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NEREGULAĴOJ DA MASDITRIBUO EN LA TERKRUSTO

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(Ricevita 16. VI 1976)

RESUMÉ:

En se basant sur la fonction de force (1), avec les coefficients empiriques J_n, après l'inclusion en (2) de tous les forces connues agissantes au satelite, observées aux moments (3), on peut attribuer les autres deviations (O−C) aux petites masses m_i, chacune dans un centre M_i du secteur correspondant de l'écorce terrestre ($i=1, 2, \ldots, N$). La linéarisation donne les équations (5). Le vecteur inconnu **x**, avec les composantes (8), peut etre trouvé par l'integration dans la forme (14). La condition (19) et les équations normales (20), où les $\mathbf{E}_k$ sont les directions des observations du satelite, sont la conséquence de la méthode des moindres carrés. Et quand les $\mathbf{X}_{ik}$ sont les composantes (21), les équations (20) deviennent (28), avec les notations (22), d'où vient la solution (24). On a donné enfin un schème possible pour partager l'écorce terrestre à N secteurs, de même qu'un aperçu de tous les calculs.

1. Enkondukaj konsideroj

La esploroj de la gravita kampo de la Luno, pere de la lunaj (aŭ lun-teraj) satelitoj, ebligis malkovri plurajn densaĵojn en supraj tavoloj de la Luno. Similaj densaĵoj ekzistas ankaŭ sur la Tero, sed la terkrusto estas multe pli komplika ol la luna krusto, intermiksiĝas ankaŭ la montaroj kaj submaraj masoj. Multego estis jam farita por ekkoni la mezan formon de la geoido kaj la lokajn deviojn de ĝi. Sed la sputnikoj ebligus ricevi iom pli ĝeneralan bildon de la masdistribuo, kiu bildo ne estus tro „loke koloriĝita", sed kiun oni povus poste kunligi kun la gravimetriaj kaj geodeziaj detalaĵoj kaj tiel havi la kompletan bildon.

La unua ekestanta demando estas: kio servu kiel la ekira stato, la regula maso, de kiu oni serĉu la deviojn? La plej nature estus preni mezan rotacian elipsoidon (kun la meza ekvatora kaj la polusa diametroj). Sed oni disponas je tre malmultaj scioj pri ĝia altirforto. Nome oni povas rajte supozi ke ĝi (almenaŭ interne) konsistas el samdensaj elipsoidaj tavoloj, sed oni ne konas la leĝon laŭ kiu ŝanĝiĝas la denseco (ekde la centro ĝis la periferio). Kaj pro la nesfereco estas tre signifa la devio de la altirforto ekde la direkto tercentro-altirpunkto, la devio dependanta ankaŭ de tiu direkto. La problemo kompliĝas pro la fakto ke la esplorsatelitoj estas tiucele utilaj nur se ili estas sufiĉe proksimaj, sed tiam oni devas gravite konsideri ankaŭ tiun proksimecon.

Pro ĉio tio ne utilus, aŭ utilus treege malmulte, ekiri teorie de la elipsoido kaj seriigi ĝian altirforton laŭ la gradoj de ĝia plateco. Estas pli bone eviti la koncernajn nesciojn per utiligo de la klasika seriigo laŭ la gradoj (negativaj) de la satelitdistanco, lasante determinon de la necesaj koeficientoj ne al la teorio sed al la empirio, des pli ĉar la persatelitaj esploroj donis jam tre precizajn valorojn de la koncernaj koeficientoj (ekz. King-Hele, 1964, aŭ King-Hele, Cook and Rees, 1963).

Konklude: oni devas preni ke la meza elipsoido (kun la empirie-gravite trovitaj dimensioj), senkonsidere la internan densodistribuon, altiras eksteran punkton laŭ la potencialo

$$(1)\qquad U=\frac{GM}{r}\left[1-\sum_{n=2}^{\infty} I_n\left(\frac{R}{r}\right)^n P_n(\sin\varphi)\right]$$

Al tio necesas aldoni aliajn jam konatajn influojn: aerrezisto (kvankam estus multe pli bone ke la tiucela satelito trakuru ĝuste la aertavolojn kie la rezisto estas sensignife malgranda), altirforton de aliaj astroj k.s. La tiel ekestintajn ekvaciojn oni devas integri — ju pli precize des pli bone (plej praktike per la pure numeraj metodoj) kaj trovi O−K diferencojn por ĉiuj momentoj en kiuj oni observis la sateliton. Oni rajtas supozi ke la trovitaj diferencoj grandkvante devenas pro la influoj de la devioj en la masdistribuo; oni devas do starigi la kunligajn rilatojn kaj utiligi ilin por trovi la serĉatajn deviojn.

2. Solvo de la perturbaj ekvacioj

Signu per $\mathbf{f}$ la sumon de ĉiuj konataj fortoj altirantaj la sateliton de la maso 1, kun la pozici-vektoro $\mathbf{r}^p$ ekde la tercentro. Tiam estas

$$\frac{d^2\mathbf{r}^p}{dt^2}=\mathbf{f} \tag{2}$$

la ekvacio de ĝia moviĝo. Estu plue $\mathbf{E}_k$ la direktoj en kiuj – laŭ la kalkuloj – devis esti observita la satelito en la momentoj

$$t=t_k,\ k=1,2,\ldots,K \tag{3}$$

kaj $\mathbf{E}_k+\delta\mathbf{E}_k$ estu la direktoj en kiuj tiutempe oni fakte observis ĝin.

La devioj $\delta\mathbf{E}_k$ – almenaŭ iliaj ĉefaj partoj – devenas el la influo de la mas'ekscesoj (pozitivaj aŭ negativaj) en la tera krusto. Por trovi ilin, dividu la tersurfacon je N sekcioj, proksimume egalaj, sed tute difinitaj (la nombro de la observoj estu almenaŭ double pli granda). Iliajn mezpunktojn signu per M_i, kun la sferaj koordinatoj (r_i, λ_i, φ_i) aŭ kun la pozicivektoro $\mathbf{r}_i$ (ekde la tercentro). La plion (malplion) de la maso en unu tia sektoro (kiel en ĝia mezpunkto) signu per m_i. Kun tiaj signoj, la ekvacio (2) estos

$$\frac{d^2(\mathbf{r}+\mathbf{x})}{dt^2}=\mathbf{f}+\sum_{i=1}^{N} m_i\,\frac{(\mathbf{r}_i-\mathbf{r}^p-\mathbf{x})}{|\mathbf{r}_i-\mathbf{r}^p-\mathbf{x}|^3} \tag{4}$$

kie $\mathbf{x}$ prezentas la deviojn de la satelito kaŭzitajn per suma gravita influo de la masdevioj. Laŭ la problemo mem, $\mathbf{x}$ estas tiom malgranda kvanto ke oni povas lineigi (4), konsiderante (2):

$$\frac{d^2\mathbf{x}}{dt^2}=\delta\mathbf{f}+\sum_{i=1}^{N} m_i\cdot\frac{\mathbf{r}_i-\mathbf{r}^p}{|\mathbf{r}_i-\mathbf{r}^p|^3}$$

En la esprimo por $\mathbf{f}$ oni nature renkontas plurfoje $\mathbf{r}^p$, sed ĝia influo ĉe la lineigo povas esti nur pro la ĉefa (neperturbata) membro $-\mu\,|\mathbf{r}|^{-3}\,\mathbf{r}$, pro kio

$$\delta\,\mathbf{f}=GM\left(-\frac{\mathbf{x}}{r^3}+3\frac{\mathbf{r}\,\mathbf{x}}{r^5}\,\mathbf{r}\right)$$

($\mathbf{r}$ estas la neperturbata vektoro, ĉar la etaj perturbo-membroj nemulte ŝanĝiĝas pro $\mathbf{x}$). Do la lasta ekvacio fariĝos

$$\frac{d^2\mathbf{x}}{dt^2}+\frac{\mu}{r^5}\,[r^2\mathbf{x}-3\,(\mathbf{rx})\,\mathbf{r}]=\mathbf{F}=\sum_{i=1}^{N} m_i\,\frac{\mathbf{r}_i-\mathbf{r}}{|\mathbf{r}_i-\mathbf{r}|^3} \tag{5}$$

La solvado de ĉi tiu ekvacio povas esti tute la sama kiel ĉe la ekvacio (1,6) en la verketo de Popoviĉ (1971). Nome la unua integralo, ricevebla per la vektora multipliko je $\mathbf{x}$, estas

$$\mathbf{r}\mathbf{x}\frac{d\mathbf{x}}{dt}-\frac{d\mathbf{r}}{dt}\,\mathbf{x}\mathbf{x}=\mathbf{G}, \tag{6}$$

$$\mathbf{G}=\sum_{i=1}^{N} m_i\int_0^t \frac{\mathbf{r}\times\mathbf{r}_i}{|\mathbf{r}_i-\mathbf{r}|^3}\,dt=\int_0^t(\mathbf{r}\times\mathbf{F})\,dt$$

Simile oni trovas la unuan skalaran integralon (la detalojn bonvolu vidi en Popoviĉ, 1971, precipe ekvacio (1,14)):

$$\mathbf{v}\,\frac{d\mathbf{x}}{dt}+\mu r^{-3}\,(\mathbf{r}\cdot\mathbf{x})=F_r, \tag{7}$$

$$F_r=\sum_{i=1}^{N} m_i\int_0^t\frac{\mathbf{r}_i-\mathbf{r}}{|\mathbf{r}_i-\mathbf{r}|^3}\,d\mathbf{r}$$

Se oni uzu la saman diskomponon kiel en Popoviĉ (1971, utiligita unue de la sama aŭtoro en 1962), nome

$$\mathbf{x}=\xi\,\mathbf{r}+\eta\,(\mathbf{c}\times\mathbf{r})+\zeta\,\mathbf{c},\quad \mathbf{c}=\mathbf{r}\times\mathbf{v}, \tag{8}$$

ĉi tiuj integraloj donas tri skalarajn ekvaciojn

$\mathbf{xc}=-\mathbf{r}\cdot\mathbf{G}$ – skalara multipliko de (6) per $\mathbf{r}$

$2\,\xi+r^2\eta'=c^{-2}\,\mathbf{c}\cdot\mathbf{G}$ – la samo per $\mathbf{c}$

$(\mathbf{rv})\,\xi'+\mathbf{v}^2\,\xi+c^2\,\eta'+\frac{\mu}{r}\,\xi=F_r$ – el (7)

El la unua kaj la dua oni tuj havas

$$\begin{cases}\zeta=-c^{-2}\,(\mathbf{rG})\\ \eta'=-2\,r^{-2}\,\xi+c^{-2}\,r^{-2}\,(\mathbf{cG})\end{cases} \tag{9}$$

kaj la tria fariĝas

$$\mathbf{rv}\,\xi'+(\mathbf{v}^2-2\,c^2\,r^{-2}+\mu/r)\,\xi=F_r-r^{-2}\,\mathbf{cG} \tag{10}$$

Restas solvi nur ĉi tiun ekvacion, ĉar tiam (9) donas la aliajn du (η per kvadraturo kaj ζ rekte). Enkonduku novan variablon, y („reguliga anomalio"), per

$$dt=dy\cdot r\,\sqrt{r_0/\mu} \tag{11}$$

kaj (10) fariĝas

$$\frac{1}{r}\,\frac{dr}{dy}\,\frac{d\xi}{dy}-r\,\frac{d}{dy}\left(r^{-2}\,\frac{dr}{dy}\right)\xi=\sigma$$

$$\frac{d}{dy}\left(r^2\,\xi:\frac{dr}{dy}\right)=\frac{\sigma}{r}:\left(r^{-2}\frac{dr}{dy}\right)^2=\sigma\,r^3\left(\frac{dr}{dy}\right)^{-2}$$

$$\xi=r^{-2}\,\dot r\int_0^y\sigma\,r^3\left(\frac{dr}{dy}\right)^{-2}dy,\quad \sigma=\frac{r_0}{\mu}\,(F_r-r^{-2}\mathbf{cG}) \tag{12}$$

Sekve (9) kaj (11) donas

$$\eta=\sqrt{r_0/\mu}\int_0^y(c^{-2}\,\mathbf{cG}-2\,\xi)\,r^{-1}\,dy \tag{13}$$

La trovitajn esprimojn (por η, ζ) oni povas detaligi kaj liberigi de la doublaj kvadraturoj. Por ne ripeti la laborojn raportitajn en la verketo de Popoviĉ (1971) mi donos nur la finajn esprimojn:

$$(14)\quad \begin{cases} \xi = \sigma Q - \dfrac{dr}{dy} Q^* r_0/\mu \\ (\mu/r_0)^{3/2}\,\eta = c^{-2}\left[\mathbf{c}\cdot\mathbf{G}\,Q_2 - \displaystyle\int_0^t Q_2\,(\mathbf{crF})\,dt\right] + \\ + \displaystyle\int_0^y \frac{1}{r}\,(\mathbf{r}\,\mathbf{F})\,Q dy - Q^* \\ c^2\,\zeta = -\mathbf{rG} \end{cases}$$

kie

$$(15)\quad \begin{cases} \mathbf{G} = \displaystyle\int_0^t (\mathbf{r}\times\mathbf{F})\,dt,\ F_r \text{ el } (7),\ \sigma \text{ el } (12), \\ \eta Q = yc_1 + \eta y^2 c_2 \\ 2\,\nu^2\,Q_1/r_0 = y^3\,[3\,c_3 + (2\nu^2 - 1)\,c_1 c_2] + \\ + \dfrac{1}{\eta}\nu^2 y^2 c_2\,[2 + (\eta^2 + \zeta) y^2 c_2] \\ Q_2\,(\eta r_0) = c^2 r^{-2} y^2 c_2 - \dfrac{\mu}{r}\,(1 - y^2 c_2 - r/r_0) \\ r^2 Q^* = \displaystyle\int_0^y (\mathbf{rF})\,rQ\,dy + 2Q_1 F_r - 2\int_0^t Q_1\,(\mathbf{Fdr}) \end{cases}$$

Ĉi tie estas utiligataj la signaĵoj praktikaj ĉe utiligo de la „reguliga anomalio" y, nome

$$(16)\quad \xi = \nu y,\quad \nu^2 = 2 - r_0 v_0^2/\mu = r_0/a_0,\quad \eta = \mathbf{r}_0\mathbf{v}_0 : \sqrt{\mu r_0},$$

$$\zeta = 1 - \nu^2 = \frac{1}{\mu}\,r_0\,v_0^2 - 1$$

$$(17)\quad c_0 = \cos\xi,\ c_1 = (\sin\xi) : \xi,\ c_2 = (1 - \cos\xi) : \xi^2,$$

$$c_3 = (\xi - \sin\xi) : \xi^3 \ldots$$

per kiuj facile esprimiĝas aliaj kvantoj de la neperturbata moviĝo:

$$(18)\quad \begin{cases} r = r_0 L,\ L = 1 + \eta y c_1 + \zeta y^2 c_2,\ \mathbf{r} = f\mathbf{r}_0 + g\mathbf{v}_0 \\ f = 1 - y^2 c_2,\ ng = nt - y^3 c_3 = yc_1 + \eta y^2 c_2 \\ (n^2 = \mu r_0^{-3}) \\ \dfrac{dr}{dy} = r_0\,(\eta c_0 + \zeta y c_1),\ \dfrac{df}{dy} = -yc_1,\ n\dfrac{dg}{dy} \\ = c_0 + \eta y c_1 \end{cases}$$

Estas nenia danĝero por konfuzo pro la uzo de ξ, η, ζ kiel la koordinatoj en la diskompono (8) de $\mathbf{x}$ kaj kiel la helpaj esprimoj (16).

3. Solvo de la ĉefa problemo

Dum observado de sputnikoj kutime estas mezurataj nur iliaj observodirektoj. Laŭ la principo de la „metodo de minimuma kvadratsumo" devus esti minimuma sumo de kvadratoj de la devioj de tiuj direktoj disde la kalkulitaj direktoj **OP**, t.e. sumo de kvadratoj de la distancoj PA:

$$(19)\quad \sum_k \{[\mathbf{E}_k \times (\mathbf{r}^p + \mathbf{x})] \times \mathbf{E}_k\}^2 = \min,$$

aŭ

$$(19a)\quad \sum_k [\mathbf{E}_k \times (\mathbf{r}^p + \mathbf{x})]^2 = \min$$

La „normalaj ekvacioj" (por la nekonataj masdevioj m_j, troviĝantaj en $\mathbf{x}$), estas

$$(20)\quad \sum [\mathbf{E}_k \times (\mathbf{r}^p + \mathbf{x})_k] \cdot \left(\mathbf{E}_k \times \frac{\partial \mathbf{x}_k}{\partial m_j}\right) = 0,$$

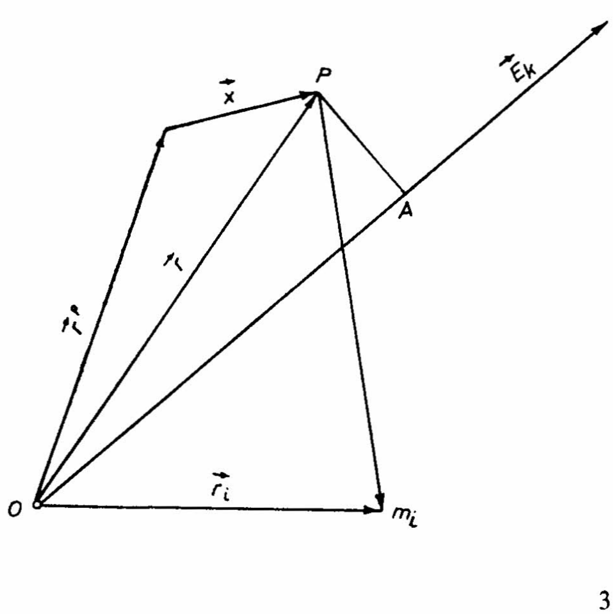
$$j = 1, 2, \ldots N$$

La esprimo (8) por $\mathbf{x}$ estas detaligita per ξ, η, ζ (14). Jam la supraĵa rigardo de la donitaj esprimoj montras ke ξ, η, ζ estas homogenaj unuagradaj funkcioj de ĉiuj m_i, do oni povas noti

$$(21)\quad \mathbf{x}_k = \sum_{i=1}^{N} m_i \mathbf{X}_{ik},\ \frac{\partial \mathbf{x}_k}{\partial m_j} = \mathbf{X}_{jk} = \frac{\partial \xi_k}{\partial m_j}\,\mathbf{r}_k + \frac{\partial \eta_k}{\partial m_j}(\mathbf{c}\times\mathbf{r}_k) + \frac{\partial \zeta_k}{\partial m_j}\,\mathbf{c}$$

Kun ĉi tiuj signaĵoj (20) fariĝas

$$\sum_k (\mathbf{E}_k \times \sum_i m_i \mathbf{X}_{ik})(\mathbf{E}_k \times \mathbf{X}_{jk}) = -\sum_k (\mathbf{E}_k \times \mathbf{r}_k{}^p)(\mathbf{E}_k \times \mathbf{X}_{jk}).$$



$$\sum_i^N m_i \sum_k (\mathbf{E}_k \times \mathbf{X}_{ik}) \cdot (\mathbf{E}_k \times \mathbf{X}_{jk}) = -\sum_k \mathbf{r}_k{}^p \cdot [(\mathbf{E}_k \times \times \mathbf{X}_{jk}) \times \mathbf{E}_k]$$

Pro malplilonga skribo signu

$$c_{ij} = \sum_k (\mathbf{E}_k \times \mathbf{X}_{ik}) \cdot (\mathbf{E}_k \times \mathbf{X}_{jk}) = \sum_k \mathbf{X}_{ik} \cdot \mathbf{a}_{kj} \tag{22}$$

$$\mathbf{a}_{kj} = (\mathbf{E}_k \times \mathbf{X}_{jk}) \times \mathbf{E}_k, \quad b_j = -\sum_k \mathbf{r}_k{}^p \cdot \mathbf{a}_{kj}, \tag{22a}$$

$$C = \{c_{ij}\} \quad i = 1, 2, \ldots N; \quad j = 1, 2, \ldots N$$

kaj la lasta (normala) ekvacio prenas la formon

$$\sum_{i=1}^{k} m_i c_{ij} = b_j, \quad j = 1, 2, 3, \ldots N \tag{23}$$

aŭ

$$C \cdot m = b, \quad m = \{m_1, m_2, \ldots m_N\}^T, \tag{23a}$$

$$b = \{b_1, b_2, \ldots b_N)^T$$

La solvo de ĉi tiu ekvacio estas

$$m = C^{-1} b \tag{24}$$

kaj oni efektivigos ĝin post elkalkuloj de la elementoj c_{ij} de la matrico C el (22) kaj de la koordinatoj b_j de la vektoro b el (22a). Pro tio estas necese antaŭe elkalkuli $\mathbf{X}_{ik}$, $\mathbf{E}_k$ kaj $\mathbf{r}_k{}^p$. La unuovektorojn $\mathbf{E}_k$ oni havas el la observoj en la momentoj (3), $\mathbf{r}_k{}^p$ oni havas el (2) — inkludinte en $\mathbf{f}$ ĉiujn konatajn perturbojn — do nur eltrovo de $\mathbf{X}_{ik}$ postulas novajn esprimojn, kun helpo de (21) kaj (14).

