2	Lick Obs. Bull., N. 491.	+10.7	− 1
1944.79	145.6	0.19	V	4	La corr. pers., Obs. de Nice.	+10.9	0
1963.072	185.3*	0.16	Wor	2	Pub. Naval Obs., Sec. Ser., Vol. XVIII, Part VI.	− 2.2	+ 5
1963.944	Not quite round		Wor	1	La corr. pers., Obs. de Nice.	−	−
1965.776	146.1*	0.10	Wor	2	Pub. Naval Obs., Sec. Ser., Vol. XXII, Part VI.	− 8.4	− 0.01

* Quadrant changé

LITTERATURE:

Bos, W.H., 1926, UOC, 68.

Parenago, P., P., 1938, Kurs zvezdnoj astronomiji.

Popović, G.M., Angelov, T. D., Bull. de l'Obs. Astr. de Beograd, Vol. XXVIII, F.2. N. 124.

Bull. Obs. Astron. Belgrade, N° 129

TRAJECTOIRE APPARENTE RECTILIGNE DE ADS 2923

V. Erceg

(Reçu le 27 mai 1977)

RESUME:

On donne les formules linéaires de la trajectoire apparente rectiligne, les éphémerides et les résidus pour l'etoile double visuele ADS 2923.

ADS 2923 = A 1936 BC

Pos. (1950) : $03^h\ 57^m.5$
$+08^\circ\ 10'$
Mgns. 9.6–9.7

Les formules linéaires

$$\cos(\theta - 90^\circ.8) = 0''.288$$
$$\sin(\theta - 90^\circ.8) = 0''.0257\,(t - 1941.11)$$

Tableau I.

Les éphémérides

t	θ°	ρ''	t	θ°	ρ''
1977.0	18.1	0.97	1982.0	16.1	1.09
1978.0	17.7	0.99	1983.0	15.8	1.11
1979.0	17.3	1.02	1984.0	15.4	1.14
1980.0	16.9	1.04	1985.0	15.1	1.16
1981.0	16.5	1.06	1986.0	14.8	1.19

Tableau II.

Les observations et les residus

t	θ_o^o	ρ_o''	Obs	n	Références	$(0-C)_\theta^o$	$(0-C)_\rho''$
1908.84	136.3	0.37	A	3	ADS	– 0.4	– 0.04
1918.43	124.9	0.41	A	2	”	– 1.9	+ 5
1922.69	119.7	0.38	A	2	”	– 1.6	+ 5
1938.76	99.9	0.31	V	4	La corr. pers. Obs. de Nice.	+ 8.7	+ 2
1942.87	85.6	0.34	VBs	2	Pub.Yerkes Obs., Vol.VIII, Part VI.	– 4.9	+ 5
1944.76	92.7	0.27	V	3	J.O.Vol. XXXVIII, N.6.	+ 8.6	– 2
1948.71	79.6	0.28	VBs	3	Pub. Yerkes Obs., Vol. VIII, Part VI.	+ 2.5	– 2
1958.081	66.1	0.34	C	1	La corr. pers., Obs. de Nice.	– 0.6	+ 3
1961.830	57.2	0.38	B	4	Lick Obs. Bull., N. 579.	0.0	+ 3
1962.210	48.6	0.33	Wor	3	Pub. Naval Obs., Sec. Ser. Vol. XVIII, Part VI.	– 8.2	– 0.02

LITTERATURE:

Arend, S., Ann. de l'Obs. Roy. de Belgique, troisieme série, Tom VIII, Fasc. 2.

Bull. Obs. Astron. Belgrade, N° 129

MESURES MICROMETRIQUES DES ETOILES DOUBLES

(Serie 28)

V. Erceg

(Reçu le 27 mai 1977)

RESUME:

Dans cette serie sont presentées 58 mesures de 46 etoiles dobules visuelles.

La série est la continuation des séries des mesures micrometriques efectués au réfracteur Zeiss 65/1055 cm. de l'Observatoire de Belgrade. Dans les colonnes de tableau I. sont presentés; les nombres du Catalogue ADS, les abréviations des decouvereurs d'après le Catalogue IDS et les coordonées pour l'anné 1900, les epoques d'observations, les angles de la position, les distances, les magnitudes visueles, les nombres des observations, et les remarques soit sur les changements des angles de la position, soit les résidus d'après les éphémérides calculées.

Tableau I. Mesures micrométriques des étoiles doubles

ADS	Decouv. Coord.	Comp.	Epoque 1900+	θ^{o}	ρ"	Δm	n	Remarques
287	BU 1093 00158N1025		74.884	116.4.	0.86	1.2	1	En 85 ans θ augmenté de 62°.
497	STF 42 00307N2927	AB	73.700	23.5	6.14	1.3	1	
6946	BU 209 08367N3870		71.273	6.0	1.68	-	1	En 96 ans θ augmenté de 11°.
7724	STF 1424 10145N1981	AB	71.372	123.7	4.19	1.5	1	Guntz.–Ling.1956: + 1°.5 ; –0".20; Rabe 1958; –1°.1; + 0".07
7959	A 2773 10474N0532		71.273	9.6	1.26	-	1	En 57 ans θ diminué de 20°.
8561	STF 1645 12232N4481		71.361	159.0	9.76	0.3	1	

Tableau I (suite)

ADS	Decouv. Coord.	Comp.	Epoque 1900+	θ^o	ρ"	Δm	n	Remarques
8630	STF 1670	AB	71.370	303.2	4.18	0.1	1	
	12366S0054		71.424	304.3	4.24	0.1	1	
			71.387	303.8	4.21	0.1	2	Strand 1937: +1°1; –0"30.
8695	STF 1687	AB	71.306	159.3	-	-	1	Schmeidler 1939: + 0°4; –.
	12484N2147							
8949	STF 1757	AB	71.372	108.4	2.36	1.1	1	
	13292N0012		71.457	108.8	2.27	1.1.	1	
			71.414	108.7	2.32	1.1	2	Heintz 1955: –0°5; –0"06.
8974	STF 1768	AB	71.457	110.0	1.64	2.0	1	Jackson 1921: +6°2;–0"07.
	13330N3648							
9031	STF 1785		71.446	154.0	3.50	0.5	1	Strand 1955: +1°3; +0"24.
	13445N2689							
9182	STF 1819		71.383	265.7	1.16	-	1	Hopmann 1945: –0°9; +0"15.
	14103N0336							
9413	STF 1888	AB	71.424	340.0	7.39	2.1	1	Strand 1937: +1°0; +0"27.
	14468N1931							
9626	STF 1938	BC	71.271	20.5	1.91	-	1	
	15207N3742		71.457	20.0	2.10	0.7	1	
			71.364	20.2	2.00	0.7	2	Baize 1951: +1°4; –0"10.
9979	STF 2032	AB	72.457	233.7	-	-	1	Rabe 1954: +2°2; –
	16109N3367							
10312	STF 2114		72.473	180.5	1.60	1.5	1	En 142 ans θ augmenté de 44°.
	16572N0836							
10345	STF 2130	AB	71.591	60.9	1.99	0.1	1	
	17033N6436		71602	59.4	1.88	0.0	1	
			71.596	60.2	1.94	0.0	2	Heintz 1965: +3°2; –0"03.
10988	STF 2271	AB	72.474	269.4	2.81	0.3	1	
	17581N5251							
11005	STF 2262	AB	71.613	275.7	-	1.0	1	Wierzbinski 1958: +1°4; –.
	17576S0811							
11046	STF 2272	AB	71.665	43.6	2.15	2.0	1	Strand 1952: –4°0; –0"07
	18004N0232							
11291	AG 222		72.457	146.2	1.72	0.5	1	
	18176N1410							
11483	STT 358	AB	71.654	168.5	1.79	0.2	1	Heintz 1954: +3°1; +0"11.
	18314N1654							
11562	A 1380	AB	72.474	201.8	1.14	0.1	1	
	18372N5554							
11568	STF 2384	AB	71.596	314.8	0.84	–	1	Baize 1950: +6°2; –0"15
	18385N6702							
11635	STF 2382	AB	71.591	0.9	2.69	2.0	1	Guntz.-Ling. 1955: +3°5; –0"04.
	18410N3934							
11722	STF 2402		76.615	202.8	1.61	-	1	
	18450N1034							
12040	STF 2454	AB	75.706	283.3	1.16	-	1	Baize 1975: +5°9; –0"04.
	19023N3017							