Nome (14) donas unue

$$\begin{cases} \dfrac{\mu}{r_0} \dfrac{\partial \xi_k}{\partial m_j} = \left[\left(\dfrac{\partial F_r}{\partial m_j}\right)_k - r_k^{-2} \left(\mathbf{c} \cdot \dfrac{\partial \mathbf{G}_k}{\partial m_j}\right)\right] Q_k - \left(\dfrac{dr}{dy}\right)_k \dfrac{\partial Q_k^*}{\partial m_j} \\ \left(\dfrac{\mu}{r_0}\right)^{3/2} \dfrac{\partial \eta_k}{\partial m_j} = c^{-2} \left[\left(\mathbf{c} \dfrac{\partial G_k}{\partial m_j}\right) (Q_2)_k - \displaystyle\int_0^{t_k} Q_2 \left(\mathbf{cr} \dfrac{\partial \mathbf{F}}{\partial m_j}\right) dt\right] - \displaystyle\int_0^{y_k} \dfrac{1}{r} \left(\mathbf{r} \cdot \dfrac{\partial \mathbf{F}}{\partial m_j}\right) Q dy - \dfrac{\partial Q_k^*}{\partial m_j} \\ c^2 \dfrac{\partial \zeta_k}{\partial m_j} = -\mathbf{r}_k \cdot \dfrac{\partial G_k}{\partial m_j} \end{cases} \tag{25}$$

Kaj por la dekstraflankaj esprimoj — (5), (6), (15) kaj (7) donas

$$\begin{cases} \left(\dfrac{\partial Fr}{\partial m_j}\right)_k = \displaystyle\int_0^{t_k} \dfrac{\mathbf{r}_j - \mathbf{r}}{|\mathbf{r}_j - \mathbf{r}|^3} d\mathbf{r}, \\ \dfrac{\partial G_k}{\partial m_j} = \displaystyle\int_0^{t_k} \dfrac{\mathbf{r} \times \mathbf{r}_j}{|\mathbf{r}_j - \mathbf{r}|^3} dt, \\ \dfrac{\partial \mathbf{F}}{\partial m_j} = \dfrac{\mathbf{r}_j - \mathbf{r}}{|\mathbf{r}_j - \mathbf{r}|^3} \\ r_k^2 \dfrac{\partial Q_k^*}{\partial m_j} = \displaystyle\int_0^{y_k} \left(\mathbf{r} \dfrac{\partial \mathbf{F}}{\partial m_j}\right) rQdy + 2(Q_1)_k \left(\dfrac{\partial F_r}{\partial m_j}\right)_k - 2 \displaystyle\int_0^{t_k} Q_1 \left(\dfrac{\partial \mathbf{F}}{\partial m_j} \cdot d\mathbf{r}\right) \end{cases} \tag{26}$$

La signifoj de diversaj esprimoj ĉi tie estas donitaj en la parto 2 de ĉi tiu verkaĵo.

4. Trarigardo de la kalkuloj

Unue oni devas fiksi la nombron, N, de la sektoroj de la Tersurfaco — ju pli granda ĝi estas des pli bone, sed ĝin limigas la nombro de la observoj (aŭ oni devas adapti la nombron de la observoj al N, se oni planas tiucelan eksperimenton). Por plifaciligi la dividon de la surfaco je kiom eble pli egalaj sektoroj, mi ekiris de la zonoj kun la latituda diferenco 2k°, t.e. de la sektoroj kies mezaj direktoj havos la latitudojn (en gradoj): 90—k, 90—3k, . . . , 90—(2n —1) k, . . . , +k, —k, . . . , —90+k. La unua (ĉirkaŭpolusa) zono havos la surfacon $4 R^2 \sin^2 k$ kaj oni povas preni ĝin kiel unu sektoron. La rilato de la surfacoj de aliaj zonoj al la ĉirkaŭpolusa zono estos $\sin(2n-1)k : \sin k$ kaj tio devus esti la nombro de la sektoroj en la koncerna zono. Tion oni povas fari nur proksimume kaj oni povus preni ekzemple

$$\sin(2n-1)k \approx (2n-1)\sin k, \quad 2nk < 90°$$

kio estas bona proksimumigo por negrandaj n. Tio signifus ke oni dividus la sinsekvajn zonojn je 1, 3, 5, ... $\frac{90}{k} - 1$, entute

$$2 \cdot \frac{90}{2k} \left(1 + \frac{90}{k} - 1\right) = \left(\frac{90}{k}\right)^2$$

sektoroj por ambaŭ hemisferoj. Tio estus plej simpla divido, se la nombro de la sektoroj por grandaj n (en ekvatorproksimaj zonoj) estus tro granda. Oni vidas tion el la esprimo en la formo

$$\sin(2n-1)k = (2n-1)\sin k \cdot \cos^{2n-2} k \left[1 - \frac{1}{3}\binom{2n-2}{2} \operatorname{tg}^2 k + \frac{1}{5}\binom{2n-2}{4} \operatorname{tg}^4 k - \ldots\right]$$

kie por n proksima al 45/k° jam la dua sumato estas neforĵetenda.

Ne eblas trovi tian proksimumigon kiu estus simpla kaj konvenus same por grandaj kiel por malgrandaj n. Tamen oni povas trovi multe pli bonan proksimumigon ol estas la supra. Nome, por la lasta (apudekvatora) zono ni devas havi la nombron de la sektoroj

$$\frac{\sin(90-k)^\circ}{\sin k} = \operatorname{ctg} k = \frac{1}{k} - \frac{1}{3} k + \ldots$$

Praktike oni prenu nur la unuan membron, do la nombro de la sektoroj devas esti iom malpli ol $180/(\pi k^\circ)$, t.e. multe malpli ol la supra nombro $(90/k)-1$, proksimume $2/\pi$ foje malpli. Se oni uzu la saman koeficienton ankaŭ por negrandaj n (kio tiam preskaŭ ne malgrandigas la nombron de la sektoroj), oni povas ĝenerale por la nombro de la sektoroj en unu zono preni

$$(27) \qquad (2n-1)\frac{2}{\pi} \approx 1.274n, \quad n = 1, 2, 3, \ldots (45/k^\circ)$$

La nombro de la sektoroj ŝanĝiĝas nur proporcie eĉ se ni prenu 1,3n aŭ $\frac{4}{3}n$. Ekzemple por $k = 1^\circ$, la plej granda diferenco $\left(\text{kiam } n = \frac{45}{k}\right)$ montriĝos en la nombroj 57, 58 kaj 60 por la tri diversaj esprimoj.

Do ŝajnas la plej akceptindaj du variantoj:

$$(28a) \qquad 1.274\,n, \quad n = 1, 2, \ldots, \frac{45}{k}, \quad k < 1$$

$$(28b) \qquad \frac{4}{3}\,n, \quad n = 1, 2, \ldots, \frac{45}{k}, \quad k \geqslant 1$$

estu la nombro de la sektoroj en unuopaj zonoj.

Kompreneble oni prenos k° tian ke ĝia numeratoro estu divizoro de 45. Praktike por $k \geqslant 1$ oni prenus nur $k = 3^\circ$, $\left(\frac{5}{2}\right)^\circ$, $\left(\frac{3}{2}\right)^\circ$, 1°, por kiuj valoroj de k mi kalkulis la koncernajn nombrojn de la sektoroj (en unuopaj zonoj kaj entute) donitaj en la tabelo:

k°	larĝeco	n ĝis	Nombroj de la sektoroj en unuopaj zonoj	N
3	6°	15	1; 3,4,5; 7,8,9; 11,12,13; 15,16,17; 19,20	2·160
$\frac{5}{2}$	5°	18	1; 3,4,5; 7,8,9; . . .; 15,16,17; 19,20,21; 23,24	2·228
$\frac{3}{2}$	3°	30	1; 3,4,5; . . . ; 31,32,33; 35,36,37; 39,40	2·620
1	2°	45	1; 3,4,5; . . . ; 51,52,53; 55,56,57; 59,60	2·1380

Por $k < 1$ ekzistas multaj eblecoj (utiligendaj kiam oni postulos ampleksan detalecon) kaj la nombrojn oni kalkulos facile laŭbezone.

La nombro (3) de la observoj estu multe pli granda ol la nombro de la sektoroj (N), nur escepte malpli ol 2N.

Tiam oni faros la kalkulojn laŭ jena skemo:

1) $\mathbf{E}_k$ por ĉiuj observoj en la momentoj t_k(3)

2) $\mathbf{r}_i$ por ĉiuj mezpunktoj de N elektitaj sektoroj (konsiderante ankaŭ nesferecon de la terglobo)

3) la konstantoj

$$\nu^2 = 2 - r_0 \cdot \mathbf{v}_0^2/\mu = r_0/a_0, \quad \eta = \mathbf{r}_0 \cdot \mathbf{v}_0 : \sqrt{\mu r_0},$$

$$\zeta = 1 - \nu^2 = \frac{1}{\mu} r_0 \mathbf{v}_0^2 - 1$$

4) anomalioj y el

$$\frac{1}{r_0}\sqrt{\frac{\mu}{r_0}}\,(t - t_0) = y\,(1 + \eta y c_2 + \zeta y^2 c_3)$$

por ĉiuj t_k $(k = 1, 2, \ldots K)$

$$\left(c_0 = \cos\xi, \; c_1 = \frac{\sin\xi}{\xi}, \; c_2 = \frac{1-\cos\xi}{\xi^2},\right.$$

$$\left. c_3 = \frac{\xi - \sin\xi}{\xi^3}, \; \xi = \nu y\right)$$

5) neperturbata moviĝo — laŭ (18)

6) perturbata moviĝo: $\mathbf{r}^p$ en ĉiuj momentoj t_k (3) el la ekvacio (2) — kun ĉiuj konataj perturbofortoj en $\mathbf{f}$ — laŭ ajna perturbometodo

7) $$\mathbf{f}_j = \frac{\mathbf{r}_j - \mathbf{r}}{|\mathbf{r}_j - \mathbf{r}|^3} = \frac{\partial \mathbf{F}}{\partial m_j}$$

$$\mathbf{g}_{jk} = r_0 \sqrt{\frac{r_0}{\mu}} \int_0^{y_k} \mathbf{f}_j\,(1 + \eta y c_1 + \zeta y^2 c_2)\,dy = \frac{\partial \mathbf{G}_k}{\partial m_j},$$

$$\varphi_{jk} = \int_0^{y_k} \mathbf{f}_j \frac{d\mathbf{r}}{dy}\,dy = \frac{\partial F_{rk}}{\partial m_j}$$

8) $$r_k^2\,q_{jk} = \int_0^{y_k} \mathbf{r} \cdot \mathbf{f}_j\, r\, Q\, dy + 2\varphi_{jk}\,(Q_1)_k -$$

$$-2 \int_0^{y_k} Q_1 \left(\mathbf{f}_j \cdot \frac{d\mathbf{r}}{dy}\right) dy = r_k^2 \frac{\partial Q_k^*}{\partial m_j}$$

kie Q, Q_1, Q_2 estas donitaj per (15).

9) $$\frac{\mu}{r_0}\frac{\partial \xi_k}{\partial m_j}=(\varphi_{jk}-r_k^{-2}\mathbf{c}\cdot\mathbf{g}_{jk})(Q)_k-\left(\frac{dr}{dy}\right)_k q_{jk}$$

$$\left(\frac{\mu}{r_0}\right)^{3/2}\frac{\partial \eta_k}{\partial m_j}=c^{-2}\left[(\mathbf{c}\cdot\mathbf{g}_{jk})(Q_2)_k-\int_0^{t_k}Q_2(\mathbf{crf}_j)\,dt\right]-$$

$$-\int_0^{y_k}\frac{1}{r}(\mathbf{r}\cdot\mathbf{f}_j)\,Qdy-q_{jk}$$

$$c^2\frac{\partial \zeta_k}{\partial m_j}=-\mathbf{r}_k\cdot\mathbf{g}_{jk}$$

10) $\mathbf{X}_{jk}$ el (21), $\mathbf{a}_{kj}$, b_j el (22a)

11) $C=\{c_{ij}\}$ $i=1, 2. \dots N$ el (22)
$j=1, 2, \dots N$

12) $m=C^{-1}b$, $b=\{b_1, b_2, \dots b_N\}^T$,
$m=\{m_1, m_2, \dots m_N\}^T$

La trovotaj $m_1, m_2, \dots, m_N$ prezentos la mas-deviojn (rilate al la supozita masdistribuo esprimita en la forto f de la ekvacio (2)) en la prenitaj sektoroj (N) el la komenco de ĉi tiu punkto.

Bull. Obs. Astron, Belgrade, № 128

RECENT STUDIES OF ASTRONOMICAL REFRACTION*

G. TELEKI

(Received August 13, 1976)

SUMMARY:

A survey is given of some of the present-day investigations of the astronomical refraction, having a broader interest. With some more details description is presented of the plan for elabotion of new international refraction tables, meant to replace Pulkovo Tables, 4th edition, currently in use.

1. This survey of some of the present-day investigations of the astronomical refraction might commence by noting that in 1974 first collection of papers of the Study Group on Astronomical Refraction of the IAU Commission 8 ,,The Present State and Future of the Astronomical Refraction Investigations" appeared as the 18th Volume of ,,Publications de l'Observatoire de Beograd". 17 authors in 15 papers strived to present an answer, as complete as possible, on a number of questions related to this field. In addition to manysided problems of astronomical refraction, belonging to the optical astrometry, presentation has been given of the corresponding questions of geodetic astronomy and radio astrometry, and at the same time attention has been drawn to the site selection for the astrometric instruments.

This paper collection has opened some new ways of investigations and it is to be expected that it will promote this field. We hope that possibilities will be created to publish before long a second paper collection of this Group.

2. At its latest session in 1973 in Sydney, IAU Commission 8 has adopted Resolution No. 11 (Fricke, Gliese, 1974) on the need of working out new international tables of refraction. The task has been entrusted to Soviet astrometrists and the members of the Study Group on Astronomical Refraction.

Late in 1974 a Working Group has been set up (with G. Teleki as chairman) to carry out this project. The Group has adopted a plan of the preparation of new Pulkovo Rerfaction Tables, 5th edition (Teleki, 1976). The main points of the plan are the following:

a) As foundation of the new tables a model ot steady Earth's atmosphere should be chosen such that it would allow calculation of the refraction for different regions of the Earth's body, for different altitudes above the sea level (up to 4500 m), for different parts of the year and the day. This model is to be given supposing clear weather (state ot cloudlessness).

The objective is therefore to approximate, as much as possible, when choosing the model of atmosphere, the real state and for this reason not one only vertical section of the atmosphere is taken, unique for all points on the Earth's surface, but an averaged atmosphere of the whole globe, with its regional characteristics. In doing so we get the possibility not only of introducing into tables a bit of local ,,coloury", which hitherto has been missing, but we seize the possibility to calculate the variation of the refraction as function of the azimuth, a need greatly felt in view of the asymmetry of the atmosphere. Even so, however, the full, real, value of the refraction influence is not obtained, but at least we come closer to it.

A novelty in this plan is presented also by the fact that only meteorological conditions prevailing by clear weather are taken into account, by which astrometric measurements are solely carried out. During night clarity there frequently occur temperature inversions, which, according to Kolchinskij (1974), are causing the changes in the refractional values of the size that must be accounted for when larger zenith distances are in question (over 70°). According to Schott (1975), the effect of the inversion on the refraction values does not exceed $0''.05$ for zenith distances up to 50°.

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Concerning modelling of the atmosphere most has been performed by C. Sugawa and N. Kikuchi (International Latitude Observatory, Mizusawa, Japan), who produced a model of the atmosphere for the northern hemisphere for each 10th degree of latitude (from $+10^\circ$ to $+80^\circ$) and each 10th degree of longitude. Their analysis of the atmosphere (Sugawa, Kikuchi, 1974, 1975) brings to light regional variability as well as the variability with time of the meteorological elements. Refractional influences are of the nature that greater average asymmetry is appearing in the NS direction (mean annual value for zenith region is 0''.0030) than in the EW direction (up to 0''.0015).

Besides these data we have other analysis too — for instance: supplemental atmospheres for northern latitudes of 15°, 30°, 45° and 75° (Sissenwine, 1969) — consequently possibility is presented for modelling the atmosphere for the northern hemisphere.

There remains, however, the need for the elaboration of a model for the atmosphere in the southern hemisphere, to be followed by unification of models for the whole Earth, as well as the need for estabilishing deformations in the models of the atmosphere in the regions of changing altitudes of given terrains above the sea level.

We attach great importance to the study and choice of the most suitable model of the atmosphere, because the quality of the calculated tables is dependent upon it.

b) Chromatic refraction should be calculated on the basis of spectrophotometric stellar gradients (black body gradients) accounting for the corrections for chromatic characteristics of the instrument, atmosphere and registering apparatus (including eye).

A radical change in determining of the chromatic refraction is thus proposed — for more details of this question see (Teleki, 1974). Instead of the spectral type hitherto in use, the spectrophotometric gradient will be amployed, whereby other factors also, causing chromatic effects, should be taken into account.

Lengauer (1976) has already given the solution for the first part of the problem. As gradients for only a very limited number of stars are known, he presents a table, giving — for visual observations with considerable accuracy — the relationship between absolute spectrophotometric gradients and color indices (B—V) which are better known. Secondly: he gives the procedure of chromatic refraction calculation for the conditions of standard air.

There is still the problem, for every observing station, of determination of chromatic characteristics of the instrument, atmosphere and registering apparatus (including eye). Some researches into the problem are under way. Schott (1975), for instance, has investigated receivers of various spectral response: human eye for bright and scant light, photographic plate (Ilford HPS) and photomultiplier (spectral response S—20). For zenith distances up to 50°, the corrections to the effective wavelengths of starlight are less than 0''.07 for human eye and 0''.44 resp. 0''.46 for the photographic plate and multiplier tube.

It is just because this kind of calulation of the total effect of chromatic refraction requires more extensive investigation at observatories that we deem real the assumption of its gradual application: first only the influence through the value (B—V) of the star and the other influences only later, when the required data will have been collected.

In view of the new procedure of chromatic refraction calculation, the Group suggests that astrometric stellar catalogues should contain, besides magnitudes and spectral types, spectrophotometric gradients and color indices (B—V) values as well.

c) Refraction values should be given as function of the refractive index in the surface air layer. The index is to be calculated according to Owens' formula (1967) for the basic wavelenght 5500 Å.

The refraction will be expressed as function of the refractive index in order to allow the determination of the index in other ways too, not only by means of the given formula.

From comparison of various formulae for the calculation of the index, Sergienko (1976) has arrived at the conclusion that Owens' formula, among similar expressions, is yielding in the praxis the most accurate values.

d) Refraction values will be given in natural units, not in logarithmic form, for the zenith distances from 0° through 90°. In calculating these values the use will be made only of the model of the atmosphere and of the law of refraction — there will consequently be no utilization of usual integral of refraction whatever.

e) Calculation of the refraction values will be exectuted by means of electronic computers as well.

Once new refraction tables are completed, the Group will propose to the IAU to adopt them as an international standard for the calculation of refraction.

3. As the calculation of the new tables is requiring some time, the Working Group has provided for, concerning new Pulkovo Refraction Tables, the elaboration, by 1976, of a simplified version of tables as a first approximation of the future complete ones, meant to replace now existing Pulkovo Tables, 4th edition. This task has been entrusted to A.I. Nefed'eva (Engelhardt Observatory, Kazan, USSR) who performed the task.

In elaborating the tables she has made use of the Soviet Standard Atmosphere GOST-73. For the calculation of the refractional influences she used formula she published in 1973 (Nefed'eva, 1973). Owens' formula (1967) has been applied for the basic wavelength 5500 Å. Refractional values are given for each minute of the zenith distance.

The author points to the difficulty of calculation of the corrections to the tables dependent on the altitude of stations above the sea level and infers that it would be very useful to work out refraction tables separately for observatories at altitudes above 0.5 km.

These tables together with necessary explanations are to appear in the near future.

We would like to indicate that these tables should remove the objections (Teleki, 1967; Nefed'eva, 1973; Vasilenko, 1974; Kolchinskij, 1976 and others), advanced concerning Forth edition of the Pulkovo Refraction Tables, the most important amnog them relating ot the errors depending on the air temperature, and we would like therefore to recommend them for use.

4. The calculation of refraction values by way of direct aerological measurements in the vicinity of the observing station is certainly profitable, for it takes into account the instantaneous state of the atmosphere. In order to avoid difficulties in calculating refractional influences on the observations at great zenith distances, Kolchinskij (1976) has employed usual geodetic method for determining terrestrial refraction. By proceeding in this manner he has obtained 33′ 55″.5 for the value of refraction at the zenith distance 90° under conditions 288.2 K and 1013.25 mb in the surface layer. This value is by 25–26″ lower then those obtained by Pulkovo Tables, or by theories of Radau, Garfinkel and Bessel. The author explains this by inaccurately calculated temperature gradients in the troposphere.

It is to be remarked, however, that the effect of refraction, once determined from aerological measurements, does not necessarely mean its true value, this especially if the observations were made off zenith. When saying this we, first of all, have in view the changeability of the meteorological elements, as wall as the fact that there is no spherical symmetry of the atmosphere as it is usually assumed. It would be therefore well, where such possibilities are presented, to take into account data from several nearby stations in calculations of refractional influences. A transition would have thus been effectuated, the same as if we were to make use, instead of usual tables — based upon one vertical cross-section of the atmosphere — such tables which are taking into account spacial characteristics of the atmosphere. The possibility would therewith be seized to embrace some of the so called anomalous refraction as well, i.e. it would be nearer to its real value.

5. Being aware of the fact that refractional tables do not give refractional influences sufficiently accurate, the astronomers are long practising the determination of the corrections to the refraction from the astrometric measurements themselves. That are only attempts, of course, for it is always a question what is the true nature of the term obtained. This is also the case with the so called correction to the constant of refraction, determined from the observations of the same star at lower and upper transits. By analysing this kind of values one is led to the conclusion — see, for instance, (Teleki, 1973) — that they lack definite physical background and cannot therefore be treated as real correction to the tabular values of refraction. This, clearly, does not imply that they were completely unreal or useless — being result of evenning of the basic data — what one wants is to stress that they are not pure refractional corrections even through they enclose such influences as well.

Concerning this object we would like to mention three papers.

Kharin (1976) has studied under what conditions these corrections might have a real refractional character. Although he used a very simplified model of influence, neglecting instrumental errors, his conclusion is that the corrections might be real only in case the observational program has been specially chosen. Consequently, some misgivings about the refractional nature of these corrections still remain.

Fukaya (1975) has derived an empirical relationship between correction to the refraction constant and the air density for surface layer by using data compiled at Tokyo Astronomical Observatory. He has deduced a similar correlation for the layer at 1000 gpm, but none for the layer at 5000 gpm. His conclusion is that correction to the refraction is depending on lower layers of the Earth's atmosphere and that it could be calculated for every evening from the meteorological elements to the surface layer.

Proceeding from these investigations and taking into account the exponential law of the air density changes with altitude, Yasuda (1976) has deduced the correction term of the refraction value depending only on temperature and pressure prevailing in the surface air layer.

These explorations are significant but further analysis of the very nature of the corrections derived is needed to allow this method to be employed at other observatories also.

6. Presented here are some of the more recent works and plans, having, in our opinion, a broader interest. In this the whole complex of problems relating to the anomalous refraction has been omitted.

What is to be said about the present-day investigations of the astronomical refraction? They are getting, from the physical and meteorological point of view, ever more grounded — an important fact — for it is therewith that the reliability of the data obtained is increased. It is just because we are acquiering more reliability that we point out with a greater justification how necessary it is to carefully select the locations for astrometric instruments. This prevention is desirable in view of the practical impossibility — now and most probably in the future — to calculate all the refractional influences, especially in cases where meteorological field, surrounding the nstrument, is excessively complex, with to many changes escaping treatment. It must, for instance, be considered as very correct that Anglo-Danish meridian circle is to be located in Canary Islands on a site with excellent seeing conditions.

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A RETROSPECT ON THE VACUUM MERIDIAN MARKS OF THE BELGRADE LARGE TRANSIT INSTRUMENT*

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(Received August 14, 1976)

SUMMARY:

Evidence, collected so far, shows that vacuum meridian marks meet two principal requirements: the steadiness of the mark image through durable vacuum and the position stability of the vacuum tubes. The precision of the vacuum marks readings is equal to that of collimator readings in all circumstances.

1. **Generalities.** During 1970–71 new meridian marks for the Belgrade Large Transit Instrument were constructed according to a design outlined by L.A. Mitić. Some basic elements of the project were made known to the IAU Commission 8 at its Brighton Session in 1970 (Pakvor, 1972–73). Presented herein, in a fragmentary form, after a period of investigations and experience, are only essentials econcerning this technical innovation. For the sake of completness some of the particulars are re-stated from the already published related papers.

Concrete mark pillars with corresponding housings, providing thermal insulation, were erected at distances 30 m (north mark) and 51 m (south mark), at depression angles 2°.5 for the former and 3°.5 for the latter, as viewed from the main instrument. The distances and depression angles were imposed, rather than freely chosen, by local circumstances.

Protection of the mark pillars foundation against break-through of the atmospheric waters, a point of particular concern when elaborating the project, has been achieved mainly by a horizontal watertight layer of clay, 0.5 m thick, 2 m wide, pressed against and surrounding the quadrilateral concrete mark basements near the soil surface. This watertight layer is in its turn bordered all around, at its bottom, by drain pipe with a prolonged siding to ensure the driving away of residual waters, should they penetrate thus far. The protection proved adequate since no moisture has been perceived inside basements even in the exceptionally reiny period May-August 1975, when heavy reins produced abundant surface waters almost daily. There are otherwise no underground waters within the teritory of the Belgrade Observatory at depths normally reached by astrometric pillars.

2. **Steadiness of the vacuum meridian mark image.** The main feature of our meridian marks, however, are their steel vacuum tubes, 30 cm in diameter, inserted between the meridian marks and their lenses in the pavilion (Fig. 1) in order to eliminate from the mark readings in a radical way that annoying and precision destroying agency as is refraction. The tubes are sealed at both ends by plane-parallel glass plates, manufactured by Zeiss–Jena,

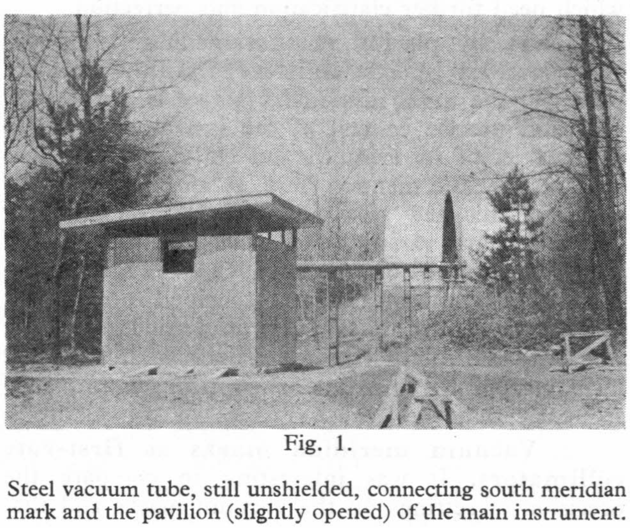

Fig. 1.

Steel vacuum tube, still unshielded, connecting south meridian mark and the pavilion (slightly opened) of the main instrument.

* Presented to the IAU Commission 8 at its Grenoble Session 1976

according to our specified demands. The plane-parallel glasses, facing the instrument, have a 20 cm opening and a 4 cm thickness, whereas the glasses at opposite ends, facing the marks, have a 5 cm opening and 1 cm thickness. The basic condition to be fulfilled by plane-parallel glasses was complete preservation of their plane formed surfaces under durable, full, one-sided air pressure, once vacuum has been created in the tubes. This explains also the difference in thickness of the glass plates, the larger having, evidently, to resist much larger air pressure than the smaller ones.

One sole vacuum-pump is connected to both tubes, but taking the air out fo them can proceed separately for each one, and the state of vacuum is measured by vacuum-meters, attached to each tube. Both vacuum-pump and vacuum-meters that have been in use so far were not of the preconceived quality and will consequently be replaced, but even so the substance of the results is preserved.

When deciding upon introducing this qualitatively new element in the traditional meridian marks scheme, a step not lightly taken as it involved risks inherent in realization of all novelties, in spite of the incontestable soundness of the basic concept, promising experiments with the vacuum tubes, performed by G. van Herk and J.C. de Munk (1954) at Leiden Observatory, have been held in view.

But it came out that the results justified the step taken. The mark image appeared totally steady in the main instrument, resulting in great coherence of the mark readings. The mean error of a single reading is $\pm 0^{s} \cdot 005$, but it is not seldom smaller and it even happens, now and then, as an indicative curiosity, that all five readings (the usual number of settings taken in each clamp position) are identical. This image steadiness is preserved irrecpective of weather conditions or day-time. The prospects of determination of absolute RAs of the members ot the solar system by day may appear different in the light of the above stated, although there are points which need further clarification and perfection.

Thus, by placing vacuum medium along the path traversed by light on its way from the meridian marks to the main instrument a tool is created for easy and precise control of the instrument's behaviour, i. e. of its azimuth and collimation changes at any time. We mention here, as an effective apllication of this new possibility offered, the pursuing of the seasonal variations of these two instrumental parameters carried out during 1973—74 (Mitić, Pakvor, 1975). These measurements helped to establish, in addition to the annual course of the two quantities, thanks to the internal precision indicated, a minute instability of the instrument's optical system, subsequently removed.

3. **Vacuum meridian marks as first-rate collimators.** It was interesting to compare the precision of settings on the vacuum marks and that of settings on a full-size, modern, Opton-type collimator (0 = 190 mm, F=2678 mm, equalling respective parameters of the main instrument), acquired after works with the vacuum meridian marks have already been started. It is convenient here to recall the definition of meridian marks as long-focused collimators.

Parallel settings on both vacuum meridian mark (southern) and the Opton collimator, mounted in the pavilion on the opposite, northern mark lens pillar, were carried out in 1974 (Knežević, 1975). It was found that the precision of settings on the vacuum mark was the same (even slightly better) as that of settings on collimator. Hence the important conclusion that vacuum meridian marks are at the same time fine collimators, making in fact classical collimators superfluous. A factual demonstration of this assertion are our own measurements of azimuth a n d c o l l i m a t i o n by way of vacuum meridian mark, thus with the s a m e high precision, referred to in paragraph 2.

If there has been a requirement in the meridian astrometry to have meridian marks readings as precise as collimator readings, then this requirement has found its fulfilment in the shape of vacuum meridian marks, which in respect to the above stated could, with equal right, be called vacuum long-focused collimators.

Thus, vacuum meridian marks represent in some way a fusion into one technical unit of two, anyhow so kindred auxiliary instruments, as are classical meridian marks and collimators, that unit having the advantage of the former (long-term stability of their reference base line) and also the advantage of the latter (internal precision of settings). It should be remarked, however, that these collimators cannot be „collimated" at each other and have to be used as singles, and not „au pair".

4. **Stability of the vacuum tubes.** Another possible source of refraction, connected with the vacuum tubes, but of different origin than the ordinary air refraction, is presented by plane-parallel glasses closing the vacuum tubes. A. A. Nemiro has shown (private communication) how the variation of the angle between the plane-parallel glass and the meridian plane can affect the apparent position of the mark in case that variation during observation exceeded certain limites. The thicker the plane-parallel glass, the narrower the tolerance of the angle variation. For the thicker plane-parallel glass, facing the instrument, the tolerable angle variation is ± 1 arc minute, whereas for the thinner ones, facing the marks, it is ± 5 arc minutes.

The tolerance limit imposed to the thicker glasses being substantially more severe, as above stated, the investigation relating to the glass position stability began with one of them, namely with that carried by the south tube end, nearest the main instrument (Fig. 2).

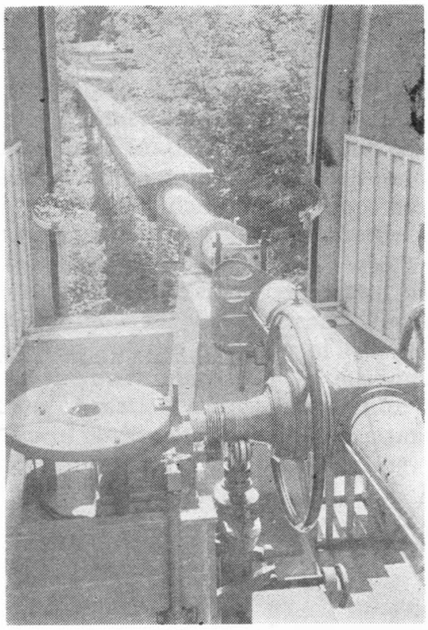

Fig. 2.
South vacuum tube, with its protective envelope, except for its part within pavilion, and the main instrument directed on it.

The following procedure has been applied. On the tube end is attached, by a thread 15 cm long, a plumb weight of some 50 g. At its underside a thin vertical steel needle is sticking out, serving as an indicator. The needle is projecting itself on a horizontal ruler, fixed behind it on the mark lens pillar in the east-west direction, just below the tube end. The position changes of the plumb weight, i.e. of the needle, identical, by necessity, to the position changes of the vacuum tube end to which it is attached, are readable on the ruler's millimetre scale through a small telescope mounted on the opposite north mark lens pillar, some 6 m apart. Later on a small collimator instead of simple telescope was installed, so the changes in the plumb weight position up to one hundredth of millimetre could be traced by the collimator's micrometre, adjusted extrafocally. The 6 m distance of the scanning telescope provides for the elimination of the parallax of the needle-indicator vis à vis the ruler and prevents the observer to exercise disturbing effects upon them.

The results of this investigation are the following. Seasonal variations and the variations of the tube end position on cloudy days and during night are in evident correlation with the temperature changes, but Slight, of the order of 0.05 mm to 0.1 mm per 1°C of temperature changes (Fig 3).

But on sunny days, especially in sommer, there is a pronounced dependence on the insolation direction and intensity, i.e. on the azimuth and elevation of the sun, in addition to the purely thermal dependence. By sunny whether the drift of the tube end is closely following the sun's motion across the sky, increasing as the sun is ascending towards meridian, reaching its maximum very nearly about noon, then decreasing as the sun is descending down to the horizon (fig. 4).

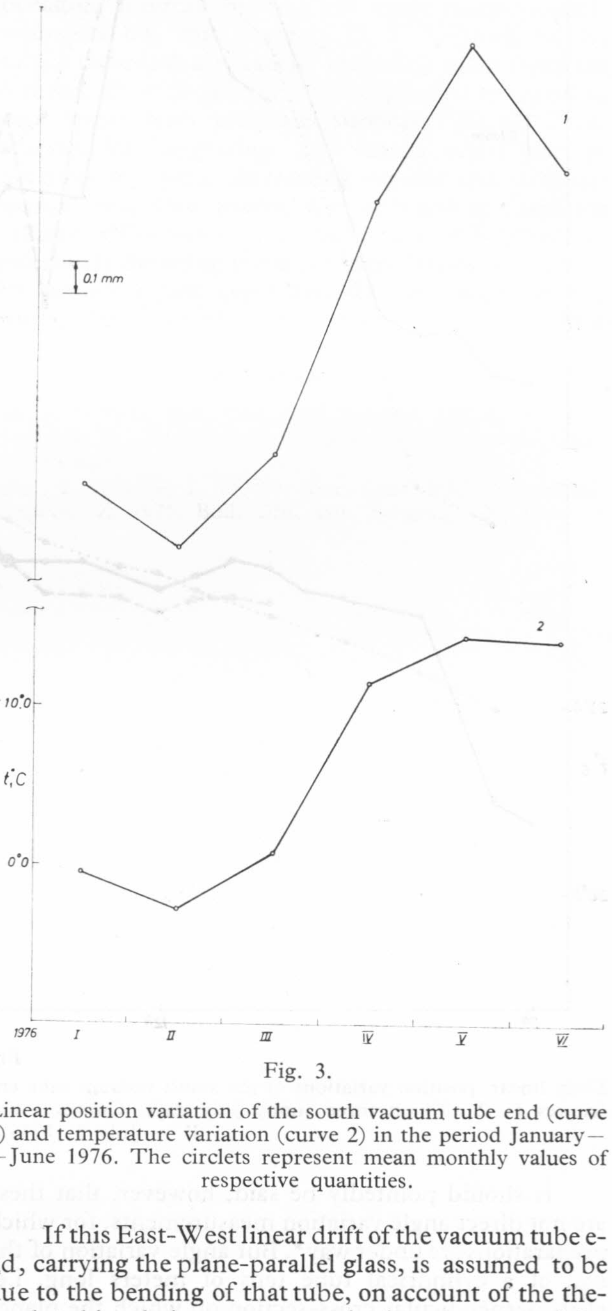

Fig. 3.
Linear position variation of the south vacuum tube end (curve 1) and temperature variation (curve 2) in the period January—June 1976. The circlets represent mean monthly values of respective quantities.