Tableau I (suite)

ADS	Decouv. Coord.	Comp.	Epoque 1900+	θ^o	ρ''	Δm	n	Remarques
12447	STF 2525		73.711	295.0	1.65	0.1	1	Finzen 1937: +2.6; +0.03.
	19225N2707							
			76.615	288.1	1.79	0.2	1	
			76.692	295.5	1.71	0.2	1	
			76.654	291.8	1.75	0.2	2	Finzen 1937: −0.2; +0.11.
12626	STF 2553		76.602	123.1	1.24	0.8	1	En 144 ans θ augmenté de 43°.
	19321N6150							
12880	STF 2579	AB	71.654	239.8	2.09	3.5	1	
	19418N4453		71.665	233.2	2.04	3.5	1	
			71.660	236.5	2.06	3.5	2	Rabe 1961: −0°9; −0″11
			73.711	235.7	2.21	-	1	Rabe 1961: −0°3; +0″03
12889	STF 2576	AB	71.596	8.1	1.65	0.1	1	Rabe 1948: +1°6; −0″04
	19418N2236							
12962	STF 2583	AB	76.604	108.2	1.44	—	1	
	19440N1134							
13082	STF 2596		75.714	308.0	1.87	2.0	1	En 144 ans θ diminué 45°.
	19494N1502							
13165	BU 425	AB	76.684	242.1	1.56	0.1	1	
	19531N2002							
13178	AC 12		75.706	304.2	1.35	–	1	
	19532S0230							
13277	STT 395		75.706	121.7	0.98	0.4	1	En 131 ans θ augmenté de 42°.
	19578N2439							
14499	STT 2737	AB	76.605	283.9	1.02	0.1	1	Van den Bos 1933: −1°8; −0″04.
	20541N0355							
14499	STF 2737	ABXC	76.605	64.9	10.21	-	1	Zeller (hyp. orb.) 1965: −4°1; −0″57.
	20541N0355							
14558	STF 2746		75.706	314.3	1.34	0.4	1	En 146 ans θ augmenté de 39°.
	20580N3852							
			76.605	315.1	1.08	-	1	
14573	STF 2744	AB	75.714	133.7	1.57	0.8	1	Popović 1964: +5°5; +0″29.
	20580N0108							
14626	BU 680	AB	73.711	287.8	0.88	1.0	1	En 96 ans θ diminué de 21°.
	21025N5316							
14829	HO 153		75.706	127.9	1.28	-	1	
	21135N3320							
15007	STF 2799	AB	76.692	272.6	1.88	0.1	1	
	21240N1039		76785	274.0	1.76	0.1	1	
			76.738	273.3	1.82	0.1	2	En 145 ans θ diminué de 60°.
15270	STF 2822	AB	71.596	296.6	1.77	2.0	1	
	21397N2817		71.654	292.3	1.83	2.0	1	
			71.625	294.4	1.80	2.0	2	Heintz 1965: +3°0; 0″06.
15988	STF 2912		71.597	120.8	1.23	2.0	1	Knipe 1959: +3°3; +0″15.
	22249N0355							
			73.711	-	1.29	2.0	1	Knipe 1959: –; +0″21.

Bull. Obs. Astron. Belgrade, N° 129

OBSERVATIONS PHOTOGRAPHIQUES DES PETITES PLANÈTES ET DE LA COMÈTE 1976 e – D'ARREST FAITES À L'OBSERVATOIRE ASTRONOMIQUE DE BELGRADE AU COURS DE 1976

par V. Protitch – Benishek

(Reçu le 7 juillet 1977)

Positions précises que nous présentons ici sont obtenues à l'astrographe Askania 125/1000 mm. Outre les observations des petites planètes brillantes on y trouvera également les deux positions de la comète d'Arrest, seules qu'on a pu mesurer avec certitude sur les clichés. Quant à quatre autres négatifs, à cause des conditions atmosphériques peu favorables et la présence de la Lune, malgré une pose convenablement prolongée, on n'y révéla que des traces douteuses de cet objet. Il était, d'ailleur, diffuse et de faible éclat, quoique d'après la prévision il devait alors atteindre le sixieme magnitude. Les écarts (O–C) démontrent l'existence d'une avance de 0.04 jours dans le passage de la comète au périhélie, ce qui est en plein accord avec les résultats des autres observateurs et confirme l'extrême validité des éléments orbitaux, déduits par B. G. Marsden.

Les mesures des clichés furent faites par l'observateur lui-même, et les réductions des positions précises, se référant toujours à trois étoiles de repères, ont été accomplies dans sa majeure partie au bureau de calculs, avec calculatrice „Wang 2200".

Nous tenons à exprimer nos vifs remercîments aux M^{mes} V. Sekulović et N. Djokić pour leur aide précieuse.

1976

N°	Date	TUC	Équin. 1950.0		O – C	
			4 Vesta			
			h m s	° ′ ″	s	″
1	Nov.	18.00002	07 50 53.76	+19 46 46.9	–0.01	–1.1
2		25.89724	07 51 09.64	+20 01 50.0	–0.09	+0.6
3		27.90974	07 50 55.48	+20 06 45.7	–0.04	–0.2
4	Déc.	23.85974	07 36 49.65	+21 47 48.2	–0.01	–1.2
			6 Hebe			
5	Nov.	23.77919	00 08 54.85	–20 13 59.4	–0.04	–2.2
6		27.85002	00 12 06.33	–19 32 50.8	+0.01	+1.5

			20 Massalia			
			h m s	° ′ ″	m	′
7	Nov.	18.00002	07 51 18.85	+20 01 19.4	0.0	0
8		25.89724	07 54 18.90	+19 48 38.9	–0.1	+0
9		27.90974	07 54 43.36	+19 46 19.4	–0.1	+0
10	Déc.	23.85974	07 46 39.22	+19 54 08.4	+0.1	0
			22 Kalliope			
11	Nov.	03.92711	04 24 46.99	+18 29 53.3	0.0	+0
12		10.81183	04 19 03.79	+18 50 46.4	0.0	+0
			43 Ariadne			
13	Nov.	29.91113	05 42 15.40	+23 55 50.7	0.0	–0
			52 Europa			
14	Nov.	25.86877	04 12 07.04	+10 31 18.7	0.0	–0
15		27.87294	04 10 24.07	+10 28 56.8	0.0	–0
			78 Diana			
16	Nov.	23.82641	04 37 21.20	+37 19 13.8	0.0	+0
17		27.89169	04 32 46.49	+37 16 32.8	0.0	+0
			80 Sappho			
18	Nov.	10.85002	01 10 01.07	+08 51 15.9	0.0	–0
19		23.80280	01 09 43.57	+07 11 38.5	–0.1	0
			106 Dione			
20	Nov.	29.91113	05 58 07.47	+25 49 14.9	+0.1	+0.5
			110 Lydia			
21	Nov.	17.97572	03 22 43.69	+18 02 31.6	–0.2	–1
22		23.84516	03 17 08.26	+17 55 52.5	–0.1	–1
			185 Eunike			
23	Déc.	06.89447	06 41 13.73	–08 28 39.8	0.0	+0.5
24		18.95766	06 31 23.12	–08 18 18.5	–0.1	+0
			306 Unitas			
25	Nov.	28.92016	04 52 13.38	+11 09 36.5	0.0	–0
			313 Chaldea			
26	Nov.	29.93821	06 11 59.32	+02 31 47.0	–0.1	–0.1
27	Déc.	23.84030	05 51 23.04	+01 16 42.0	0.0	+0.1