If this East-West linear drift of the vacuum tube end, carrying the plane-parallel glass, is assumed to be due to the bending of that tube, on account of the thermal and insolation assymetrny in the tube, around the nearest (4 m distance) of the tube supporting pillars — one of several plausible presumptions, but the least favourable of them all, -whereby the minutness of the drift should be kept in mind, then even the maximum diurnal drift yet found, by the harshest outdoor conditions: clear July day, with temperature rising to 30° C or more, is about +1 arc minute. But this is just the tolerance drift. Ordinarily the tube end drift is hardly noticeable, or a few tenths of millimetre, which is safely below the tolerance limit.

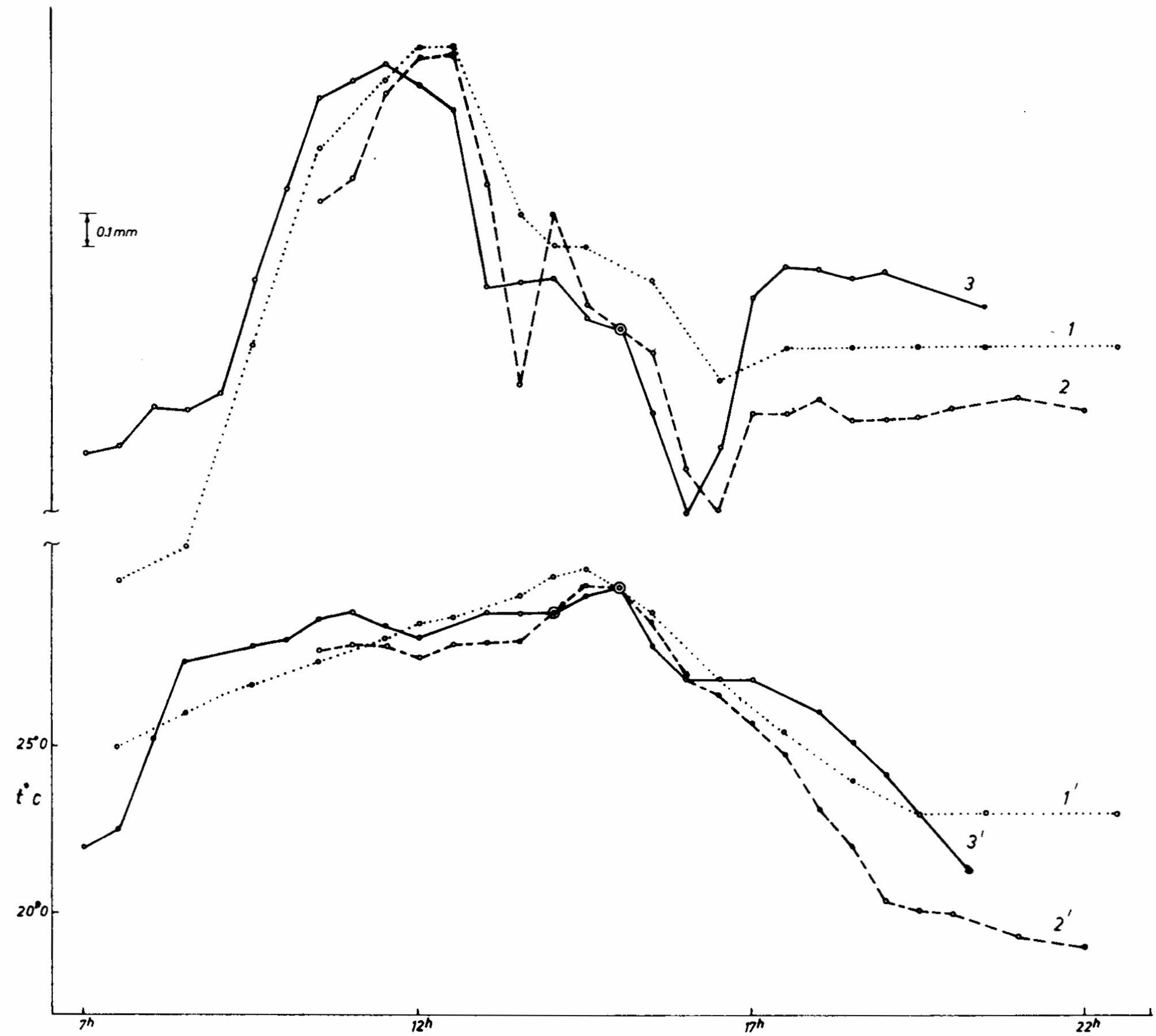

Fig. 4.

Daily linear position variations of the south vacuum tube end (curves 1, 2, 3) and respective daily temperature variations (curves 1', 2', 3') on three sunny July days. Curves 1 and 1' — July 18, 1975, curves 2 and 2' — July 4, and curves 3 and 3' — July 5, 1976). Measurements: L. A. Mitić.

It should pointedly be said, however, that these are not direct angle variation measurements, for which preparations are under way*. But angle variation of the end of a cylindrical tube tens of meters long, i.e. of its perpendicular cross-section on which the plane-parallel glass is fixed, cannot proceed without bending of that tube as a whole, with consequent linear drift of that tube's end, and it is just what we have systematically measured and have found these reassuring results.

This stability of the vacuum tubes, proved manyfold during last two years, is explanable by the following facts: the rigidity of the tubes and their great weight, (the latter is essential against wind), about 4 tons, resulting from their 7 mm thick walls made of steel; the tube diameter is large, 30 cm., which in itself has a bending-opposing effect; relatively good thermal conductivity of steel, conditoning a relatively good temperature equalisation. As a matter of course the tubes are all the length protected against direct insolation and precipitations by meteorological-type covering, allowing at the same time free airing. The supporting pillars of the tubes are themselves mounted also as firmly as possible.

Further improvement of the stability of the tubes is expected after supporting pillars are also provided with insulation shield and the tubes end

* Meanwhile direct angle variations measurements were commenced. They prove definitely daily variations to be below 1 arc minute.

within pavilion are coated by a protecting film, reflecting light and thermal radiation.

Although these investigations have to be supplemented by further studies of all the components playing their part in the complex, and the whole system has yet to be apllied to actual astronomical observations, of which daily observations are of particular interest, there is still a multitude of facts, accumulated in four yers or so, which indicate that two essential questions connected with vacuum meridian marks have already found their positive answers: a) the question of the permanent steadiness of the mark image, alloving maximum internal precision of mark readings, and b) the question of the sufficient position stability of the vacuum tubes, i.e. of the plane-parallel glasses, securing external precision of the mark readings.

It is with pleasure that we record our thanks to collaborators of the Pulkovo Observatory: prof. A. A. Nemiro, who has displayed a constant, encouraging interest in, and has made many valuable comments on, this project; D. S. Usanov, for his skilled technical assistance, including manufacturing of three, all with different foci, high quality meridian mark lenses with adequate supports: K. N. Tavastsherna for suggesting, and taking active part in execttion of, some interesting experiments with our vacuum meridian marks. We wish also to thank the Pulkovo Observatory for supporting this project by generously donating the three mark lenses, wherewith the project could constructively be completed and consequently actual investigations could be started.

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Bull. Obs. Astron. Belgrade, № 128

PRELIMINARY RESULTS OF THE COMPARISON OF THE AGK3 CATALOGUE WITH THE GENERAL CATALOGUE OF LATITUDE STARS AND OBSERVATIONAL DATA FROM ZENITH-TELESCOPES AND PHOTOGRAPHIC ZENITH TUBES

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Presented at 16 General Assembly of the IAU, France, Grenoble, August 1976, Commission 8

(Positional astronomy)

SUMMARY:

Preliminary results are presented of the analysis of systematic errors of declinations and proper motions in declination of the AGK3 catalog, The analysis was made by comparison with the General Catalogue of Latitude Stars and with the data of latitude observations with the ZT and PZT at a number of observatories during last IO-15 yr. A brief characteristic of the compared catalogues is given.

1. Introduction

The purpose ot the present paper is to report the preliminary results of a comparison (using declinations only) of the AGK3 catalogue with the General catalogue of latitude stars (GCLS) [1] and declinations obtained from observations with visual zenit-telescopes (ZT) and photographic zenith-tubes (PZT) at a number of observatories during the last 10—15 yrs. It is believed that the results will permit the estimation of systematic errors of the AGK3 catalogue, with particular reference to $\Delta\delta_\alpha$, while latitude observations are nearly free from these errors.

2. Characteristics of the Catalogues compaired

The AGK3 catalogue is widely used for different astronomical studies. Particularly, the application of homogeneous positions and proper motions of the catalogue could be of great use for reduction of minor planets photographic observations in order to determine orientation elements of star catalogues. Mean epoch of observations of the AGK3 catalogue is 1958.95, mean errors of declinations and annual proper motions in declinations are as follows: $\varepsilon_\delta = \pm 0''21$, $\varepsilon_\mu = \pm 0''010$.

The General catalogue of latitude stars (GCLS) [1] has been compiled recently in the FK4 system on the base of 87 meridian catalogues at the Belgrade astronomical observatory. It containes 3895 stars of the ZT and PZT programs in the declination zone 13° to 86°. The mean epoch of observations is 1954.44, mean errors of declinations of annual proper motions are $\varepsilon_\delta = \pm 0''06$, $\varepsilon_\mu = \pm 0''005$ respectively.

The number of the stars common to AGK3 and GCLS is 3777. Practically, all the stars of the ZT and PZT programs for the northern hemisphere are in AGK3. In rare instances when a star was absent from AGK3, declinations and proper motions of GCLS were used for the comparison with the latitude observations data.

3. Preliminary Results of the Catalogues comparison

Declination differences and those of annual proper motions of stars of the compared catalogues (GCLS—AGK3) were represented by trigonometric series of the type:

$$\Delta_\delta = K_0 + A_1 \sin\alpha + B_1 \cos\alpha + A_2 \sin 2\alpha + B_2 \cos 2\alpha + A_3 \sin 3\alpha + B_3 \cos 3\alpha$$

$$\Delta_\mu = K'_0 + A'_1 \sin\alpha + B'_1 \cos\alpha + A'_2 \sin 2\alpha + B'_2 \cos 2\alpha + A'_3 \sin 3\alpha + B'_3 \cos 3\alpha$$

Coefficients of the series $\Delta\delta$ and $\Delta\mu$ are given in 0''.001 and 0''.0001 respectively in Tables I and 2. Mean errors of the coefficients, mean errors of the weight unit (one difference) (ε) and the number (n) of common stars of the catalogues for each declination zone are also given in the tables.

Declination diferences of the AGK3 catalogue were analysed similarly, as well as those obtained from latitude observations. The results of the analysis of Δ_δ for ZT and PZT are given in Tables 3 and 4 respectively. The data in Tables 1–4 are presented for the epoch 1950.0.

4. Conclusions

The analysis of the preliminary results of the comparison of the AGK3 and GCLS catalogues, ZT and PZT programmes shows that systematic errors of the AGK3 catalogue are sufficiently small. A more detailed study of the $\Delta\delta_\alpha$ systematic errors of the AGK3 catalogue with the aim of reducing star declinations of all the latitude programmes to one system will be carried out in the near future.

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Table 1

Declination	K_0	A_1	B_1	A_2	B_2	A_3	B_3	ε	n
	55	−71	−79	−43	−15	−23	−11		
13°–30°	±13	±18	±18	±18	±18	±18	±18	238	353
	5	−78	−41	46	−26	−44	−13		
30°–40°	±10	±14	±15	±14	±14	±14	±15	258	650
	−13	−62	−40	23	19	−93	−13		
40°–50°	±10	±13	±14	±14	±13	±13	±14	275	848
	−53	−7	−44	99	66	60	−6		
50°–60°	±7	±10	±10	±10	±10	±10	±10	250	1303
	−44	−7	−64	−47	−7	−14	34		
60°–70°	±12	±18	±17	±17	±17	±17	±17	252	443
	−3	−116	−206	−158	−58	−4	148		
70°–90°	±22	±31	±31	±31	±31	±31	±31	180	290
	−23	−40	70	28	15	−51	7		
13°–90°	±4	±6	±6	±6	±6	±6	±6	271	3777

Table 2

Declination	K_0	A_1	B_1	A_2	B_2	A_3	B_3	ε	n
	28	−12	19	−17	7	8	−16		
13°–30°	±11	±11	±11	±11	±11	±11	±11	143	353
	−1	−17	40	25	1	−14	−1		
30°–40°	±5	±7	±8	±7	±8	±7	±8	135	650
	−1	−26	38	39	23	−47	−12		
40°–50°	±7	±10	±10	±10	±10	±10	±10	204	848
	−24	2	2	61	41	−23	−15		
50°–60°	±5	±7	±7	±7	±7	±7	±7	171	1303
	−9	−1	85	−24	−19	−26	37		
60°–70°	±8	±12	±11	±12	±11	±12	±12	170	443
	−4	−67	121	−74	−42	−0	35		
70°–90°	±15	±21	±21	±21	±21	±21	±21	194	290
	−9	−11	35	25	13	−22	−1		
13°–90°	±3	±4	±4	±4	±4	±4	±4	178	3777

Table 3

Observatory mean epoch of observations	K_0	A_1	B_1	A_2	B_2	A_3	B_3	ε	n
Belgrade I	−369	−245	−32	24	−61	41	−30		
1953.00	±47	±66	±66	±66	±66	±65	±67	396	146
Belgrade 2	3	34	−38	13	18	123	−26		
1971.38	±43	±61	±61	±60	±62	±50	±88	328	116
Blagovestchensk	−100	−46	−120	161	−7	67	−27		
1964.64	±58	±82	±82	±81	±83	±83	±81	569	190
Borowiec	228	326	−24	−307	153	131	146		
1965.60	±67	±106	±116	±143	±43	±112	±92	111	64
Warsaw	−113	53	53	−17	41	3	−8		
1966.50	±30	±43	±42	±44	±42	±43	±43	254	144

Observatory mean epoch of olservations	K_0	A_1	B_1	A_2	B_2	A_3	B_3	ε	n
Irkutsk	404	336	205	122	320	267	62		
1964.50	± 77	±123	±135	±165	± 76	±129	±107	128	64
Kazan	149	116	− 22	− 59	58	−149	− 51		
1964.50	± 19	± 27	± 28	± 31	± 24	± 27	± 28	48	64
Moscow	− 94	131	76	34	10	25	8		
1959.12	± 30	± 42	± 42	± 42	± 42	± 42	± 42	361	294
SIL	− 77	52	14	8	92	− 2	105		
1970.00	± 46	± 64	± 65	± 65	± 64	± 65	± 64	384	142
Poltawa I	− 46	− 67	− 30	−245	− 6	34	134		
1955.65	± 57	±229	±139	±247	± 79	±237	±132	146	64
Poltawa 2	1	−107	− 90	− 65	5	−117	71		
1963.00	± 54	±126	±125	±168	± 57	±126	±125	305	64
Pulkovo 1	21	− 26	69	− 84	31	− 18	− 5		
1952.30	± 31	± 44	± 43	± 43	± 44	± 44	± 43	312	206
Pulkovo 2	6	− 45	75	− 71	32	15	3		
1958.30	± 30	± 43	± 43	± 43	± 43	± 43	± 43	308	206
Pecny	− 92	− 4	− 82	177	64	− 53	170		
1965.70	± 54	±136	±139	±186	± 56	±139	±139	314	70
Ulan Bator	−113	− 52	137	54	− 38	− 60	− 42		
1967.00	± 35	± 46	± 51	± 47	± 50	± 48	± 50	308	164

Table 4

Observatory mean epoch of observations	K_0	A_1	B_1	A_2	B_2	A_3	B_3	ε	n
Washington	− 9	−42	−32	−14	−12	− 4	5		
1954.00	±18	±24	±26	±25	±25	±25	±24	159	90
Greenwich	396	4	84	50	6	−11	20		
1961.50	±18	±23	±27	±24	±26	±24	±25	180	111
Mizusawa	102	26	54	−25	−24	−12	19		
1959.00	±40	±54	±59	±57	±56	±57	±56	362	85
Moscow	81	8	− 5	− 3	53	12	−54		
1964.50	±16	±22	±22	±22	±22	±22	±22	169	119
Neuchatel	11	67	43	47	−34	5	−46		
1956.75	±18	±25	±26	±26	±25	±26	±25	190	103
Ottawa	11	−48	26	−14	26	25	−12		
1964.50	±12	±16	±17	±17	±17	±16	±17	146	156
Potsdam	70	153	−96	6	35	33	− 1		
1958.60	±24	±32	±36	±34	±35	±34	±34	286	146
Richmond	1	−65	74	3	22	−39	12		
1959.50	±20	±26	±31	±29	±29	±28	±30	178	85
Hamburg	−93	−29	51	−11	− 8	1	−19		
1972.50	±12	±17	±18	±18	±18	±18	±18	138	124
Herstmonceux	295	−39	−47	15	−69	−52	− 7		
1971.00	±34	±45	±50	±45	±50	±46	±40	379	134
Tokyo	73	− 8	13	31	5	− 9	48		
1968.50	±23	±29	±35	±30	±33	±31	±32	225	106
The mean		5	6	4	− 3	− 4	11		
weighed		± 3	± 4	± 2	± 2	± 3	± 2		1259

Bull. Obs. Astron. Belgrade, No 128

PROBLEMS OF EARTH'S ROTATION AND ANOMALOUS REFRACTION*

G. TELEKI

(Received August 13, 1976)

SUMMARY

The role is studied of the refraction anomalies in the investigation of the problem of Earth's rotation, and the importance of regional refractional influences is specially emphasised. Proceeding from the analysis of the latitude variations during night at ILS stations (Teleki, 1976), the author points out the need for careful selection of the site for the astrometric instruments.

In the studies of the Earth's rotation an important role is played by the anomalies of the astronomical refraction, so called anomalous refraction. By this we understand the difference between the true value and the values calculated from the refraction tables. What we have in mind is the sum of all discrepances of various origin, bearing sometimes separate denominations.

There have been and there are attempts to determine these anomalies and calculate their effects on astrometrical results because it is beyond any dispute that atmospherical factors and among them anomalous refraction, are affecting our observing data. Most simple are those formal attempts, attributing to the refractional effects all inexplicable discordances in the astrometrical results. No particular analysis stands behind these attempts. Incomporable more serious and founded are the studies which, by using meteorological data, are aimed at calculating refractional effects on the basis of astronomical results themselves. The essential problem in these calculations is the simultaneous dependence of the astrometrical data from other factors, from instrumental factors in the first place. The observing instrument is located within the same field of meteorological elements through which light beam is passing and if the instrument were not specially protected against the changes in that field — as is usually the case, then it is exposed to the influences of the same factors as is the value of refraction. The most correct procedure would be to create possibilities to calculate the anomalous refraction quite independently from the astrometric observational results. However, we are met there by numerous unknowns. We are not able to calculate the total of all influences, so we have to confine ourselves to particular influences, which, obviously, cannot give the anomalous refraction in its entirety. In this the use is usually made of aerological data (from stations near observing sites), direction and speed of wind in the vicinity of the instrument, temperature gradients in the pavilion or around it. But all these sporadic attempts have yielded no satisfactory results, so new ways have to be found.

But pending such results how is one to combat these refraction anomalies? Certainly by precaution measures: by careful selection of the observing sites.

It has repeatedly been emphasised that in the site selection for the astrometric instruments one should be very careful and it has been indicated what kind of instrument's location should be (Teleki, 1974a). The basic requirement is that the density field be as simple as possible. With the transit instrument of N.N. Pavlov in Pulkovo not only has such protection been secured to the utmost, but the instrument itself is shaped in such a way that it is „withstanding" the influence of outside factors. To our knowledge this is rather an exeption, thus the study of the meteorological field around instrument and the possible anomalous refraction is very aggravated. Let us draw your attention to the anomalies studies through many years in Kiew, carried out by Vasilenko (1976). His results reveal a considerable variation of these values, containing anomalies of local as well as regional character as the observations had been extended over large zenith distances.

*Presented to the IAU Commission 19 in Grenoble, 1976.

We would like to draw attention just to these factors, which are not local but are embracing a wide area of the Earth's surface. In connection with this question, valuable information is obtained from the studies of Sugawa and Kikuchi (1974, 1976) of the characteristics of the astronomical refraction in the northern hemisphere. By using data from the aerological stations, the authors were able to study the atmospheric properties in the northern hemisphere and to indicate the possible variations in the value of astronomical refraction. One realizes that on a global scale, even at small zenith distances, refractional anomalies of the order of 0''.01 are possible. These values are variable with the time and from one place to another. It is therefore difficult to ascertain, on the basis of these data only, where to locate and where it is not recommendable to locate astrometric instruments.

Once such a question has been posed — and it must be posed — then the characteristics of the region in which the instrument is to be sited must be taken into account in the first place. Here are results of one of such analyses (Teleki, 1976).

We have studied the latitude variations during night at the stations of the International Latitude Service in the period 1949—1961 and have established the following facts. The Table I gives the latitude

Table I

Mean differences of monthly latitude values of two observation groups. The unit: 0.''001.

Observatory	1949—1954	1955—1961		Mean
	$\Delta\varphi$ (e−m)	$\Delta\varphi$ (e−i)	$\Delta\varphi$ (i−m)	
Mizusawa	0	− 8	− 1	− 3
Kitab	+24	+26	+14	+21
Carloforte	+ 7	− 2	− 4	0
Gaithersburg	−15	− 2	+ 1	− 5
Ukiah	−20	− 7	−14	−14

variations during night from the mean values of the evening (e), intermediate (i) and morning (m) groups in 0''.001 units. Standing out are relatively large variations in Kitab and Ukiah and, moreover, they have opposite signs. The question has been posed what is the explanation of this. It could be stated (Sugawa et al., 1972) that rahter great changes in the observing conditions take place during night in Kitab and Ukiah. We therefore made efforts to familiarize ourselves with as many meteorological factors, connected with these localities, as possible. The Figure 1. shows the map

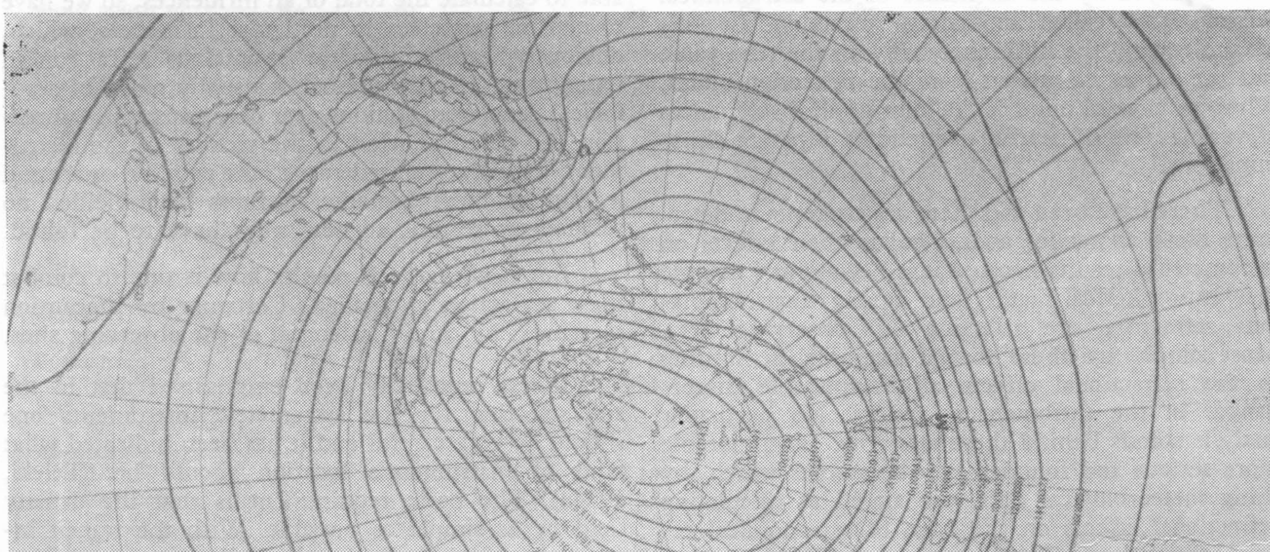

Fig. 1.

Yearly mean values of air temperature and density, over the northern hemisphere, at 850 mb level (Hanevskaya, 1964).

(Hanevskaya, 1974) of the average annual temperature and density above the northern Earth's hemisphere, at 850 mb (about 1.5 km above the soil). Significant deformation of the density field near Ukiah and somewhat lesser near Kitab are evident, while the rest of the ILS stations do not show such variations. The next Figure 2 (Bean et al., 1966) shows the regions which are — to term them simply — radiorefractionally perturbed zones. Kitab and Ukiah are belonging to these zones. Furthermore: in the Northern Pacific the phenomenon of subrefraction is frequently occuring (at times when the gradient of variation of refractive index by height has a large negative value) while in the desert areas south and east of Caspian Sea there is a superrefraction (the gradient is zero or a positive value). Ukiah lies near or within the first zone and Kitab is in the second. It is difficult to find out whether or not these two stations are placed exactly within the two specified zones but it is quite real to assume their being under the influence of these zones. If so, then a diminished refractional influence is to be expected in Kitab and an increased one in Ukiah. Unfortunately there are no informations on hand about the changes of the meteorological elements during night when astronomical observations are being made.

This question requires more detailed study but, in all likelihood, we might draw the conclusion that Kitab and Ukiah are placed in the fields of meteorological elements such that: first, they are essentially different from those of other ILS stations and, second, the influences in Ukiah and Kitab are disparate among themselves. Such a field is exercising an influence not only on refraction value but on the instrument as well, and it is therefore difficult to substantiate the character of latitude variations in Ukiah and Kitab.

From this analysis it appears that we have an additional confirmation of the need to select with equal care the observing sites both for astrometric as well as for astrophysic stations. This is what we would like to emphasize in particular.

How are to be conducted further analysis of the refractional anomalies and of factors originating them? Surely by continuing current investigations but endeavouring to create an entirety, to extract a composite influence of various factors. As a novelty one

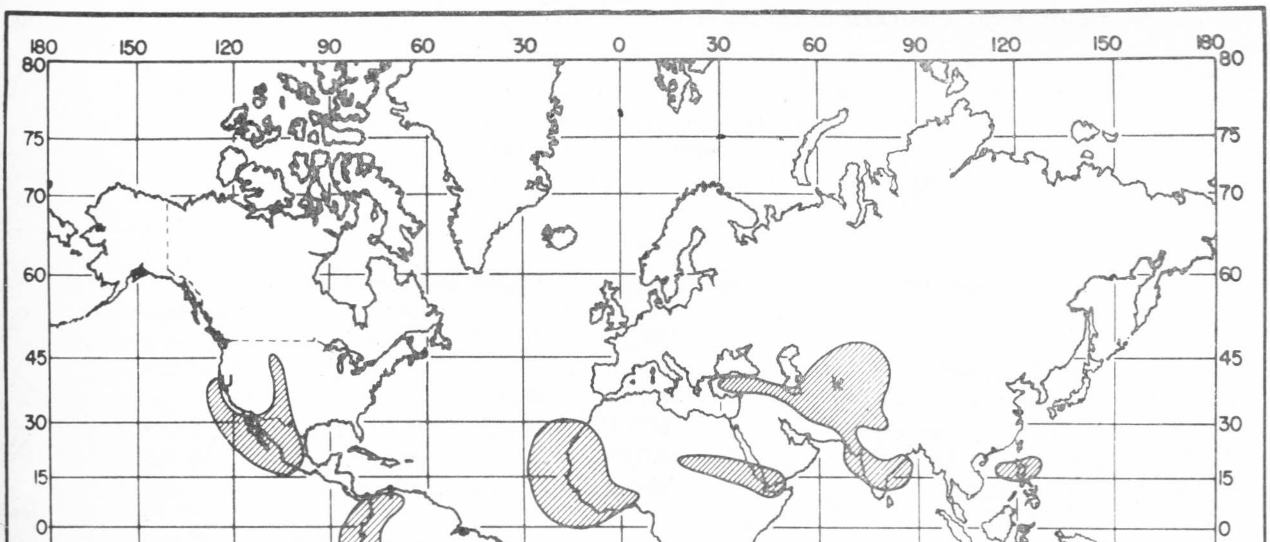

Fig. 2.

Areas of doubtful applicability of using surface monthly mean value of radiorefractivity (N) to predict the monthly average gradient of N over the firts km above the surface (Bean te al., 1966, p. 62).

might try to utilize the results of measurements by the meteorological satellites (Teleki, 1974b). In fact, the data from satellites can yield useful evidence about the atmosphere as a whole along with the vertical profile of the atmospheric temperature, but they can also be utilized in the comparison of the astrometric results acquired at various stations. The question arises, however, what are possibilities of the application of the geodetic dispersion method in astrometry (Tengström, 1968) — i.e. the observations of the same object through different filters — but it would not ne useless to study in detail that method also.

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LES ORBITES DE DEUX ETOILES DOUBLES VISUELLES

V. ERCEG

(Reçu le 15 juin 1976)

RÉSUMÉ

On a donné les éléments des orbites, les quantités astrophysiques et les parallaxes dynamiques pour les étoiles doubles visuelles ADS 1227 et ADS 1530.

En utilisant la méthode de Thiele – Innes- Van den Bos (1926) on a determiné les éléments des orbites pour les étoiles doubles visuelles ADS 1227 et ADS 1530. Sur la base des orbites, on a calculé les parallaxes dynamiques, les magnitudes absolues et les masses des composantes (Parenago, 1938). Pour l'étoile double ADS 1227 on a calculé les éphémérides des vitesses radiales relatives.

Dans les Tableaux I on donne les éléments orbitaux, les constantes de Thiele-Innes, les parallaxes dynamiques, les magnitudes absolues et les masses des composantes.

Dans les Tableaux II od donne les éphémérides des angles de position et de la distance. Dans le Tableau II, pour ADS 1227 on donne aussi les éphémérides de la vitesse radial relative.

Dans les Tableaux III on donne les observations, les abréviations des nomes des observateurs, les nombres des observations, les références te les résidus.

ORBITE DE ADS 1227 = A 1913 AB
Pos. (1950) $1^h\ 31^m.6$; $+34°\ 24'$
Mgns. 9.5 – 9.5; Type sp. G5

Tableau I

Les éléments orbitaux, les quantités astrophysiques et les constantes

P = 96.10 ans		
n = 3°.7462	A = +0″.0825	
T = 1982.14	B = +0.0975	π_{dyn} = 0″.008
e = 0.67	F = +0.1548	$M_A = M_B = 3.9$
a = 0″.217	G = −0.1550	$\mathfrak{M}_A = \mathfrak{M}_B = 1.26\ \odot$
i = 125°.46	C = ±0.1763	a = 28.3 U.A.
Ω = 132°.52	H = ±0.0129	
ω = 85°.80		
T = 1977.39; 1987.80		
V_r = ±9.7; ∓8.8		

Tableau II

Les éphémérides

t	Θ°	ρ″	V_r kms^{-1}
1976.0	139.6	0.13	± 9.5
77.0	134.7	12	± 9.5
78.0	128.7	11	± 9.6
79.0	120.8	9	± 9.1
80.0	109.3	7	± 7.9
81.0	90.1	6	± 5.4
82.0	55.7	4	± 1.7
83.0	14.1	5	∓ 2.3
84.0	347.5	6	∓ 5.4
1985.0	332.7	0,08	∓ 7.3

Tableau III

Les observations et les résidus

	t	Θ°₀	ρ″₀	Obs.	n	Références	(O−C)°Θ	(O−C)″ρ
1.	1908.87	267.9	0.22	A	3	ADS	− 3.5	+0.01
2.	1920.68	247.0	22	A	3	ADS	− 5.0	0
3.	1930.29	237.5	20	VBs	2	Publ. Yerk. Obs. Vol. VIII, Part II.	+ 1.3	− 2
4.	1934.09	242.9	23	A	2	La corresp. pers. Obs. de Nice.	+13.2	+ 2
5.	1948.78	205.8	18	VBs	2	Publ. Yerk. Obs. Vol. VIII, Part VI.	+ 2.0	− 2
6.	1958.657	182.3	20	B	3	Publ. Yerk. Obs. Vol. IX, Part I.	− 2.5	0
7.	1961.73	181.5	0.18	Cou	2	J.O. Vol. 45. N. 9, 1962.	+ 2.9	−0.01

ORBITE DE ADS 1530 = A 2407
Pos. (1950) $1^h\ 52^m.8$; +24° 43′
Mgns. 9.2−11.2; Type sp. KO

Tableau I

Les éléments orbitaux, les quantités astrophysiques et les constantes

P = 168.46 ans		
n = 2°.1370	A = +0″.4400	π_{dyn} = 0″.018
T = 2061.75	B = +0″.2690	M_A = 5.4
e = 0.35	F = −0″.2400	M_B = 7.4
a = 0″.622	G = +0″.5600	$\mathfrak{M}_A$ = 1.10 ☉
i = 36°.70	C = ∓0″.3486	$\mathfrak{M}_B$ = 0.68 ☉
☊ = 96°.69	H = ±0″.1289	a = 28.4 U.A.
ω = 290°.29		
T☊☋ = 1910.33; 2010.36		

Tableau II

Les éphémérides

t	Θ°,	ρ″
1976.0	209.5	0.69
77.0	210.8	70
78.0	212.1	70
79.0	213.3	70
80.0	214.6	70
81.0	215.9	70
82.0	217.1	70
83.0	218.0	70
84.0	219.6	71
1985.0	220.4	0.71

Tableau III

Les observations et les résidus

	t	Θ°₀	ρ″₀	Obs.	n	Références	(O−C)°Θ	(O−C)″ρ
1.	1912.74	103.7	0,53	A	3	ADS	+ 0.3	+0.02
2.	1919.88	117.6	53	A	2	ADS	− 1.6	− 2
3.	1939.730	158.6	56	VBs	1	Publ. Yerk. Obs. Vol. VIII, Part VI.	+ 2.9	− 5
4.	1940.676	159.5	55	VBs	1	,,	+ 2.2	− 5
5.	1941.906	158.8	62	VBs	1	,,	− 0.5	+ 1
6.	1948.786	160.2	74	VBs	1	,,	−10.2	+ 11
7.	1951.42	171.1	63	VBs	1	,,	− 3.5	0
8.	1950.930	177.4	78	MRZ	3	Publ. Nav. Obs. Vol. XVII, Part V.	+ 1.0	+ 15
9.	1951.920	174.5	69	MRZ	1	,,	− 2.5	+ 6
10.	1955.026	184.7	56	Cou	1	J.O. Vol. XXXVIII. N. 9, 1955.	+ 5.0	− 8
11.	1958.06	178.2	54	VBs	4	La corresp. pers. Obs. de Nice.	− 6.4	− 11
12.	1960.77	190.0	67	Wor	4	Bull. Lick Obs. N. 576.	+ 1.4	+ 1
13.	1961.758	189.6	55	Wor	3	Publ. Nav. Obs. Vol. XVIII, Part VI.	− 0.4	− 11
14.	1963.85	191.8	0.74	VBs	2	Contr. Kitt Peak N.O. N. 180.	− 1.2	+0.08

LITTÉRATURE:

Bos, W., H., 1926, U.O.C., 68.
Parenago, P., P., 1938, Kurs zvezdnoj astronomiji, 154.

THE ORBIT OF THE VISUAL DOUBLE STAR COU 79

(BD +24° 329, Mg. 6.5−6.8)

D. OLEVIĆ

SUMMARY:

The orbital elements and the residuals of COU 79 are given.

For the first time eliptical orbital elements of this pair have been computed on the basis of observations (Table 1) by using Thiele Innes — Van den Bos method.

The data used have previusly been corrected by the Ines method (1936).

By applying Parenago's equation (1951) the mass, absolute brightness and dynamical paralax of the system are derived from the computed elements.

Table 2 contains ephemeris up to 1982.

Acknowledgements I am obliged to Dr. P. Couteau, discoverer of this pair, who kindly put at my disposal the observations of this pair.

REFERENCES:

Aitken G.: 1963, The binary Stars

Parenago P. P.: 1951, Trudy GAIŠ, 20.

ELEMENTS

P	$18^a.614$	A	− 0″.09775	π_{dyn}	0″.0146
n	19°.3400	B	− 0″.07825	a	10.82 AU
T	1958.725	F	− 0″.03625	M_A	2.33
e	0.616	G	+ 0″.13500	M_B	2.63
a	0″.158	$t_{\Omega,\mho}$	1961.506, 1976.671	$\mathbf{M}_A$	1.88 ☉
i	130°.1	G	± 0.09606	$\mathbf{M}_B$	1.74 ☉
Ω	78°.9	H	± 0.07325		
ω	232.°7				

Table 1.

t	Θ	ρ	Obs.	n	(O−C)	
1965.91	49°.7	0″.25	C	5	− 0°.8	+0″.04
1966.11	50.7	0.23	Hz	4	+ 1.3	+ 2
1967.07	39.5	0.19	C	4	− 4.7	− 2
1967.85	39.3	0.21	C	5	− 0.4	+ 1
1967.94	41.6	0.21	Wor	?	− 2.6	+ 1
1968.95	40.5	0.20	Hz	3	+ 7.6	+ 1
1968.95	33.6	0.20	C	5	+ 0.7	+ 1
1969.80	25.4	0.19	C	3	− 1.6	+ 1
1969.95	23.8	0.18	C	3	− 2.0	0
1970.85	17.8	0.16	C	3	− 0.6	0
1970.87	20.6	0.17	C	3	+ 2.4	+ 1
1970.72	25.*)	pas ronde	Mul (0″.15)	?	+ 5.4	—
1971.76	8.2*)	0.17	Mul	?	− 1.3	+ 2
1971.83	22.0*)	0.14	Mul	?	+13.3	− 1
1971.89	13.1	0.15	C	3	+ 5.0	0
1971.94	9.9	0.14	C	4	+ 2.4	− 1
1972.86	0.5	0.14	C	5	+ 4.6	+ 1
1972.94	357.2	0.12	C	6	+ 2.4	− 1
1973.94	333.5	0.12	C	3	− 4.8	+ 1
1974.919	319.0	0.10	C	1	+ 1.6	0

*) Quadrant reversed

Table 2.