			354 Eleonora			
			h m s	° ' "	m	'
28	Déc.	18.94238	06 32 30.96	+01 51 07.4	0.0	0
			471 Papagena			
29	Nov.	25.86877	04 26 34.16	+12 59 46.4	0.0	–1
30		27.87294	04 24 28.04	+13 11 42.6	0.0	–1
			480 Hansa			
31	Déc.	18.90905	07 01 06.21	–00 27 38.3	0.0	0
			532 Herculina			
					s	
32	Nov.	28.86044	05 59 41.80	+12 35 26.3	–0.02	–1".9
33	Déc.	16.83335	05 43 11.04	+13 39 02.0	+0.12	+1.0
34		18.97918	05 40 59.83	+13 48 42.0	+0.12	+0.5
			712 Boliviana			
					m	
35	Nov.	17.97572	03 11 32.62	+16 51 24.1	0.0	–0'
36		23.84516	03 06 55.90	+15 44 46.5	0.0	+1

N°	Étoiles de repères			Dépendances			Rem.
1	Yale 18 3067	D+20° 1938	Yale 18 3100	0.39533	0.29987	0.30480	
2	Yale 18 3068	AGK2+20° 907	Yale 25 3180	0.30926	0.38856	0.30218	
3	Yale 18 3068	AGK2+20° 907	Yale 25 3168	0.21646	0.42636	0.35718	
4	Yale 25 3037	3065	3071	0.39066	0.21870	0.39064	
5	Yale 13 24	BD–19° 0009	Yale 13 39	0.41403	0.27363	0.31234	
6	Yale 12 29	Yale 12 48	Yale 13 60	0.21214	0.46905	0.31881	
7	Yale 18 3068	AGK2+20° 907	Yale 25 3180	0.28121	0.36029	0.35850	
8	Yale 18 3100	Yale 25 3188	Yale 18 3136	0.18478	0.51808	0.29714	
9	Yale 18 3100	Yale 25 3188	Yale 18 3157	0.33510	0.38986	0.27504	
10	Yale 18 3029	Yale 25 3129	Yale 18 3068	0.31719	0.33635	0.34646	
11	Yale 18 1172	1188	1194	0.44377	0.22808	0.32815	
12	Yale 18 1139	1140	1164	0.31718	0.30622	0.37660	
13	Yale 25 1895	1933	1934	0.22755	0.43004	0.34242	
14	Yale 19 1234	Yale 22 1555	Yale 19 1251	0.30672	0.42229	0.27099	
15	Yale 19 1218	1240	Yale 22 1555	0.27238	0.36408	0.36355	
16	AGK2+37°509	+36°473	+37°514	0.22409	0.34521	0.43070	
17	AGK2+37°505	+36°467	+37°506	0.47228	0.18611	0.34160	
18	Yale 22 417	426	443	0.25994	0.47749	0.26257	
19	Yale 22 409	418	446	0.19882	0.44665	0.35453	
20	Yale 24 2823	2867	2890	0.25811	0.36916	0.37272	1
21	Yale 18 906	914	BD+17°558	0.32529	0.37431	0.30040	
22	Yale 18 880	881	902	0.30471	0.33382	0.36147	
23	Yale 16 2093	2125	2136	0.39048	0.26204	0.34748	
24	Yale 16 2001	2037	2047	0.23274	0.46871	0.29856	
25	Yale 19 1400	1413	1429	0.25255	0.35430	0.39315	2
26	Yale 20 2069	AGK2+1°669	Yale 20 2096	0.36702	0.37384	0.25915	

27	Yale	20	1916	AGK2+0°595			Yale	20	1950	0.30982	0.31589	0.37429	
28	Yale	18	853			857			877	0.24636	0.40900	0.34465	
29	AGK2+13°351			Yale	19	1308			1313	0.33177	0.43085	0.23738	1
30	Yale	19	1284	AGK2+13°351			Yale	19	1306	0.27373	0.33964	0.38663	
31	Yale	21	1960			1981			2000	0.26052	0.23094	0.50853	1,2
32	Yale	19	1933			1969			1973	0.34124	0.24551	0.41325	
33	Yale	19	1764			1787			1814	0.33949	0.30083	0.35968	
34	Yale	19	1759			1768			1786	0.31606	0.26983	0.41411	
35	Yale	18	853			857			877	0.24636	0.40900	0.34465	
36	BD+15°436			Yale	18	839			851	0.33473	0.40823	0.25704	

Remarques: 1 – près du bord de la plaque, 2 – mesure difficile.

N°	fact. par.		N°	fact. par.		N°	fact. par.	
1	$-0\overset{s}{.}285$	$+4\overset{''}{.}18$	13	$-0\overset{s}{.}215$	$+3\overset{''}{.}40$	25	$-0\overset{s}{.}098$	$+4\overset{''}{.}87$
2	−0.415	+5.04	14	−0.178	+5.03	26	−0.182	+5.91
3	−0.395	+4.81	15	−0.151	+5.00	27	−0.223	+6.05
4	−0.352	+4.29	16	−0.392	+2.39	28	−0.077	+5.96
5	+0.013	+7.95	17	−0.177	+1.34	29	−0.204	+4.77
6	+0.223	+7.62	18	−0.006	+5.13	30	−0.077	+4.70
7	−0.286	+4.16	19	−0.037	+5.34	31	−0.206	+6.21
8	−0.416	+5.08	20	−0.246	+3.24	32	−0.336	+5.18
9	−0.397	+4.87	21	+0.137	+4.02	33	−0.274	+4.86
10	−0.359	+4.06	22	−0.161	+4.08	34	+0.114	+4.55
11	−0.211	+4.11	23	−0.283	+6.78	35	+0.156	+4.20
12	−0.389	+4.89	24	−0.036	+7.01	36	−0.141	+4.33

Positions précises de quelques étoiles de repères, deduites d'après nos mesures et appliquées lors de réductions précedentes (ou dans des cas analogues):

N°	Étoiles BD	Équin. 1950.0		Ép. 1900+
1	−19°0009	$00^h08^m45\overset{s}{.}67$	−19°25'49".1	76.9
2	+15°0436	03 05 03.11	+15 52 53.9	76.9
3	+17°0558	03 25 00.55	+18 16 05.6	76.9
4	+20°1939	07 51 14.83	+20 18 48.4	76.9
5	+20°1938	07 51 16.04	+20 29 33.2	76.9

1976 e – d'Arrest

N°	1976 UT	Équin. 1950.0		O-C		fact. par.	
1	Juill.19.89301	$19^h39^m31\overset{s}{.}53$	+18°02'18".7	$-0\overset{m}{.}68$	$-0\overset{s}{.}7$	$-0\overset{s}{.}114$	+3".99
2	30.91460	20 22 12.35	+08 49 07.8	−0.86	−0.3	−0.054	+5.14

N°	Étoiles de repères					Dépendances		
1	Yale	18	7608	7629	7641	0.32036	0.42389	0.25575
2	Yale	22	10012	AGK2+9°2762	10091	0.40598	0.33068	0.26334

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PATROL OBSERVATIONS OF AD LEO DURING 1976

J. Arsenijević, A. Kubičela, I. Vince

(Received December 22,1976)

SUMMARY:

Some photoelectric patrol obsevations of flare star AD Leo are presented. No flare event has been recorded.

Photoelectric patrol observations of flare star AD Leo were made with the Belgrade polarimeter (Kubičela et al., 1976) during ten nights in 1976 with total duration of 845 minutes.

In Table I the beginning and end of observations, the duration of continuous observations Δt, the error of observations σ^m expressed in magnitudes and the limiting magnitude interval Δm_{lim} are shown. The last two quantities are calculated according to formulae given in an earlier paper (Arsenijević et al., 1976). All observations were made in V photometric spectral region.

No flare activity was detected.

Table I.

Date	Begin. of observation UT	End of observation UT	Δt	σ^m	Δm_{lim}
1976	h m	h m	m		
Febr. 22	20 48	21 23	35	0.012	3.65
	21 32	22 25	53		
	22 34	23 31	57		
	23 38	23 54	16		
26	23 04	23 17	13	0.024	2.94
	23 54	24 19	25		
	24 41	25 04	23		
28	21 54	22 08	14	0.018	3.25
	22 15	22 31	16		
	22 40	22 50	10		
	23 01	23 08	7		
29	22 40	22 54	14	0.010	3.91
	23 00	23 09	9		
	23 14	23 30	16		
	23 37	23 47	10		
	23 55	24 08	13		
	24 14	24 25	11		
March 28	19 14	19 33	19	0.014	3.51
29	18 51	19 12	21	0.009	4.00
	19 22	19 36	14		
	19 45	19 51	6		
	20 04	20 17	11		
	20 22	20 33	11		
	20 57	21 04	7		
30	19 10	19 25	15	0.009	3.98
	19 33	19 54	21		
	20 01	20 21	20		
	20 29	20 40	11		
	20 53	21 27	34		
	21 45	22 05	20		
	22 16	22 36	20		

Table I (continued)

Date		Begin. of observation UT	End of observation UT	Δt	σ^m	Δm_{lim}
		h m	h m	m		
	31	19 00	19 50	50	0.014	3.49
		19 59	20 27	28	0.014	3.49
		20 40	21 23	43		
		21 32	22 10	38		
April	1	19 10	19 31	21	0.011	3.84
		19 39	19 52	13		
		20 00	20 15	15		
		20 23	20 37	14		
		20 44	21 03	19		
		21 10	21 19	9		

Date		Begin. of observation UT	End of observation UT	Δt	σ^m	Δm_{lim}
		h m	h m	m		
	26	19 47	20 04	17	0.014	3.50
		20 11	20 17	6		

REFERENCES:

Arsenijević, J., Kubičela, A., Vince, I., 1976, Bull. Obs. Astr. Belgrade, 127,9.

Kubičela, A., Arsenijević. J., Vince. I., 1976, Publ. Dept. Astr. Univ. Belgrade, 6,25.

Bull. Obs. Astron. Belgrade, N° 129

OCCULTATIONS OF STARS BY THE MOON OBSERVED AT THE BELGRADE ASTRONOMICAL OBSERVATORY IN 1976

V. Protitch–Benishek

(Received January 15, 1978)

The following table presents the occultations of stars by the Moon, observed at the Belgrade Astronomical Observatory during the year 1976 with Askania refractor 135/1600 (standard magnification 128x).

The observations were carried out on the basis of the preliminary data, prepared by H. M. Nautical Almanac Office, England.

Time was registered by chronograph using the time signals of quartz oscillator Rohdé and Schwarz.

Personal equation has been applied to the timing data.

In the table below the following designations of the columns are used:

PE – personal equation

PA – position angle

PH – phenomenon

- DD disappearance at dark limb
- DB disappearance at bright limb
- RD reappearance at dark limb
- RB reappearance at bright limb

LC – limb correction for the irregularity of the moon's outline at the point of occulation;

(O–C) – residual distance (in seconds of arc) star from the computed position of the Moon's outline for the given time of occultation;

Remarks – observers: (4) – M. B. Protitch
(22) – V. Protitch–Benishek

Table I.

Occultation observations in 1976

Mth	Day	Hr	Min	Sec	ZC	SAO	Mag	PA	PH	LC	(O–C)	Remarks
								°		"	"	
01	18	22	28	19.17	1937		5.5	274.4	RD	+0.35	+1.02	4
04	07	20	23	35.5	1106		3.6	166.6	DD	–	+0.77	4
06	10	20	57	42.0	2302		2.9	84.4	DD	+0.53	+0.24	22
06	10	20	57	55.0	2303		5.1	83.6	DD	–0.24	+0.35	22
08	04	19	03	04.30	2353		4.6	102.9	DD	–0.18	+0.56	22
08	07	20	03	08.25	2828		6.0	112.3	DD	–0.60	+0.58	22
09	29	17	24	07.5	2561		7.6	76.8	DD	–0.03	–0.19	22
10	04	21	49	31.5		146045	8.1	112.5	DD	–0.42	–0.81	22
10	29	16	41	59.1	2968		6.2	57.9	DD	+1.03	–0.80	22
10	29	16	50	05.62	2969		3.2	61.5	DD	+0.57	–0.84	22
10	29	18	09	33.1	2969		3.2	256.9	RB	–	+4.36	22

Table I (continued)

Mth	Day	Hr	Min	Sec	ZC	SAO	Mag	PA	PH	LC	(O–C)	Remarks
11	08	20	17	14.85	0658		4.2	196.8	RD	+0.13	+0.70	22
11	27	15	31	36.10	3185		5.3	47.7	DD	+0.99	–0.73	22
11	27	15	35	12.80	3184		7.1	35.6	DD	+1.83	+0.88	22
11	27	16	25	09.60	3187		6.2	129.3	DD	–0.57	–0.31	22
11	29	17	11	46.30	3445		8.5	92.4	DD	–1.13	+0.04	22
12	01	22	36	20.10	0146		4.4	60.6	DD	–0.02	+0.00	22
12	31	15	48	53.87	0445		7.3	88.1	DD	+0.48	–1.00	22
12	31	16	06	28.78		93238	8.5	108.5	DD	–0.98	–0.95	22

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OCCULTATIONS OF STARS BY THE MOON OBSERVED AT THE BELGRADE ASTRONOMICAL OBSERVATORY IN 1977

V. Protitch–Benishek

(Received March 15, 1978)

A program of visual observations of lunar occultations was carried out at the Belgrade Astronomical Observatory during 1977. The observations were made with Askania refractor 135/1600 (standard magnification 128x) by the observer V. Protitch-Benishek.

Annual predictions have been prepared for Belgrade Observatory by HMNAO, England, and USNO, USA.

Time was recorded by chronograph, using the time signals of quartz oscillator Rohdé and Schwarz.

The following designations of the columns are used:

UTC time, corrected for personal equation in amount of $0\overset{s}{.}3$;

ZC Robertson'Zodiacal Catalog number;

SAO Catalog number;

PA position angle;

PH phenomenon;

DD disappearance at dark limb;

LC limb correction for the irregularity of the Moon's outline at the point of occultation;

(O–C) residual distance (in seconds of arc) of the star from the computed position of the Moon's outline for the given time of occultation.

Table I.

Mth	Day	Hr	Min	Sec	ZC	SAO	Mag	PA	PH	LC	(O–C)
								°		"	"
01	01	17	50	28.96	577	93650	6.0	74.6	DD	–0.00	+0.08
01	29	18	52	53.71	663	93942	6.9	48.2	DD	+0.44	–0.82
03	23	19	05	15.19	449	93256	8.0	133.7	DD	–1.13	–0.15
03	24	20	02	42.90	581	93662	6.9	97.9	DD	+1.51	–0.13
03	26	18	31	07.57	829	94617	7.0	109.6	DD	+0.74	–0.29
03	26	18	33	33.05	–	94604	8.4	21.0	DD	+0.64	–0.10
03	26	18	39	11.77	–	94621	9.0	113.0	DD	+0.04	–0.28
03	27	17	53	52.80	970	95572	6.5	139.4	DD	+0.04	+1,34
03	27	21	29	58.24	–	95690	7.8	165.6	DD	–1.14	+0.09
04	25	18	59	07.07	–	97262	8.7	90.4	DD	–0.07	–0.25
04	25	20	25	03.77	1183	97298	7.2	134.9	DD	–	+0.26
04	26	18	40	06.18	–	97991	8.7	127.6	DD	+2.26	+1.39
04	27	20	19	27.50	–	117750	8.5	61.7	DD	–	+0.07

Table I. (Continued)