Ephemeris

t	Θ	
1975.00	315°.5	0.″10
1976.00	287.9	0.09
1977.00	246.3	0.06
1978.00	137.0	0.05
1979.00	94.5	0.11
1980.00	80.1	0.15
1981.00	71.3	0.18
1982.00	64.6	0.20

Bull. Obs. Astron. Belgrade, No 128

RECTILINEAR ORBIT OF THE PAIR ADS 12040 = Σ2454

Mgn. 8.5–9.7, Sp. KO

D. OLEVIĆ

SUMMARY:

Rectilinear trajectory of the pair ADS 12040 is given.

By analysing the graphs $\rho = \rho(t)$ and $\Theta = \Theta(t)$ representing the data of the Table 1. it is inferred that the observations could best be satisfied for the time being by a rectilinear obrit. Owing to the shortness of the arc covered by observations and large accidental errors of the first measures of the pair, a second order orbit could barely be determined with any noteworthy certainty.

In view of the above stated 9 new normal places Table 2. have been deduced from the Table 1., out of wich parameters a, m, Φ and T_0 of the rectilinear orbit have been computed (Aitken, 1963) and equations (1) and (2) of the rectilinear motion derived .

$$\rho^2 = 0''.697225 + 0''.000056235\,(t-1882.16)^2 \quad (1)$$

$$\mathrm{tg}\,(\Theta - 237^\circ.7) = 0.008981\,(t-1882.16) \quad (2)$$

or

$$\rho \sin(\Theta - 237^\circ.7) = 0''.007499\,(t-1882.16) \quad (3)$$

$$\rho \cos(\Theta - 237^\circ.7) = 0''.835000 \quad (4)$$

In Table 3. ephemeris are given up to 1984.0 using 2 years intervals.

It is to be indicated that eliptical elements of this pair have been published by Baize, 1975 ($P = 687^a$).

In Table 2. residuals are given of the rectilinear orbit present paper as well as of the eliptic orbit for the same normal places.

Table 1.

t	Θ	ρ	n	Obs.	References
1831.50	204°.0	0''.75	3	STT	ADS
1835.5.	204.0	0.75	3	STT	BDS
1843.76	208.1	0.6.	2	Ma	,,
1843.76	219.3	0.90	3	STF	,,
1865.32	226.0	1.02	2	D	,,
1869.64	235.1	0.88	2	STT	,,
1875.89	235.0	0,8±	4	Sp	,,
1879.62	230.4	0.80	3	Hl	,,
1881.59	231.7	0.70	2	Ho	,,
1883.39	243.6	0.85	8	En	,,
1883.63	233.6	0.78	3	Per	,,
1884.67	233.8	0.76	3	Hl	,,
1885.54	233.6	0.81	2	Per	,,
1888.61.	234.4	0.94	5	STH	,,
1894.13	241.5	0.69	3	Com	,,
1895.11	243.6	0.87	3	Sp	ADS
1895.59	243.7	0.7±	2	Gla	BDS
1903.57	246.6	0.91	2	Do	,,
1904.48	250.4	0.91	11	A2, GrO9	ADS
1910.91	253.4	0.88	19	Dob 3, Doo4, Al, GrO11	ADS
1915.85	252.7	0.96	7	Fox3, Dob2, Ly2	,,
1918.16	255.6	0.74	12	Com	,,
1922.19	257.1	0.82	12	B4, Chan4, GrO4	,,
1925.62	258.4	0.93	1	Plq	,,
1946.805	271.6	0.82	3	Ly	Publ. U.S.O. **17**, II
1948.701	268.08	1.184	5	R	Veröf., B. 6, 1961
1949.731	267.64	1.131	6	R	,,
1951.697	268.63	1.205	8	R	,,

t	Θ	ρ	n	Obs.	References
1953.550	274.2	0.83	1	Arend	A.O.R. Belgique, 9, 3, 1963
1953.69	270.3	0.98	3	Baize	J.O. **37,** 7–8
1954.680	269.92	1.064	8	R	Veröf. Munchen. **6.** 1961
1955.476	268.4	0.81	2	Arend	Annal. O. Roy. Belg., **9.** 3
1955.62	270.9	1.01	3	Worley	Lick. O., **553**
1955.708	270.71	0.99	8	R	Veröf. St. Munchen, **6,** 1961
1956.733	271.10	1.106	6	R	,,
1957.490	270.1	1.06	4	V. Bos	Lick. O., **558**
1957.580	268.3	0.95	2	Arend	Ann. Obs. Roy. belg., **9,** 3
1957.739	270.58	1.096	7	R	Veröf. St. Munch., **6,** 1961
1958.600	273,9	1.12	3	V. Bos	Publ. Yer. O., **9,** p. 1
1959.32	271.7	1.08	7	Hertz	A. N., **285,** 1959, 60
1959.76	274.5	1.22	3	Werley	Lick. O., **564**
1961.55	273.7	1.15	4	Heinz	J. O., **46,** 1, 1963
1963.318	272.5	0.93	6	V. Bos	A. J., **1313**
1963.57	271.5	1.07	2	Dj, Dz	Bullten A. O. Beograd, **26,** 1, 1967
1963.71	274.8	1.12	3	Baize	J. O. **48,** 1, 1965
1965.802	276.4	1.08	4	Walker	Publ. U. S. Naval. Obs., **18,** 4, 1966
1965.81	275.1	1.17	3	Baize	J. O., **50,** 1967
1966.45	276.1	1.09	3	Morel	J. O., **51,** 4, 1968
1966.547	276.0	1.09	3	Walker	Publ. Naval Obs., **22,** 1
1966.74	275.1	1.21	3	Heinz	J. O., **50,** 4, 1967
1975.653	277.0	1.05	3	GP	Bull. A. O. Beograd, **128**

Table 2.

t	Θ1900	ρ	Baize, 1975	O−C	Olević, 1975		n
1836.92	208°.4	0.″80	+2°.5	−0″.01	−6°.9	+0″.10	9
1867.48	230.4	0.95	+3.9	+0.13	−1.6	+0.11	4
1884.16	236.2	0.83	−0.8	−0.03	−2.5	−0.01	26
1901.01	247.5	0.87	+0.8	−0.04	+0.2	+0.02	19
1914.11	253.4	0.85	0.0	−0.10	−0.3	−0.02	38
1924.83	259.0	0.89	+0.6	−0.10	+0.3	0.00	17
1949.81	268.9	1.12	+0.3	+0.03	0.0	+0.14	22
1959.50	272.5	1.08	+0.4	−0.06	0.0	+0.06	59
1975.65	277.0	1.05	+0.3	−0.15	−0.7	−0.04	3

Table 3.

EPHEMERIS

t	Θ	ρ
1976.0	277°.8	1″.09
1978.0	278.4	1.10
1980.0	279.6	1.11
1982.0	279.6	1.12
1984.0	280.1	1.13

REFERENCES:

Aitken, G.: 1963, The Binary Stars p. 122
Baize, P.: 1975, Circulaire UAI, Comm. 26, **67**

Bull. Obs. Astron. Belgrade, No 128

ORBITS OF TWO VISUAL BINARIES

D. J. ZULEVIĆ

(Received 10 December 1976)

SUMMARY:

Orbits and dynamical parallaxes are presented for two visual binary systems: ADS 11247, and ADS 15530. Calculated positions are compared with observations and ephemerides are given for each system.

Orbits for two visual binaries have been computed using the methods of Thiele-Innes. Precessional corrections for the year 1950 were applied to the position angles of all the observations. Dynamical parallaxes were computed by the method of Baize and Romani (1946) with magnitudes and spectral types taken from the Lick Index Catalogue of Visual Double Stars, 1961.0 (1963). The relevant information is given in Table I.

For calculating the orbits the observational data (Table III) of the following authors are used: A (1932), COU (1972), MRZ (1956), MUL (1954), VBs (1954, 1960, 1966), Van den Bos (1960) and Wilson (1954).

Table I

Elements Campbell and Thiele-Innes

ADS	11247		15530	
IDS	18148N4348		21559N4839	
Disc.	A 578		HU 774	
Vis. mag.	9.2–9.9		8.2–8.2	
Sp. type	—		Ao	
P(yr)	249.83	A = + 0″.26000	215.17	A = – 0″.14000
n	1.4410	B = 0″.00000	1.6731	B = – 0″.11250
T	1921.30	F = 0″.00000	1943.36	F = + 0″.14900
a	0″.26	G = – 0″.26000	0.20	G = – 0″.10575
e	0.00	C = 0″.0	0.16	C = ± 0″.12455
i	0°.0	H = 0″.0	41°.0	H = ± 0″.11655
ω	0°.0		226°.8	
Ω	0°.0		0°.0	
πdyn	0″.004		0″.003	
Σ Mass	3.7 ☉		6.2 ☉	

Table II

Ephemerides

T	ADS 11247 P	ADS 11247 ρ	ADS 15530 P	ADS 15530 ρ
1977.0	279°.7	0″.26	307°.4	0″.16
78.0	278.3	0.26	309.4	0.16
79.0	276.9	0.26	311.5	0.16
80.0	275.4	0.26	313.5	0.16
81.0	274.0	0.26	315.4	0.17
82.0	272.5	0.26	317.3	0.17
83.0	271.1	0.26	319.1	0.17
84.0	269.6	0.26	320.8	0.17
85.0	268.2	0.26	322.6	0.18

Table III

Observations and residuals

ADS 11247	T	P	ρ	mag	n	Obs.	(O−C)Θ	(O−C)ρ
	1903.60	28°.4	0″.22	8.5−9.2	4	A	+ 2°.9	−0″.04
	17.66	5.2	0.27		3	A	0.0	+0.01
	21.52	352.6	0.30		2	A	− 7.1	+0.04
	41.88	328.5	0.26	9.2−9.7	3	VBs	− 1.8	0.00
	53.56	344.3	0.24		2	Wilson JR.	+30.8	−0.02
	58.58	305.8	0.24	9.1−9.6	3	Bos	− 0.5	0−.02
	1959.81	308.2	0.26	9.2−9.9	5	VBs	+ 3.7	0.00

ADS 15530	T	P	ρ	mag	n	Obs.	(O−C)Θ	(O−C)ρ
	1904.5	151°.2	0″.20	7.5−7.5	1	Hu	+ 0°.0	+0″.02
	23.29	175.1	0.16		3	VBs	− 5.8	−0.02
	43.75	216.9	0.18	8.1−8.3	3	VBs	+ 0.2	+0.03
	50.79	278.4	0.13	7.5−7.5	1	MRZ	+41.1	−0.01
	51.66	279.9	0.19		1	MRZ	+40.3	+0.05
	52.81	242.6	0.14		1	MRZ	− 0.2	0.00
	53.74	255.8	0.11		3	MUL	+10.5	−0.03
	57.626	round	0.1	8.1−8.3	1	VBs	(256.5	0.14)
	1970.823	283.8	0.12		3	COU	− 9.3	−0.02

REFERENCES:

Aitken, R. G., 1932, New General Catalogue of Double Stars, Washington, **2.**

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Markowitz, W., 1956, Publ. Naval Obs. **17,** Pt 5.

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Van den Bos, W. H., 1960, Publ. Yerkes Obs., **9,** Pt 1.

Wilson, JR., 1954, Astron. Journ., **59,** 1.

Bull. Obs. Astron. Belgrade, No 128

NEW DOUBLES STARS DISCOVERED IN BELGRADE WITH THE ZEISS REFRACTOR 65/1055 cm, SUPPLEMENT V

G. M. POPOVIĆ

(Received 2 November 1976)

SUMMARY:

Presented are positions and 60 measures of 31 double stars discovered at Belgrade with the Zeiss refractor 65/1055 cm. The positions are related to the epochs 1900, 1950 and 2000..

This Supplement (Table III) contains results of checking of duplicity of BD stars carried out with the Zeiss refractor 65/1055 cm of Belgrade observatory, acquired mainly in 1975 and 1976. The form in which this supplement appears is identical to that of the previous one (Popović G., 1975). The checking in the declination zones +34° and +35° has been continued but the programme was widened to include declinations outside these zones. The distribution of all pairs carrying the designation GP and GPO (Supplements I—V) by declination zones for the time being is given in Table I.

Table I

Distribution of 126 double stars designated by GP and GPO discovered at Belgrade, according to declination zones

BD +13°	1	BD +37°	2
BD +29°	4	BD +39°	1
BD +32°	2	BD +41°	2
BD +33°	7	BD +42°	3
BD +34°	67	BD +43°	1
BD +35°	27	BD +44°	2
BD +36°	6	BD +47°	1

The distribution of the pairs by ρ in previous supplements and in the present is given in Table II.

Table II

Distribution of the pars by ρ

Suppl.	$\rho < 1''$	$1'' \leq \rho < 3''$	$\rho \geq 3''$	Σ
I—IV	9	27	59	95
V	4	19	8	31
I—V	13 (10%)	46 (37%)	67 (53%)	126 (100%)

The checking program on duplicity of stars in Belgrade is allocated only 1/9 of the total observing time possible with this instrument, the periods of the new moons being completely used by Astrophysical Group.

REFERENCE:

Popović G., 1975: Bull. Obser. Astron. Belgrade, No **126,** pp. 47.

Table III

New double stars

Double star	1900 α 1950 δ 2000	t	Θ	ρ	m	Mgf.	W	BD Δα Δδ	C. I. UAI Comm. 26
GP 124	00367N3952	76.755	25°.1	3″.82	9.5—11.0	700	1+2	+39°159 (9m.0)=ADS 585	–
	00394N4009	76.779	21.7	3.51	10.0—13.0	500	1+1	—7ˢ +10′	
	00421N4025	**76.765**	**23.7**	**3.70**	**9.8—12.0**		**2n**		
GP 125	01429N4145	76.771	48.7	1.25	12.0—12.1	700	2+2	+41°351 (8m.8)	70
	01459N4201	76.777	47.7	1.50	12.0—12.1	590	3+2	+6ˢ 0′	
	01489N4216	**76.774**	**48.1**	**1.39**	**12.0—12.1**		**2n**		
GP 126	03598N4258	76.777	339.0	1.26	11.0—11.2	590	2+2	+42°889 (9m.0)	70
	04032N4307							—4ˢ +1′.5	
	04066N4315								
GP 108	05160N3657	75.167	150.8	2.61	11.0—13.0	700	1+1	+37°1163 (9m.2)	66
	05195N3700							—1ˢ —6′	
	05228N3703								
GP 107	05180N3610	75.166	141.2	2.45	12.0—13.0	590	1+2	+36°1122 (6m.8)	66
	05213N3614	76.772	141.9	2.62	12.0—13.0	700	2+2	—4ˢ +4′	
	05248N3617	**75.969**	**141.5**	**2.54**	**12.0—13.0**		**2n**		
GP 114	06533N1346	76.215	95.8	2.83	12.0—12.7	590	1+1	+13°1501 (9m.5)	69
	06561N1344	76.259	89.1	3.00	12.5—13.0	590	2+1	—3ˢ —1′	
	06589N1339	76.264	86.0	3.10	—	590	1+1		
		76.248	**90.1**	**2.98**	**12.3—12.9**		**3n**		

Double star	1900 α 1950 δ 2000	t	Θ	ρ	m	Mgf.	W	BD Δα Δδ	C. I. UAI Comm. 26
GP 105	07259N3555	75.085	50.2	0.60	9.5 – 9.7	700	2+1	+36°1643 (9m.2)	65
	07292N3549	75.134	47.9	0.60	9.5 – 9.7	700	1+1		
	07325N3542	75.210	43.8	0.51	dm=0.1	590	1+1		
		75.135	**47.7**	**0.57**	**dm=0.2**		**3n**		
GP 109	08042N3500	75.167	23.2	1.56	10.5 – 11.5	590	1+2	+35°1771 (8m.6)	66
	08075N3451							−12s −1′	
	08107N3443								
GP 110	08078N3557	75.167	230.1	3.88	10.0 – 13.0	590	1+1	+36°1767 (9m.5)	66
	08110N3548	75.287	228.8	3.47	10.0 – 13.0	590	1+1	−9s+1′	
	08143N3539	**75.227**	**229.4**	**3.68**	**10.0 – 13.0**		**2n**		
GP 111	08084N3553	75.167	52.4	1.16	9.3 – 9.6	590	2+2	+36°1771 (9m.1)	66
	08116N3544	75.287	55.2	0.83	—	590	1+2		
	08149N3535	**75.218**	**53.6**	**1.02**	**9.3 – 9.6**		**2n**		
GP 106	09158N3338	75.145	67.8	1.29	9.5 – 10.0	420	1+2	+33°1845 (9m.2)	66
	09189N3325	76.259	70.6	1.22	9.8 – 10.6	590	3+2	+47s −3′	
	09219N3313	**75.841**	**69.6**	**1.25**	**9.7 – 10.4**		**2n**		
GP 115	09556N4356	76.259	267.6	1.46	9.5 – 10.0	590	2+2	+44°1943 (9m.4)	69
	09586N4342	76.265	268.2	1.88	dm=2.0	880	2+2		
	10017N4327	**76.262**	**267.9**	**1.67**	**dm=1.2**		**2n**		
GP 116	10057N4252	76.259	249°.8	0.″49	9.0 – 9.0	700	3+3	+43°1996 (9m.2)	69
	10089N4238	76.264	252.4	0.48	—	700	2+2		
	10120N4225	**76.261**	**250.8**	**0.49**	**9.0 – 9.0**		**2n**		
GP 117	10123N4416	76.264	262.9	0.55	8.5 – 9.5	880	3+3	+44°1972 (7m.7)	69
	10154N4401	76.341	262.0	0.61	dm=1.0	700	1+1		
	10185N4346	**76.283**	**262.7**	**0.56**	**dm=1.0**		**2n**		
GP 112	10511N3528	75.303	239.8	1.63	11.0 – 13.0	420	1+2	+35°2195 (9m.1)=ADS 7984	66
	10540N3513							−4s +12′	
	10568N3457								
GP 113	11245N3336	75.304	50.1	1.13	9.0 – 9.3	500	1+2	+33°2119 (9m.1)	66
	11272N3319	75.367	47.7	1.03	9.0 – 9.2	500	1+1		
	11299N3303	**75.329**	**49.1**	**1.09**	**9.0 – 9.2**		**2n**		
GP 119	13187N4101	76.382	11.9	0.53	9.2 – 9.5	590	3+2	+41°2389 (9m.1)	69
	13209N4045								
	13232N4030								
GP 118	15122N4215	76.377	346.4	2.69	9.5 – 9.6	500	2+2	+42°2580 (9m.4)	69
	15140N4204							+32s +3′	
	15158N4152								
GP 103	16103N3525	75.416	51.9	3.31	9.0 – 11.5	590	1+1	+35°2793 (8m.0)	66
	16122N3516	75.542	56.0	2.54	10.0 – 13.0	590	2+1	+34s −2′	
	16141N3508	75.544	53.4	3.04	10.0 – 13.0	500	1+2		
		75.511	**54.0**	**2.92**	**9.8 – 12.6**		**3n**		
GP 123	17556N4231	76.593	232.2	2.89	11.0 – 11.2	590	1+2	+42°2972 (8m.3)	70
	17571N4231							−4s −3′	
	17586N4231								
GP 121	19417N3641	76.591	322.7	1.35	10.0 – 10.0	590	1+2	+36°3687 (9m.2)	70
	19436N3648	76.615	325.7	1.46	dm=0.5	590	2+2		
	19454N3656	76.784	322.9	1.34	dm=0.2	590	1+1		
		76.645	**324.1**	**1.40**	**dm=0.3**		**3n**		
GP 122	19419N3654	76.591	78.7	2.36	12.0 – 12.5	590	1+1	+36°3689 (9m.4)	70
	19437N3701							−6s −4′	
	19455N3708								
GP 127	19441N3724	76.752	8.6	2.76	13.5 – 14.0	590	1+2	+37°3610 (9m.5)	70
	19459N3731							−5s +1′	
	19476N3738								