Mth	Day	Hr	Min	Sec	ZC	SAO	Mag	PA	PH	LC	(O–C)
05	01	22	02	32.24	1886	139175	5.7	173.3	DD	–0.82	+0.89
05	22	18	39	23.96	1145	97012	6.7	145.4	DD	–0.78	+0.80
05	25	21	14	34.59	–	118121	8.5	111.5	DD	–	+1.12
05	25	22	02	17.06	1489	118135	6.8	106.2	DD	–	+0.42
05	28	18	41	27.25	1817	138897	6.9	79.2	DD	+0.15	–0.47
10	17	16	31	29.51	–	160980	7.6	92.2	DD	–0.21	+0.01
10	17	17	19	49.65	2596	161004	7.3	73.5	DD	–0.03	+0.28
10	20	19	14	55.18	3070	164046	6.6	99.6	DD	–1.22	–0.44
10	20	21	09	51.69	–	164080	7.3	19.3	DD	+0.77	–0.36
10	23	18	41	55.32	3474	146780	6.0	34.2	DD	+1.79	+0.70
12	13	15	48	34.66	–	163414	8.7	61.0	DD	–0.00	–0.68
12	13	16	11	02.84	–	163418	7.4	144.9	DD	–2.16	–1.38

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DETERMINATION ASTRONOMIQUE DE L'HEURE

M. Jovanović, L. Djurović

Observateurs: J. M. Jovanović
DJ.L. Đurović

(Reçu le mars 1978)

1976.

Date		Date Julienne 2440000	TU	TUO-TUC	t_i °C	Obs
			h			
I	4	2782.25	17.9	7831	+ 3.2	J
	4	2782.28	18.7	7584	+ 2.2	J
	7	2785.27	18.5	7441	+ 0.9	DJ
	8	2786.17	16.0	7827	+ 2.6	J
	8	2786.20	16.7	7761	+ 0.9	J
	9	2787.19	16.6	7132	+ 0.2	DJ
	9	2787.23	17.6	7541	+ 2.2	DJ
	16	2794.21	17.0	7341	−1.5	DJ
II	14	2823.21	17.1	6307	+ 2.0	J
	14	2823.25	18.0	6449	+ 2.0	J
	19	2828.23	17.4	6388	+ 0.3	J
	19	2828.26	18.3	5952	+ 0.2	J
	20	2829.22	17.3	6527	+ 2.5	J
	20	2829.26	18.2	6279	+ 2.0	J
	21	2830.22	17.3	6097	+ 3.1	J
	21	2830.26	18.1	6139	+ 2.8	J
	22	2831.22	17.2	5907	+ 3.1	J
	22	2831.25	18.1	6111	+ 2.9	J
	24	2833.21	17.1	6137	+ 1.8	J
	24	2833.25	17.9	6474	+ 0.6	J
	26	2835.24	17.8	5617	+ 1.8	J
	26	2835.28	18.7	5541	+ 2.2	J
	28	2837.24	17.7	6299	+ 5.6	J
	28	2837.27	18.6	6108	+ 5.2	J
	29	2838.23	17.6	5716	+ 6.9	J
	29	2838.27	18.5	5880	+ 6.3	J

Date		Date Julienne 2440000	TU	TUO-TUC	t_i°C	Obs
III	2	2840.27	18.4	5651	+ 8.6	DJ
	2	2840.30	19.3	5840	+ 7.1	DJ
	16	2854.22	17.2	5968	+ 8.7	DJ
	16	2854.25	18.1	6084	+ 6.3	DJ
	25	2863.33	19.8	4659	+ 4.3	J
	28	2866.23	17.6	4906	+ 8.3	J
	28	2866.27	18.4	4735	+ 7.2	J
	29	2867.35	20.4	5031	+ 7.5	J
	29	2867.39	21.3	4732	+ 6.8	J
	31	2869.23	17.6	4944	+13.1	DJ
	31	2869.27	18.4	5020	+11.8	DJ
IV	1	2870.26	18.2	5087	+13.4	J
	1	2870.30	19.1	4834	+12.5	J
	2	2871.26	18.2	4524	+15.2	DJ
	2	2871.29	19.0	4732	+14.0	DJ
	3	2872.25	18.0	5193	+15.0	J
	3	2872.29	18.9	4933	+13.8	J
	4	2873.25	18.0	5371	+16.8	J
	4	2873.28	18.8	5141	+16.0	J
	5	2874.32	19.7	4933	+16.5	DJ
	5	2874.36	20.6	4748	+15.9	DJ
	6	2875.35	20.5	4529	+17.4	J
	6	2875.39	21.4	4268	+16.7	J
V	17	2916.27	18.7	3428	+19.3	DJ
	17	2916.31	19.7	3483	+17.8	DJ
	17	2916.35	20.5	3583	+17.5	J
	17	2916.39	21.4	3272	+16.6	J
	19	2918.31	19.5	3472	+19.6	DJ
	19	2918.34	20.4	3305	+18.8	DJ
	30	2929.36	20.6	2883	+18.2	DJ
	30	2929.40	21.7	2972	+17.0	DJ
VI	10	2940.29	18.9	2862	+17.3	J
	10	2940.33	19.9	2181	+16.2	J
	11	2941.29	18.9	2633	+18.4	J
	11	2941.33	19.8	2560	+17.7	J
	14	2944.31	19.5	2657	+18.4	J
	14	2944.36	20.5	2560	+18.0	J
	15	2945.31	19.5	2571	+18.7	DJ
	15	2945.35	20.5	2958	+17.9	DJ
	18	2948.31	19.3	2367	+19.0	DJ
	18	2948.34	20.2	2777	+17.6	DJ
	19	2949.46	23.0	2928	+19.2	J
	19	2949.50	23.9	3026	+18.8	J

Date		Date Julienne 2440000	TU	TUO-TUC	t_i °C	Obs
	20	2950.46	23.0	3018	+21.0	J
	20	2950.49	23.9	2780	+20.3	J
	21	2951.30	19.2	1994	+23.2	DJ
	21	2951.34	20.2	2332	+22.5	DJ
	22	2952.37	21.0	2544	+23.0	J
	22	2952.41	21.9	2603	+23.0	J
	23	2953.37	20.9	2434	+23.1	DJ
	23	2953.42	22.0	2423	+21.3	DJ
	28	2958.35	20.4	2436	+21.9	J
VII	2	2962.34	20.3	1876	+23.1	J
	2	2962.39	21.3	1812	+21.7	J
	3	2963.34	20.2	1467	+21.5	J
	3	2963.38	21.2	1517	+21.2	J
	4	2964.38	21.1	2836	+21.6	J
	4	2964.42	22.0	2656	+21.3	J
	6	2966.37	21.0	1758	+21.7	J
	6	2966.41	22.0	1419	+20.2	J
	12	2972.29	19.1	2106	+22.8	J
	12	2972.36	20.6	1449	+21.5	J
	16	2976.30	19.1	2181	+24.0	J
	18	2978.30	19.3	1591	+23.4	J
	18	2978.34	20.2	1397	+23.0	J
	19	2979.30	19.2	2054	+24.4	J
	19	2979.34	20.1	1720	+24.0	J
	20	2980.38	21.0	1678	+25.8	DJ
	20	2980.41	21.9	1970	+24.8	DJ
	26	2986.40	21.5	1175	+20.3	DJ
	30	2990.42	22.1	1028	+16.8	DJ
	30	2990.45	22.9	1335	+16.7	DJ
	31	2991.34	20.3	1386	+20.2	DJ
	31	2991.38	21.2	1435	+19.8	DJ
VIII	3	2994.37	21.0	0434	+17.5	DJ
	3	2994.42	22.0	0635	+16.8	DJ
	4	2995.37	20.9	0865	+18.4	DJ
	4	2995.41	21.8	1116	+18.2	DJ
	7	2998.29	18.9	0944	+18.3	DJ
	7	2998.32	19.8	0895	+17.2	DJ
	8	2999.36	20.7	0939	+17.5	DJ
	8	2999.40	21.5	0840	+18.8	DJ
	10	3001.28	18.7	0898	+20.2	DJ
	10	3001.32	19.6	1045	+19.5	DJ
	12	3003.27	18.5	0998	+19.3	DJ
	12	3003.31	19.5	0781	+18.9	DJ
	15	3006.26	18.2	0916	+20.2	DJ
	15	3006.30	19.3	1008	+19.3	DJ