Double star	1900 α 1950 δ 2000	t	Θ	ρ	m	Mgf.	W	BD Δα Δδ	C. I. UAI Comm. 26
GP 100	19456N3527	74.736	282.0	1.62	12.0–12.5	590	1+1	+35°3820 (9m.5)	70
	19475N3534	76.746	280.1	1.61	14.0–14.3	700	1+1	–5s 0′	
	19493N3541	**75.741**	**281.0**	**1.62**	**13.0–13.4**		**2n**		
GP 101	19459N3530	74.822	135.0	4.65	11.0–13.0	500	1+1	+35°3821 (9m.5)	–
	19477N3537	76.779	135.7	5.24	10.5–12.0	500	1+1	+3s –6′	
	19496N3545	**75.800**	**135.4**	**4.94**	**10.8–12.5**		**2n**		
GP 102	19460N3532	74.822	138.9	4.33	12.0–13.0	420	1+1	+35°3821 (9m.5)	–
	19479N3539	76.779	140.1	4.04	11.8–12.5	500	1+1	+12s –4′	
	19497N3547	**75.800**	**139.5**	**4.18**	**11.9–12.8**		**2n**		
GP 104	19461N3543	74.849	54°.6	3″.77	11.0–12.0	590	1+1	+35°3822 (9m.5)	65
	19480N3551	75.690	54.8	3.97	10.0–11.0	500	1+1	+9s +2′	
	19498N3558	76.779	54.2	4.10	10.0–11.0	500	1+1		
		75.773	**54.5**	**3.95**	**10.3–11.3**		**3n**		
GP 93	22227N3446	74.879	284.7	5.70	11.8–12.5	590	1+1	+34°4688 (9m.0)	–
	22249N3501	76.779	284.1	5.74	10.5–10.8	500	1+3	–8s –2′	
	22271N3516	**75.829**	**284.4**	**5.72**	**11.2–11.6**		**2n**		
GP 90	22239N3503	70.483	286.9	6.46	–	590	1+1	+34°4693 (9m.5)	–
	22262N3518							+8s 0′	
	22284N3533	76.591	285.1	6.69	–	590	1+1		
		76.779	285.6	6.61	9.5– 9.5	500	1+2		
		76.704	**285.4**	**6.64**	**9.5– 9.5**		**2n**		
GP 99	22242N3443	74.688	290.3	1.66	9.7–10.0	590	1+1	+34°4695 (9m.5)	65
	22264N3458	74.879	287.8	1.65	–	590	1+1	–8s –4′	
	22286N3513	**74.784**	**289.0**	**1.66**	**9.7–10.0**		**2n**		
		76.591	289.7	1.26	dm=0.5	590	1+1		
		76.779	291.5	1.63	9.5–10.0	500	1+1		
		76.685	**290.6**	**1.44**	**dm=0.5**		**2n**		
GP 120	23223N2947	74.879	256.5	3.67	12.5–13.0	590	1+1	+29°4929 (9m.5)=GP 21	–
	23247N3004							–3s –6′	
	23271N3020								

Bull. Obs. Astron. Belgrade, No 128

MICROMETER MEASURES OF DOUBLE STARS

(Series 25)

D. M. OLEVIĆ

SUMMARY:

This series contains 195 measures of 184 pairs carried out by the autohr with the Zeiss equatorial 65 cm of Belgrade observatory from 21 January 1974 till 29 Spetember 1975.

ADS	IDS	Nom.	Comp.	1900+	Θ	ρ	m (dm)	n	Notes
1	2	3	4	5	6	7	8	9	10
257	00135N1526	STF 25	AB	75.71	193°.4	1.″19	—	1	
287	00158N1025	BU		74.88	106.4	0.71	0.2	1	
524	00324N2207	HU		75.72	105.9	0.68	0.0	1	
871	00579N4954	HU		75.74	25.6	0.60	0.0	1	
		OLE	AC	75.74	186.8	36.42	—	1	
1030	01097N8020	STT 28	AB	75.72	294.6	0.75	1.3	1	
1474	01451N5808	HJ 1093		75.75	24.9	4.8	9.4–9.6	1	
1530	01502N0228	A 2407		75.75	246.5	0.88	—	1	Erceg, 1975: −5°.5, −0″.19
1615	01569N0217	STF 202		75.71	287.3	1.75	—	1	Rabe, 1945: +3°.2, −0″.04
1874	02228N1655	A 2330		75.71	196.9	0.96	0.0	1	
2117	02409N3508	BU 9	AB	75.72	192.2	1.41	6.5–8.9	1	
2416	03089N0022	STF 367		74.07	147.1	0.99	0.1	1	Heintz, 1963: +0°.9, +0″.01
2491	03164N0824	STF 380		75.71	30.7	0.90	1.1	1	
2616	03285N2408	STF 412	AB	75.72	188.3	0.68	0.0	1	Luyten, 1934: −1°.7, +0".06
2616	03285N2408	STF 412	ABXC	75.72	56.2	22.10	—	1	
2628	03294N3121	BU 533		74.07	225.7	1.00	0.0	1	
2787	03434N1440	HO 324		75.75	332.5	1.00	0.5	1	
2868	03500N2129	HU 815		75.71	207.1	2.50	3.9	1	
2873	03501N3253	BU 263		74.07	96.9	0.67	0.0	1	
2990	04005N3311	STF 71	AB	74.12	224.7	0.97	2.0	1	
				75.75	225.0	0.86	7.1–9.0	1	
				74.94	224.8	0.92	2.0	2n	
3174	04178N1109	STF 535		74.10	295.3	1.25	2.0	1	
				75.72	293.5	1.10	7.2–9.0	1	
				74.81	294.4	1.18	1.9	2n	
3187	04182N2954	HO 15		74.07	326.3	0.75	0.2	1	
3353	04323N2644	STF 572		75.75	195.2	4.09	0.0	1	
3526	04482N6136	STT 88		74.10	310.5	1.05	—	1	
3582	04538N0201	A 2628		75.72	157.3	0.85	0.0	1	
3672	04596N1940	STT 95		75.75	300.4	0.82	0.6	1	
3711	05024N0822	STT 98		74.12	40.0	1.05	0.6	1	Baize, 1969: +4°.4, +0″.33
4002	05194S0229	DA 5	AB	75.75	75.9	1.55	1.2	1	
4002	05194S0229	DA 5	AC	75.75	51.5	115.56	—	1	
4371	05410N2937	BU 560		74.12	133.7	1.49	0.2	1	
				74.16	136.0	1.60	—	1	
				74.14	134.8	1.54	0.2	2n	

ADS	IDS	Nom.	Comp.	1900+	Θ	ρ	m (dm)	n	Notes
1	2	3	4	5	6	7	8	9	10
4452	05453N3832	STF 799		74.12	169.4	0.85	—	1	
4991	06170N1737	STF 899		74.12	18.7	2.33	0.9	1	
5157	06254N2827	BU 1021		74.92	79.7	0.67	1.2	1	
5423	06408S1635	AGC 1	AB	75.21	59.1	11.10	−9.3	1	Van den Bos, 1960: +0°.7, −+0″.06
5725	06572N1314	HO 342		75.17	84.6	1.11	0.7	1	
6313	07380N0026	A 2534	AC	75.17	231.5	0.96	2.5	1	
6402	07453N0666	A 2743		74.92	185.3	0.74	0.5	1	
6650	08065N1757	STF 1196	AB	74.07	312.6	0.96	0.9	1	Gasteyer, 1954: −7°.3, +0″.02
6650	08065N1757	STF 1196	AC	74.07.	79.6	1.19	0.1	1	
6671	08086N0177	BU 1244		74.92	20.6	1.02	0.5	1	
6681	08083N3648	HU 1123		74.92	162.3	0.58	0.3	1	
6946	08367N3870	BU 209	7	75.17	5.0	1.54	0.2	1	
6963	08388N1577	A 2472		74.92	88.0	0.82	0.2	1	
7019	08435N3958	STF 1279		74.24	268.9	1.26	—	1	
7307	09147N3837	STF 1338	AB	74.26	243.4	1.02	—	1	Gu-Li, 1953: −2°.1, −0″.01
7352	09192N0647	STF 1348		75.17	137.8	2.22	0.0	1	
7390	09231N0930	STF 1356		74.07	358.6	0.65	0.1	1	Muller, 1957: 0°0, +0″.15
7499	09382N0640	A 2761		74.26	255.0	0.86	0.0	1	
				74.92	249.2	0.86	0.2	1	
				74.59	252.1	0.86	0.1	2n	
7631	09596N4132	A 2142		74.26	298.3	0.95	1.0	1	
7704	10108N1774	STT 215		74.92	185.6	1.34	0.2	1	Zaera, 1957: −3°.1, −0″.03
7802	10246N2079	STF 1439		75.16	87.3	1.30	0.2	1	
7864	10335N0575	STF 1457		74.07	329.9	1.63	0.7	1	
7929	10423N4138	STT 229		74.26	283.6	0.87	0.3	1	
8031	10574N3573	HO 47	BC	75.16	159.7	0.82	0.5	1	
8043	10588N0371	STF 1504		74.07	117.2	1.18	0.0	1	
8102	11096N3767	STT 232		74.11	240.6	1.31	0.9	1	
8114	11117S0436	A 5		75.33	328.7	0.58	0.4	1	
8222	11296N0163	AG 175		74.07	189.6	2.08	0.7	1	
				75.16	190.9	2.08	0.3	1	
				74.62	190.2	2.08	0.5	2n	
8275	11376N2138	HU 888		75.32	163.6	0.92	0.3	1	
8279	11385N0667	BU 793		75.16	104.3	1.32	0.5	1	
8406	11592N2161	STF 1596		74.11	237.5	3.54	1.5	1	
8539	12194N2568	STF 1639	AB	75.32	325.5	1.42	6.5−8.1	1	Aller, 1951: −1°.0, −0″.02
8598	12294N0591	BU 797	AB	74.11	159.5	0.77	0.2	1	
8611	12322N2145	STF 1663		75.33	81.1	0.87	0.9	1	
8625	12358N0883	STF 1668		74.07	191.0	1.47	0.1	1	
				75.23	188.4	1.41	0.3	1	
				74.65	189.7	1.44	0.2	2n	
8695	12484N2147	STF 1687	AB	75.16	157.0	1.15	5.0−8.1	1	Schmeidler, 1939: −8°.4, +0″.32
8708	12513S0025	STT 256		75.32	94.1	1.15	0.2	1	
8721	12539N2761	STF 1699		74.07	188.7	1.84	—	1	
				75.23	190.4	1.78	—	1	
				74.65	189.6	1.81	—	2n	
8734	12557N3578	HU 1141		75.73	341.9	0.62	0.7	1	
8814	13073N3237	STT 261		74.11	339.8	2.57	0.1	1	
8820	13083N4062	A 1606		74.16	198.5	1.35	0.0	1	
8887	13189N2945	HO 260		74.36	68.1	1.06	0.4	2	
				75.33	68.1	0.96	0.2	1	
				74.84	68.1	1.01	0.3	3n	Raize, 1967: +0°.1, +0″.04
8890	13192N0155	STF 1742		75.16	354.8	1.24	0.5	1	
8946	13290N0878	A 1792		74.36.	315.3	0.65	1.4	1	
8974	13330N3648	STF 1768	AB	75.23	104.1	2.21	—	1	Jackson, 1921: +1°.2, +0″.3
9031	13445N2689	STF 1785		74.11	153.0	3.54	0.3	1	Strand, 1955: −2°.0, +0″.22
9060	13513N0547	STT 273	AB	75.16	111.7	1.00	0.0	1	

ADS	IDS	Nom.	Comp.	1900+	Θ	ρ	m (dm)	n	Notes
1	2	3	4	5	6	7	8	9	10
9067	13527N3455	BU 937		74.36	127.3	0.92	0.3	1	
				74.37	129.3	1.04	0.6	1	
				75.23	132.0	0.96	—	1	
				75.38	126.6	0.94	0.2	1	
				74.84	128.8	0.96	0 .4	4n	
9078	13551N1982	STF 1794		75.16	127.0	1.95	0.1	1	
9084	13566N2551	A 569		74.36	141.9	0.63	0.2	1	
9174	14095N2934	STF 1816		74.11	268.7	0.89	0.0	1	
				75.23	272.0	1.04	—	1	
				74.67	270.4	0.97	0.0	2n	
9229	14166N4858	STT 1834		75.33	279.9	1.24	0.0	1	Van den Bos, 1938: −3°.5, +0″.06
9269	14230N2064	HO 542		74.36	224.3	1.01	0.3	1	
9413	14468N1931	STF 1888		74.48	339.0	7.27	2.6	1	Strand, 1937: +1°.8, +0″.11
9418	14478N4480	STF 287		75.23	345.8	1.19	0.3	1	Heintz, 1962: +1°.4, +0″.09
9425	14487N1567	STT 288		75.16	714.5	1.39	1.3	1	Heintz, 1955: +1°.3, +0″.05
9494	15005N4763	STF 1909		75.23	20.7	0.85	—	1	Heintz, 1963: +11°.6, +0″.25
—	15081N3432	GPO 12		75.48	165.8	4.04	9.2−9.8	1	
9554	15112N3672	STT 295		74.48	135.8	0.77	1.5	1	
9626	15207N3742	STF 1938	BC	74.23	18.7	2.36	0.6	1	Baize, 1951: +1°.2, +0″.23
9629	15220N4629	A 1632		75.23	57.8	1.78	0.5	1	
9634	15216N1831	STF 1940		75.16	326.4	0.92	0.9	1	
9639	15230N4421	STT 296	AB	75.23	335.3	2.95	0.3	1	
9647	15228N0627	STF 1944		74.36	316.3	1.25	9.0	1	
9880	15562N1333	STT 303		74.23	166.1	1.42	0.4	1	
				75.49	163.2	1.39	0.1	1	
				74.86	164.6	1.40	0.2	2n	
9907	15592N2868	STF 2004		75.16	280.0	1.72	1.1	1	
10052	16225N6155	STF 2054		75.49	353.6	1.11	—	1	
10068	16238N3966	BU 814		75.39	347.7	0.48	0.2	1	
10071	16239N2646	BU 813		74.23	170.0	1.25	0.0	1	
—	16292N3971	STF 2065	AB	75.23	215.5	32.01	—	1	
10111	16292N4019	STT 313		74.48	135.4	1.06	0.3	1	
				75.23	137.6	0.97	0.5	1	
				74.85	136.5	1.02	0.4	2n	
10184	16400N2342	STF 2094	AB	74.23	73.9	1.33	013	1	
10184	16400N2342	STF 2094	AC	74.23	310.0	25.41	—	1	
—	16413N3406	GP 5		74.36	144.6	0.80	0.1	1	
10277	16535N1518	STT 319		74.48	64.2	1.00	1.0		
10312	16572N0836	STF 2114		75.56	187.4	1.30	1.1	1	
10450	17137N3212	BU 629		74.36	346.2	1.62	0.8	1	
—	17177N2851	KUI 80		75.39	157.1	0.72	2.2	1	
10504	17181N2611	HO 414	AB	74.48	103.2	1.63	—	1	
10526	17202N3714	STF 2161	AB	75.23	316.9	4.19	—	1	
10722	17381N4142	STF 2203		74.42	304.1	0.72	0.4	1	
10743	17394N2239	HU 1285		75.54	226.7	0.50	0.0	1	
10796	17426N1504	HU 1288		75.54	149.3	0.43	0.6	1	
10850	17475N1521	STT 338	AB	75.30	353.9	0.98	—	1	
11010	17596N4414	OLE 4	Aa	75.54	45.9	0.20	—	1	
11010	17596N4414	BU 1127	AB	75.54	83.9	0.82	8.9−10.0	1	Popović, 1970: +1°.8, −0″.24
11123	18057N1627	STF 2289		75.30	226.8	1.25	—	1	
11155	18082N2737	STF 2292		75.53	268.2	1.01	0.2	1	
11186	18094N0009	STF 2294		74.61	95.3	1.12	0.2	1	Wilson JNR, 1935: +1°.2, +0″.12
11234	18132N2638	A 241		75.53	289.4	0.66	0.3	1	
11313	18195N2727	HO 83		74.42	134.9	1.38	0.5	1	
11529	18344N2837	STF 2356		75.54	65.7	1.13	0.8	1	
11766	18473N1040	STF 2408		75.53	90.5	2.10	0.5	1	
11769	18474N1141	HU 199		75.53	345.6	0.82	0.3	1	
11778	18480N1353	STF 2412		75.30	237.0	1.72	—	1	