Date		Date Julienne 2440000	TU	TUO-TUC	t_i °C	Obs
	25	3016.35	20.5	0618	+18.3	J
	25	3016.38	21.2	0929	+17.9	J
	26	3017.35	20.3	0768	+18.6	J
	27	3018.27	18.5	0682	+19.4	J
	27	3018.31	19.4	0750	+19.1	J
	31	3022.26	18.2	0989	+21.2	J
	31	3022.30	19.1	0800	+20.4	J
IX	2	3024.36	20.7	0868	+18.8	J
	2	3024.40	21.5	0686	+18.0	J
	7	3029.24	17.9	0366	+15.6	J
	7	3029.27	18.5	0186	+15.0	J
	8	3030.28	18.6	0428	+15.2	DJ
	8	3030.31	19.5	0598	+14.8	DJ
	9	3031.24	17.7	0400	+18.2	J
	9	3031.27	18.6	0336	+17.0	J
	10	3032.27	18.5	0151	+17.8	DJ
	10	3032.30	19.3	0363	+17.4	DJ
	11	3033.34	20.2	0188	+18.4	J
	11	3033.37	20.9	0215	+18.3	J
	12	3034.26	18.4	0586	+20.1	J
	12	3034.30	19.1	0143	+20.0	J
	13	3035.26	18.3	9835	+21.0	DJ
	13	3035.30	19.2	9962	–	DJ
	14	3036.26	18.2	0359	+21.9	J
	14	3036.29	19.1	0077	+21.7	J
	15	3037.36	20.7	0311	+19.2	J
	15	3037.40	21.5	0232	+18.8	J
	24	3046.23	17.6	9883	+15.8	J
	24	3046.27	18.4	9955	+15.2	J
	25	3047.37	20.9	9613	+15.5	J
	25	3047.41	21.9	9535	+15.3	J
	27	3049.22	17.3	9874	+17.2	J
	28	3050.22	17.3	9579	+18.8	DJ
	28	3050.26	18.2	9431	+18.7	DJ
	29	3051.25	18.1	9678	+20.5	J
	29	3051.29	18.9	0013	+20.4	J
X	1	3053.25	18.0	9649	+19.1	J
	1	3053.28	18.8	9929	+18.9	J
	4	3056.34	20.3	9687	+17.8	J
	4	3056.39	21.3	0051	+17.3	J
	7	3059.30	19.2	9696	+17.0	J
	7	3059.34	20.1	9869	+16.6	J
	8	3060.20	16.7	9540	+17.2	DJ
	8	3060.23	17.6	9567	+16.6	DJ

Date		Date Julienne 2440000	TU	TUO-TUC	t_i °C	Obs
	9	3061.26	18.4	9571	+17.5	J
	9	3061.30	19.1	9578	+17.4	J
	10	3062.22	17.4	9710	+18.1	DJ
	10	3062.26	18.2	9876	+17.8	DJ
	11	3063.37	20.8	9667	+17.9	J
	11	3063.41	21.8	9398	+17.7	J
	12	3064.22	17.2	9271	+19.2	J
	12	3064.25	18.1	9366	+19.1	J
	13	3065.22	17.2	9098	+19.6	DJ
	13	3065.25	18.0	8966	+18.9	DJ
	27	3079.32	19.8	8719	+ 7.4	DJ
	27	3079.36	20.5	8890	+ 7.0	DJ
	29	3081.21	17.0	9140	+10.9	J
	29	3081.24	17.8	8670	+10.0	J
XI	5	3088.26	18.1	8522	+14.2	J
	8	3091.20	16.9	8955	+13.9	J
	10	3093.24	17.9	8851	+12.2	J
	10	3093.28	18.9	8933	+11.7	J
	11	3094.32	19.6	8364	+10.6	DJ
	23	3106.18	16.2	7640	+ 5.5	J
	25	3108.21	17.0	7917	+ 1.9	J
XII	5	3118.36	20.6	7265	+ 6.9	J
	5	3118.40	21.5	7392	+ 6.8	J
	6	3119.25	18.1	7797	+ 5.3	J
	6	3119.29	18.9	7411	+ 5.0	J
	15	3128.18	16.4	7347	+ 1.9	DJ
	19	3132.16	15.9	7101	+ 7.8	J
	19	3132.20	16.9	7126	+ 7.2	J
	20	3133.18	16.2	6939	+ 5.2	DJ
	20	3133.22	17.3	7405	+ 3.6	DJ
	26	3139.16	15.7	6777	+ 0.1	DJ

Bull. Obs. Astron, Belgrade, N° 129

OBSERVATIONS À LA LUNETTE ZÉNITHALE (DE 110 mm) DU SERVICE DE LATITUDE DE L'OBSERVATOIRE DE BEOGRAD EN 1976

par R. Grujić, M. Djokić

(Reçu le 18 janvier, 1978)

RÉSUMÉ:

On a présenté les valeurs de latitude ansi que quelques données météorologiques prises au cours d'observations.

TABLEAU I

Les valeurs de latitude ansi que quelques données météorologiques au cours d'observation

Date	τ	OBS.	\Tz	Ti	Tv	Bo	GR.	φ_a	φ_b	φ_d
1976									44°48' +	
			o	o	o			"	"	"
I 7	1976.018	RG	–3.0 C	–2.3 C	–2.5 C	751.3	II	10.316	10.225	10.270
8	.021	MD	–3.7	–1.6	–2.6	750.8	I	10.446	10.263	10.354
10	.026	RG	2.7	1.2	1.6	742.4	I	10.340	10.165	10.252
II 8	.106	RG	–10.5	–7.1	–8.4	754.0	II	10.247	10.266	
	.106	RG	–9.9	–8.6	–	752.6	III	10.069	10.070	10.163
14	.122	RG	1.4	0.3	0.6	734.9	II	10.211	10.158	
	.122	RG	1.4	0.1	0.8	736.2	III	10.090	–	10.153
19	.136	RG	–2.0	–1.6	–1.5	749.9	II	10.077	10.133	10.105
21	.141	MD	1.9	1.0	1.0	748.2	II	10.189	10.105	
	.142	RG	–0.2	–0.4	–0.2	748.0	III	10.003	10.087	10.096
26	.155	RG	2.4	0.6	1.5	751.3	II	–	10.099	
	.155	RG	2.4	0.9	1.8	751.1	III	10.053	–	10.076
29	.163	RG	7.6	5.2	5.5	749.7	II	–	10.044	
	.164	MD	7.2	4.3	4.8	749.0	III	9.883	9.989	9.972
III 2	.168	RG	6.6	7.0	6.6	742.3	II	–	10.131	10.131
13	.199	RG	–0.3	0.4	0.2	732.5	II	–	10.160	
	.199	RG	–0.6	–1.0	–0.8	732.5	III	10.169	10.227	10.185
20	.218	RG	–0.6	2.6	1.5	740.9	III	10.078	–	
	.218	RG	–2.8	–0.6	–1.4	740.2	IV	9.909	–	9.994

Tableau I (suite)

Date			OBS.	Tz	Ti	Tv	Bo	GR.	φa	φb	φd
	22	.224	MD	–1.7	–0.8	–1.6	737.4	III	–	9.925	9.925
	28	.240	RG	4.8	5.0	4.6	751.3	III	10.127	–	10.127
	29	.243	MD	5.8	5.8	5.2	739.2	III	10.087	9.871	
		.243	RG	5.2	4.0	3.6	743.2	IV	10.043	10.135	10.034
IV	1	.251	RG	12.4	11.1	–	743.0	III	10.032	10.018	
		.251	RG	11.0	9.4	–	742.6	IV	10.020	10.132	10.050
	2	.254	MD	13.4	12.6	–	740.7	III	10.031	9.963	
		.254	MD	10.8	10.2	–	740.3	IV	–	10.089	10.028
	4	.259	RG	17.2	15.2	–	738.9	III	–	10.124	
		.259	RG	16.8	13.5	–	739.0	IV	10.020	–	10.072
	17	.294	RG	12.2	13.2	–	745.5	III	9.959	–	9.959
	18	.298	RG	10.4	12.0	–	743.9	IV	10.067	10.252	10.160
V	12	.364	RG	16.0	17.9	16.4	735.8	IV	10.126	10.059	
		.364	RG	14.9	15.6	15.0	735.6	V	10.126	10.185	10.124
	16	.374	RG	16.4	15.0	14.8	743.6	IV	10.233	–	10.233
	29	.410	RG	14.4	15.2	14.3	740.9	IV	–	10.298	
		.410	RG	13.2	13.4	12.8	740.8	V	10.484	10.391	10.391
VI	10	.442	RG	12.2	14.4	13.0	741.6	IV	–	10.370	
		.443	RG	11.8	12.8	12.0	742.0	V	10.210	–	10.290
	14	.453	MD	16.8	17.2	16.4	739.5	IV	–	10.068	10.068
	15	.456	RG	17.2	17.2	16.8	737.8	IV	–	10.237	10.237
	30	.497	RG	19.4	21.4	20.3	741.6	V	10.437	–	10.437
VII	1	.500	RG	19.6	20.9	19.2	740.2	V	10.547	10.583	10.565
	2	.503	MD	19.4	20.1	18.5	741.9	V	10.207	10.404	10.306
	4	.508	RG	21.5	20.4	19.4	738.6	V	10.418	10.531	10.474
	6	.514	RG	14.9	18.5	16.8	739.8	V	10.372	10.494	10.433
	12	.530	RG	19.1	19.8	18.8	735.8	V	10.369	10.422	10.396
	17	.544	MD	21.1	21.6	20.6	741.2	V	10.346	10.424	10.385
	18	.547	RG	21.7	21.7	21.2	743.0	V	10.434	–	10.434
VIII	25	.651	RG	16.0	16.4	15.4	743.2	VI	10.687	10.686	10.686
	29	.662	RG	19.0	18.9	17.8	741.3	VI	10.622	10.605	10.614
IX	2	.673	RG	13.8	16.3	15.2	735.2	VI	10.740	10.668	10.704
	7	.686	MD	10.4	11.4	10.7	747.4	VI	10.727	10.590	
		.687	RG	9.2	10.6	10.2	746.9	I	10.592	10.429	10.584
	12	.700	RG	19.8	18.7	19.0	743.0	VI	10.685	10.642	10.664
	15	.708	RG	15.8	17.3	16.4	735.2	VI	10.639	10.642	10.640
	24	.733	MD	13.8	13 2	13.1	740.4	VI	10.708	10.601	10.654
	25	.736	RG	14.4	14.8	14.2	738.4	VI	10.605	10.667	10.636
	27	.741	RG	14.8	14.9	14.8	743.0	VI	10.618	10.626	10.622
X	7	.769	RG	14.0	14.6	14.1	745.4	I	10.630	10.560	10.595
	8	.771	MD	14.6	13.9	14.0	743.6	I	10.615	10.493	10.554
	10	.776	RG	17.2	16.3	16.0	739.2	VI	10.714	10.612	
		.777	RG	16.6	15.4	15.6	738.8	I	10.576	10.547	10.612
	12	.782	MD	20.6	18.2	18.8	731.9	VI	10.466	10.631	10.548
	23	.812	RG	5.0	5.6	4.8	742.4	VI	10.650	10.698	
		.812	RG	2.4	3.6	2.8	741.8	I	10.720	10.493	10.640

Tableau I (suite)

Date	τ	OBS.	T_z	Ti	Tv	Bo	GR.	φ_a	φ_b	φ_d
XI 23	.897	RG	–0.4	1.3	0.4	738.6	I	10.548	10.489	10.518
27	.908	RG	4.7	3.0	3.4	745.6	I	10.427	10.392	10.410
XII 5	.930	RG	5.0	4.8	4.6	733.4	II	10.452	10.466	10.459
6	.932	MD	2.4	3.2	2.8	737.8	I	10.413	10.348	10.380
16	.960	RG	0.9	1.6	1.4	743.7	I	–	10.370	10.370
19	.968	RG	5.9	5.4	5.5	742.4	I	10.520	10.415	
	.968	RG	4.8	4.6	4.8	742.6	II	10.489	10.314	10.434
27	.990	MD	–6.6	–5.7	–6.1	743.4	I	10.388	10.244	
	.990	MD	–7.8	–7.0	–7.3	742.2	II	10.346	10.425	10.351
30	.998	RG	–5.7	–3.4	–4.6	741.9	I	10.357	10.369	
	.998	RG	–7.1	–5.2	–6.1	743.0	II	10.463	10.304	10.373

Les valeurs observées de φ (Tableau I) sont reduites à la maniére déjâ signalée (Ševarlić, B., Teleki, G.) mais sans tenir compte des erreurs progréessives et périodiques et de coefficient de température (Milovanović, V. et les autres). Les réductions ont été faites dans le système FK4 et on a appliqués les corrections des déclinaisons présentées dans le Tableau 2 (Grujić, R. et les autres).

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

LA LÉGENDE:

Date : Année, mois et date d'observation.
τ : Partie d'année tropique.
Obs. : Observateurs R. Grujić (RG), M. Djokić (MD).
Tz : Température à l'abri météorologique éloigné 50 m de l'instrument.
Ti : Température de l'instrument.
Tv : Température de l'air dans la salle d'observation (valeur moy. des lectures des thermométres sud et nord).
Bo : Lecture du baromètre en mm Hg (tenant compte de la température de baromètre).
GR. : Numéro de la groupe.
φ_a φ_b : La latitude de la sous-groupe a, resp. b
φ_d : La valur moy. de la latitude de la nuit.

LITTÉRATURE:

1. Ševarlić, B., Teleki, G., "Bulletin de l'Obs. Astr. de Beograd, Vol. XXIV, N° 3–4, p. 19, 1959."
2. Milovanović, V., et les autres, "Bulletin de l'Obs. Astr. de Beograd, Vol. XXVIII, N° 124, p. 159, 1970."
3. Grujić, R. et les autres, "Bulletin de l'Obs. Astr. de Beograd N° 126, p. 22, 1975."

Bull. Obs. Astron, Belgrade, N° 129

OBSERVATIONS À LA LUNETTE ZÉNITHALE (DE 110 mm) DU SERVICE DE LATITUDE DE L'OBSERVATOIRE DE BEOGRAD EN 1977

par R. Grujić, M. Djokić

(Reçu le 20 fébrier, 1978)

RÉSUMÉ

On a présenté les valeurs de latitude ansi que quelques données météorologiques prises au cours d'observation.

TABLEAU I

Les valeurs de latitude ansi que quelques données météorologiques au cours d'observation

Date	τ	OBS	Tz	Ti	Tv	Bo	GR.	φ_a	φ_b	φ_d
1977									44°48'+	
			o	o	o			"	"	"
I 18	1977.023	RG	−3.0C	−2.3C	−3.0C	743.6	I	10.244	10.258	10.251
14	.039	MD	1.5	1.7	1.2	738.9	I	10.259	10.148	
	.039	MD	0.7	0.3	0.2	738.6	II	10.212	–	10.206
19	.053	RG	−6.0	−4.4	−5.3	740.8	I	–	10.228	
	.053	RG	−4.7	−4.4	−4.2	740.5	II	10.213	10.232	10.224
23	.064	RG	1.4	2.0	1.6	738.0	II	10.062	10.217	10.140
II 8	.108	RG	9.8	7.1	8.0	735.3	II	–	10.046	10.046
15	.127	RG	6.3	5.4	5.7	735.2	III	10.026	–	10.026
20	.140	RG	12.3	12.4	12.0	738.2	II	10.154	–	10.154
23	.149	MD	12.1	13.0	12.3	741.8	II	–	10.128	10.128
28	.163	RG	−3.8	0.3	−1.5	747.3	III	9.983	10.046	10.014
III 2	.168	MD	−0.2	1.3	0.2	745.8	III	10.040	–	10.040
6	.179	RG	8.4	7.8	7.8	746.0	II	–	9.974	
	.179	RG	6.4	5.9	5.5	746.2	III	10.071	9.936	9.994
11	.193	MD	7.9	8.1	8.2	739.7	III	9.922	–	9.922
14	.201	RG	6.7	6.9	6.6	743.9	III	9.982	9.837	
	.201	RG	5.5	5.8	5.9	744.8	IV	9.996	–	9.938

Tableau I (suite)

Date	τ	OBS.	Tz	Ti	Tv	Bo	GR.	φ_a	φ_b	φ_d
16	.206	MD	8.0	6.6	6.6	749.6	III	9.976	9.883	9.930
17	.209	RG	5.7	6.8	6.2	744.8	III	10.032	10.013	10.022
19	.215	MD	8.2	8.2	8.2	735.8	III	10.025	9.934	9.980
23	.226	RG	20.9	17.0	17.1	743.4	III	9.943	9.866	
	.226	MD	20.8	16.3	17.6	743.0	IV	10.003	9.909	9.930
26	.234	MD	15.4	14.2	13.8	739.3	III	9.998	9.893	
	.234	RG	13.8	13.4	13.3	738.4	IV	9.929	9.961	9.945
IV 6	.264	RG	6.4	8.2	7.2	737.0	III	10.002	9.966	
	.264	RG	6.0	6.0	5.8	735.9	IV	9.953	10.008	9.982
17	.294	RG	3.6	4.3	3.9	740.1	IV	9.926	10.034	9.980
21	.305	MD	6.9	7.9	7.0	746.0	III	–	9.898	
	.305	MD	6.2	6.4	5.7	745.9	IV	9.910	–	9.904
27	.322	RG	12.4	11.6	11.4	739.2	IV	9.869	10.002	9.936
V 3	.338	RG	18.2	18.2	17.2	739.4	IV	9.933	–	9.933
12	.363	MD	15.2	14.3	14.0	735.6	IV	9.956	10.102	
	.363	RG	14.6	13.4	13.6	734.6	V	10.086	9.998	10.036
15	.371	RG	13.3	16.2	14.8	732.1	IV	9.951	–	9.951
25	.398	RG	14.8	16.0	14.8	739.2	IV	10.086	10.124	
	.399	MD	11.8	13.3	12.6	738.7	V	–	10.131	10.114
30	.412	RG	17.3	16.6	16.0	736.8	IV	10.033	10.142	
	.412	RG	16.2	15.0	14.7	736.7	V	10.126	10.093	10.098
VI 8	.436	RG	20.2	20.2	19.0	741.4	IV	–	10.214	
	.437	MD	19.0	18.3	17.8	740.4	V	10.289	10.315	10.273
15	.456	MD	21.4	23.7	22.0	733.6	IV	–	10.072	10.072
28	.491	RG	14.8	16.2	15.2	739.6	V	10.236	10.282	10.259
29	.494	MD	19.4	18.2	18.1	738.8	V	10.256	10.352	10.304
VII 2	.502	RG	18.2	19.2	18.0	742.0	V	10.153	10.328	10.240
12	.530	RG	15.4	19.2	17.4	739.4	V	–	10.480	10.480
13	.532	RG	20.2	20.2	19.3	738.6	V	10.280	10.306	
	.533	RG	20.6	19.0	18.9	738.0	VI	10.312	10.419	10.329
18	.546	RG	19.6	21.0	20.0	736.4	V	10.205	–	10.205
20	.552	RG	19.2	21.0	19.6	738.2	V	10.410	10.441	10.426
VIII 12	.614	MD	19.6	21.0	19.8	738.2	V	10.364	10.342	10.353
17	.628	RG	18.2	19.9	18.7	740.3	V	10.542	10.499	10.520
20	.636	RG	19.8	19.8	19.4	735.2	VI	10.626	–	10.626
26	.653	MD	15.8	15.8	15.6	741.0	VI	10.610	10.589	10.600
27	.656	RG	18.1	18.2	18.0	741.4	VI	10.703	10.647	10.675
30	.664	RG	18.2	19.6	18.8	740.4	VI	10.711	10.552	10.632
IX 4	.677	RG	19.2	20.4	19.2	740.6	V	–	10.601	
	.678	RG	19.0	19.0	18.2	740.6	VI	10.651	10.668	10.640
5	.680	MD	19.2	19.4	18.8	741.8	VI	10.697	10.660	10.678
8	.688	RG	19.6	20.8	20.1	740.1	VI	10.690	10.624	10.657
12	.699	MD	17.6	17.6	17.4	743.8	VI	10.674	–	10.674
14	.705	RG	10.1	12.6	11.2	747.9	VI	10.797	10.734	10.766
28	.743	MD	5.4	8.4	6.8	753.2	VI	10.638	10.631	
	.744	RG	5.0	6.1	5.3	752.8	I	10.719	10.560	10.637
X 4	.760	RG	11.0	9.6	9.6	744.4	VI	10.707	–	
	.760	MD	10.2	9.2	9.5	744.4	I	10.622	10.505	10.611

Tableau I (suite)

Date	τ	OBS.	Tz	Ti	Tv	Bo	GR.	φ_a	φ_b	φ_d
16	.792	RG	8.6	10.4	9.2	746.4	VI	10.717	10.722	
	.792	RG	6.6	8.3	7.7	746.8	I	10.770	10.622	10.708
18	.798	MD	11.3	9.4	9.3	747.3	I	10.678	10.549	10.614
22	.808	RG	9.6	9.9	9.9	747.4	VI	10.606	10.740	10.673
24	.814	MD	10.6	11.2	10.8	748.1	I	10.711	10.715	10.713
26	.820	RG	11.2	10.6	10.5	747.8	I	10.768	10.682	10.725
XI 24	.899	RG	1.8	1.8	1.7	738.0	I	10.603	10.605	10.604
XII 4	.926	RG	−8.0	−5.4	−6.8	748.1	I	10.538	10.442	10.490
12	.949	RG	−7.5	−5.8	−6.8	754.3	II	–	10.529	10.529

Les valeurs observées de φ (Tableau I) sont reduites à la manière déjâ signalée (Ševarlić, B., Teleki, G.) mais sans tenir compte des erreurs progreéssives et périodiques et de coefficient de température (Milovanović, V, et les autres). Les réductions ont été faites dans le système FK4 et on a appliqués les corrections des déclinaisons présentées dans le Tableau 2 (Grujić, R., et les autres).

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

LA LÉGENDE:

Date : Année, mois et date d'observation.
τ : Partie d'année tropique.
Obs. : Observateurs R. Grujić (RG), M. Djokić (MD).
Tz : Température à l'abri météorologique éloigné 50 m de l'instrument.
Ti : Température de l'instrument.
Tv : Température de l'air dans la salle d'obsérvation (valeur moy. des lectures des thermométres sud et nord).
Bo : Lecture du baromètre en mm Hg (tanant compte de la température de baromètre).
GR. : Numéro de la groupe.
$\varphi_a \varphi_b$: La latitude de la sous-groupe a, resp. b
φ_d : La valur moy. de la latitude de la unit.

LITTÊRATURE

1. Ševarlić, B., Teleki, G., „Bulletin de l'Obs. Astr. de Beograd, Vol. XXIV, N° 3–4, p. 19, 1959."

2. Milovanović, V., et les autres, „Bulletin de l'Obs. Astr. de Beograd, Vol. XXVIII, N° 124, p. 159, 1970."

3. Grujić, R. et les autres, „Bulletin de l'Obs. Astr. de Beograd, N° 126, p. 22, 1975."

TABLE DES MATIÈRES