ADS	IDS	Nom.	Comp.	1900+	Θ	ρ	m (dm)	n	Notes
1	2	3	4	5	6	7	8	9	10
12140	19071N2106	A 151		75.53	146.3	0.75	1.1	1	
12160	19081N1641	BU 139	AB	75.54	136.0	0.72	1.2	1	
12236	19115N1559	STT 368	AB	74.42	217.8	1.23	1.3	1	
12446	19226N3837	HO 450	AB	74.61	267.8	1.11	2.0	1	
—	19231N3445	GP 33		74.67	230.7	0.80	0.2	1	
12532	19265N2702	A 269		75.54	199.2	0.77	0.8	1	
12734	19345N2504	J 1139	AB	75.53	218.9	1.22	0.0	1	
—	19391N3948	BUP		75.39	16615	105.00	—	1	
12978	19450N3144	A 375		74.42	161.0	1.42	—	1	
13196	19547N3300	STF 2606		75.53	139.5	0.88	0.2	1	
13212	19554N3150	A 378		75.53	298.3	0.82	1.2	1	
13382	20018N0139	A 2278	AB	75.54	222.0	0.88	0.5	1	
13533	20086N1029	A 1202		75.54	122.2	0.73	0.2	1	
13894	20242N0650	A 610		75.54	324.5	0.60	0.3	1	Heintz, 1962: +10°.5, +0″.22
13920	20255N1034	BU 63	AB	75.56	345.5	8.09	7.1−9.1	1	
13997	20286N0506	STF 2696	AB	75.53	301.5	0.63	0.5	1	
—	21288N3834	MLB 989		75.53	152.0	3.17	0.0	1	
14007	20300N3814	A 1431		75.53	34.3	1.06	1.1	1	
14368	20469N0522	A 613		75.54	339.5	0.87	0.2	1	
14505	20546N1511	STT 424	AB	75.54	307.7	0.51	1.0	1	
—	20552N3412	GP 27		74.67	155.1	1.35	—	1	
14636	21024N3815	STF 2758	AB	75.56	144.8	28.99	0.2	1	De Caro-Vega, 1948: −0°.2, +0″.26
14636	21024N3815	STF 2758	AC	75.56	255.8	48.00	6.5−10.5	1	
14778	21105N4044	STT 432		75.56	117.7	1.38	0.3	1	
14794	21114N3952	A 1440		75.72	7.5	4.13	10.0−12.5	1	
14824	21133N4247	A 401		75.53	141.3	0.46	—	1	
14889	21166N3202	STT 437	AB	74.61	25.3	2.12	0.0	1	
15270	21397N2817	STF 2822	AB	74.61	291.5	1.92	—	1	Heintz, 1965: −°.4, 0″.06
15295	21415N4328	HO 168		75.56	233.3	1.24	0.0	1	
15401	21476N2719	HO 171		75.54	164.8	0.87	0.0	1	
15556	21573N4446	A 780	AB	74.88	145.5	1.45	0.0	1	
15579	21586N2329	J 289	AB	75.54	141.9	2.14	0.0	1	
15707	22070N3941	STT 464		75.53	132.5	0.34	—	1	
15738	22081N2943	HO 179		75.53	273.7	0.84	1.2	1	
15748	22094N5943	A 626		75.54	276.7	0.83	0.0	1	
15756	22098N5204	BU 991		75.54	141.1	0.77	0.0	1	
15763	22095N1642	STF 2877	AB	75.72	29.0	19.60	6.8−9.2	1	
15763	22095N1642	STF 2877	AD	75.72	308.7	104.25	6.8−11.2	1	
15769	22100N2905	STF 2881		74.67	82.6	1.26	0.6	1	
15902	22189S0481	BU 172		75.56	292.4	0.36	7.3−7.4	1	Heintz, 1975: +0°.4, +0″.03
15971	22237S0032	STF 2909	AB	75.56	236.9	0.52	0.2	1	Rabe, 1954: −0°.7, −1″.24
16180	22363N0412	BU 480		75.53	63.8	0.94	0.3	1	
16205	22380N2316	HU 395	AB	75.54	272.1	0.57	0.2	1	
16205	22380N2316	HU 395	ABXC	75.54	240.0	8.97	−11.0	1	
16220	22391N4530	STT 477	AB	75.56	256.1	15.24	7.5−11.6	1	
16373	22508N1515	HU 987		75.54	95.5	0.71	0.3	1	Heintz, 1965: +2°.8, +0″.07
16428	22542N1112	STT 483		75.53	289.0	0.61	—	1	Gu-Li, 1956: −5°.3, −0″.07
16435	22551N4117	HU 56		75.54	98.8	1.12	0.0	1	
16505	23010N4611	A 196		75.53	321.0	0.67	0.8	1	
16607	23085N0140	A 2299	BC	74.67	71.1	1.20	0.4	1	
16725	23186S0860	STF 3008		75.56	163.4	4.46	0.9	1	
16879	23333N6740	BU 855		74.88	19.5	0.88	—	1	
16937	23370N1945	STT 503		74.72	132.7	1.27	0.5	1	
17105	23511N2447	A 426		75.56	329.3	0.30	0.2	1	Heintz, 1962: −2°.0, +0″.01
32	23595N3343	STF 3056	AB	75.74	144.9	0.74	0.0	1	
32	23595N3343	STF 3056	ABXC	75.74	1.5	24.99	−9.8	1	

Bull. Obs. Astron. Belgrade, No 128

MICROMETER MEASURES OF DOUBLE STARS

(Series 26)

G. M. POPOVIĆ

(Received 26 October 1976)

SUMMARY:

Presented are 271 measures of 134 double stars, 29 of which are carrying the designation GP·

The measurements of this series (Table II) have been made with the „Zeiss" equatorial 65/1055 cm of Belgrade Observatory, and are a continuation of my measurements published in the Belgrade Series No 22 (Popović G., 1975). The form in which this series is presented is identical to that in which the Series 22 was published. The only change made is that relating to the apparent magnitude m of the components (first column of Table II), but only with the newly discovered pairs: where previously catalogue value of m was usually given, now comes mean value of the existing evaluations m instead, followed by the number of evaluations. In the column „Notes" are recorded, among other remarks, only significant changes in the relative coordinates Θ and ρ.

I would like to specially draw attention to the observations and remarks concerning the following pairs:

GP 54 — In addition to the measures appearing in this series, the pair has been measured three times before: 1970.972, 1971.676 and 1973.683. Each time Θ was measured in the first quadrant and each time the difference of the apparent magnitudes of the components was found to be $2^{m}.0$. It is therefore hardly probable that I might have reversed the quadrant, as indicated by P. Couteau (Couteau P., 1975). Possibly the component A is variable?

ADS 5423 — The observation of Sirius has been made without the six-sided diaphragm, with the blend fully opened: 650 mm. The image quality was good. I have noticed the component C while measuring the pair AB. In attempting to measure the relative coordintes of the pair BC I had to content myself with only one reading. The component D is optical one.

GP 74 — In 1972 the difference in right ascension of this pair and the reference star BD+34°1592 ($9^{m}.2$) was $\sim +63^{s}$. Being then unable to identify in the sky the star BD+34°1596 ($9^{m}.4$) I suspected the measured pair to be just this BD star. In 1975 I repeated the measurement and found the difference of the pair and BD+34°1592 to be $+70^{s}$. The difference in declination remained unchanged: $\Delta\delta = +1'.5$. Once again I was unable to identify the star BD+34°1596. Evidently the pair should be watched. Next measurement already might yield more relible answer to the question whether the measured pair was the star BD +34°1596. Should this prove to be the case then an exceptional proper motion of this BD star is to be suspected as no change in the position of the reference star BD+34°1592 relative to the neighbouring stars has been stated.

ADS 7186 — I have drawn the attention to this Barton pair in C.I. No 63, UAI, in 1974. The pair has been measured only once before my measurement in 1974, namely in 1893, when it was discovered. I have measured this pair again in 1975 and 1976. Nearby stars have been checked in order to remove any doubt regarding identification. No other pair has been detected. Accordingly a change in the angle of 71° is to bes stated. The pair needs further observing from time to time.

ADS 8783 — The measurement has been carried out under good atmospheric conditions. On the basis of previous measurements the conclusion might be drawn that we have to deal with an orbital pair with about 63 years period.

ADS 11010 — While measuring the orbital pair ADS 11010 on 17. VII. 1975 the A component appearad, to Olević as well as to myself, to be elongated. Notwithstanding good quality of the image it was not possible to be certain about the duplicity of the component A.

GP 34 — In the interval 1969—1975 the angle Θ has decreased by 14°, whereas ρ does not seem to have any noticeable change. Such a rapid motion (2°.3 a year) requires a pursuit of the pair every two or three years.

In Table I is presented the distribution of the numbers of measurements according to separation.

Table I

Structure of the measurements by ρ

ρ<0″.50	0″.50≤ρ<1″.00	1″.00≤ρ<2″.00	ρ≥2″.00	Σ
9 m	80 m	97 m	85 m	271 m
3.3%	29.4%	35.7%	31.6%	100%

REFERENCES:

Couteau P., 1975: Astron. and Astrophys. Suppl. Ser. **20,** No 3, pp. 391, 1975.

Popović G., 1975: Bull. Obs. Astron. Belgrade, No **126,** pp. 35, 1975.

Table II

Micrometer measures of double stars

ADS α, δ m	Disc. 1900—2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
—	GP 35	76.604	296°.5	0″.55	9.0—10.0	3+2	GP 35=BD+34°33, (9ᵐ.4)
00143—195N3511—44		76.744	296.3	0.74	10.0—11.0	3+2	
9.4—10.9 (4n)		**76.674**	**296.4**	**0.64**	**9.5—10.5**	**2n**	
287	β 1093	74.882	109.3	0.61	dm=1.0	1+1	The angle has increased by 52° since 1889.
00158—210N1025—58		76.689	105.9	0.58	dm=1.0	2+2	
7.0—7.9		**76.087**	**106.0**	**0.59**	**dm=1.0**	**2n**	
367	β 779	76.624	245.6	0.68	dm=0.7	3+2	
00226—278N2301—34		76.689	244.6	0.38	dm=0.5	3+2	
8.6—9.1		**76.656**	**245.1**	**0.53**	**dm=0.6**	**2n**	
475	D 2	76.624	253.1	0.49	dm=1.0	2+2	
00294—345S0466—33		76.689	256.6	0.50	dm=0.7	2+2	
7.5—8.0	AB	**76.656**	**254.8**	**0.50**	**dm=0.8**	**2n**	
—	GP 53	76.744	69.3	2.07	9.5—13.0	1+1	GP 53=BD+34°229, (9ᵐ.3)
01143—199N3448—80							
9.5—13.0 (1n)							
—	GP 54	76.689	40.4	1.13	dm=2.0	1+1	Couteau's note (Astr. Astroph. Supp. Ser. **20.** No 3): „Popovic inverse le quadrant" is not confirmed.
01158—214N3409—40		76.744	44.2	0.98	dm=1.5	1+2	GP 54=BD+33°214,(9ᵐ.5)
9.2—11.2		**76.722**	**42.7**	**1.04**	**dm=1.7**	**2n**	
1254	Σ 138	76.624	52.2	1.63	dm=0.1	2+2	The angle has increased by 32° since 1830.
01308—360N0708—39		76.689	53.0	1.33	dm=0.0	1+2	IDS: An orbital pair.
7.7—7.7	AB	**76.652**	**52.5**	**1.50**	**dm=0.1**	**2n**	
2516	A 1288	76.744	7.9	0.72	8.3—8.5	2+2	
03182—249N4137—58							
9.1—9.4							
—	GP 83	75.073	266.5	0.79	8.0—8.2	1+1	GP 83=COU 1080=BD+34°685,(8ᵐ.0)
03291—354N3508—28		75.084	264.8	0.76	8.0—8.5	2+2	My measure in Nice with 74 cm refractor:
8.1—8.6 (6n)		**75.080**	**265.3**	**0.77**	**8.0—8.4**	**2n**	1974. 96, 264°.5, 0″.86, 1n.

ADS α, δ m	Disc. 1900−2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
		76.021	265.7	0.76	dm=0.2	2+2	
		76.744	264.0	0.73	8.0−8.5	3+3	
		76.455	**264.7**	**0.74**	**dm=0.3**	**2n**	
3166	Es 239	75.134	238.2	4.14	—	1+2	Decrease in distance 2″.1 since 1930.
04165−231N3559−73							A component apparently elongated in dirc-e
10.1−13.1							tion Θ∼291°.
3207	Σ 531	76.062	321.6	0.83	dm=1.0	1+1	
04187−267N5525−39		76.744	319.8	0.94	dm=1.5	2+2	
7.6−8.8		**76.517**	**320.4**	**0.90**	**dm=1.3**	**2n**	
3300	A 1714	76.021	252.0	0.49	8.0−8.8	2+2	
04274−344N4228−40							
9.1−9.4							
—	GP 70	75.085	14.0	1.14	10.0−10.2	2+2	GP 70=BD+35°1056, (9^m.5)
05136−202N3555−63		75.134	12.4	1.18	9.5−9.8	1+2	
9.7−10.0 (3n)		75.145	15.1	1.31	dm=0.3	1+1	
		75.115	**13.7**	**1.19**	**dm=0.3**	**3n**	
—	GP 69	75.145	301.2	3.79	10.0−11.0	2+2	In Pub. Astron. Obs. Beograd No 19 the
05148−215N3509−15		75.158	304.1	3.98	10.0−11.5	1+1	magnitude is incorrectly printed: for
10.5−11.8 (8n)		75.166	301.0	3.73	10.0−11.0	2+2	11.0−12.2 read 11.2−12.2.
		75.156	**301.8**	**3.80**	**10.0−11.1**	**3n**	
3956	Σ 677	76.062	164.2	0.83	—	1+1	
05153−247N6317−26		76.744	159.4	0.98	—	1+2	
7.9−8.2		**76.471**	**161.3**	**0.92**	..	**2n**	Heintz, 1962: −2°.1, −0″.10
4779	Σ 861	76.062	315.2	1.52	dm=0.1	1+2	$m_A = m_{BC}$
06049−113N3042−41							
9.3−9.3	BC						
4823	Ho 22	76.062	204.9	0.72	—	1+1	
06079−134N1016−14							
8.6−8.6							
5423	AGC 1	75.203	61.0	11.30	—	1+2	
06408−452S1635−41		75.210	61.6	10.62	m_B=10.0	2+2	
(−1.58)−8.5	AB	**75.207**	**61.3**	**10.91**		**2n**	Van den Bos, 1960: +2°.9, +0″.25
	BC	75.210	144.0	1.5		2+1	
	AD	75.202	78.2	92.0	m_D=10.0	1+1	
		75.203	77.8	92.8	m_D=12.0	1+1	
		75.202	**78.0**	**92.4**	m_D=**11.0**	**2n**	
5633	J 1058	76.199	167.8	2.03	dm=−0.1	1+1	
06528−585N1351−43		76.215	170.9	2.16	10.1=10.0	1+2	
9.2−9.2		76.259	173.0	2.34	dm=−0.1	2+2	
		76.264	174.4	2.56	dm= 0.1	1+2	
		76.239	**172.0**	**2.30**	**dm= 0.0**	**4n**	
—	GP 74	75.145	144.9	9.60	9.5−10.5	1+2	The position of the pair related to
07174−240N3439−28		75.158	145.3	8.83	9.5−11.5	1+1	BD+34°1592,(9^m.2): Δα=+70 s, Δδ=+1′.5.
9.5−11.2 (5n)		75.235	146.8	9.18	9.5−11.0	1+1	Maybe BD+34°1596=GP 74.
		75.174	**145.6**	**9.26**	**9.5−11.0**	**3n**	
—	GP 75	75.145	210.4	6.22	9.0−11.0	1+2	A component apparently elongated in direc-
07250−315N3367−46		75.158	213.3	6.09	9.0−11.0	1+2	tion Θ ∼ 247°.
9.3−12.1 (7n)		**75.152**	**211.8**	**6.16**	**9.0−11.0**	**2n**	GP 75=BD+34°1624, (9^m.4)
6538	OΣ 186	76.136	73.9	0.84	dm=0.5	1+2	
07572−633N2633−16							
7.5−8.2							
7044	Vdk 3	76.221	129.7	2.00	dm=0.3	1+2	
08453−507N0774−51		76.264	128.0	2,28	9.2−9.5	3+3	
10.3−10.4		**76.250**	**128.6**	**2.19**	**dm=0.3**	**2n**	Van d. Wiele, 1974: +0°.9, −0″.63

ADS α, δ m	Disc. 1900–2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
7186	Brt 102	74.274	56.4	3.98	dm=0.5	1+1	The position of the pair related to
09013–079N4362–38		74.364	57.2	3.98	11.0–11.3	1+2	BD+44°1827, ($9^m.5$): Δα=+14s, Δδ=+2′.
10.5–10.7		**74.328**	**56.9**	**3.98**	**dm=0.4**	**2n**	
		75.145	53.0	3.39	dm=0.2	1+1	
		75.158	57.2	3.64	dm=0.5	1+1	
		75.203	57.0	3.79	—	1+1	
		76.259	56.5	3.53	10.0–10.6	1+2	
		75.976	**56.0**	**3.58**	**dm=0.4**	**4n**	The angle has decreased by 71° since 1893.
7248	Brt 103	76.254	153°.8	3″.83	—	1+1	
09079–144N4428–03							
10.7–10.8							
7764	Σ 1431	75.235	71.2	3.10	8.0–10.0	1+2	
10203–256N0877–47		75.254	72.0	3.28	8.0–10.0	1+2	
7.9–9.6		**75.244**	**71.6**	**3.19**	**8.0–10.0**	**2n**	
—	GP 73	75.287	206.5	0.87	dm= 0.0	1+2	GP 73=BD+34°2186, ($9^m.4$)
10511–560N3351–18		75.304	205.4	0.93	dm= 0.0	1+1	
9.7–9.7 (3n)		75.383	210.1	0.67	dm=–0.2	2+2	
		75.407	210.9	0.71	dm= 0.0	1+2	
		75.352	**208.6**	**0.77**	**dm=–0.1**	**4n**	Direct motion.
8007	Σ 1500	76.224	305.0	1.40	dm=0.3	1+1	
10549–600S0256–88		76.346	302.9	1.60	8.0–8.6	1+2	
7.5–9.1		76.358	301.5	1.48	—	1+2	
		76.320	**302.9**	**1.50**	**dm=0.4**	**3n**	
8119	Σ 1523	76.256	112.5	2.97	dm=0.7	1+2	
11128–182N3166–33		76.358	110.4	2.97	—	1+2	
4.4–4.9	AB	76.368	109.9	2.88	dm=0.5	1+2	
		76.327	**110.9**	**2.94**	**dm=0.6**	**3n**	Heintz, 1966: –1°.3, –0″.12
8252	OΣ 237	76.347	251.2	1.76	dm=2.0	1+2	The angle has decreased by 37° since 1845
11336–390N4142–09		76.352	248.7	1.67	8.5–9.5	1+2	with change in distance.
8.4–10.0		76.368	250.3	1.75	8.5–10.0	1+2	
		76.382	250.2	1.76	8.5–10.0	3+2	
		76.365	**250.1**	**1.74**	**dm=1.5**	**4n**	
8427	Es 2224	75.383	25.5	1.92	9.0–12.0	2+2	
12019–070N3454–21							
9.4–12.4							
8539	Σ 1639	76.369	333.0	1.39	dm=1.3	1+2	Aller, 1951: +6°.6, –0″.06
12194–244N2568–35							
6.6–7.8	AB						
8575	Σ 1647	76.257	235.2	1.26	dm=0.1	1+2	
12255–306N0976–43		76.347	238.5	1.37	8.0–8.3	1+2	
8.5–8.8		76.358	239.5	1.30	—	1+2	
		76.321	**237.7**	**1.31**	**dm=0.2**	**3n**	Hopmann, 1964: –3°.1, –0″.02
8630	Σ 1670	76.257	299.2	4.09	dm=–0.1	1+2	
12366–417S0054–87		76.347	298.3	3.85	dm= 0.0	1+2	
3.6–3.7	AB	**76.302**	**298.8**	**3.97**	**dm=–0.1**	**2n**	Strand, 1937: –0°.6, –0″.20
8783	L 12	76.363	165.7	0.47	dm=0.3	3+2	Apparently second revolution since discovery
13020–068N2689–57							in progress.
11.4–11.9							
—	GP 72	75.367	318.9	1.41	dm=1.5	1+1	The position of the pair related to
13119–166N3464–32		75.407	323.4	1.32	dm=1.5	1+1	BD+35°2430, ($9^m.5$): Δα=+4s, Δδ=+8′.
9.7–10.8 (4n)		75.484	320.2	1.43	9.7–10.7	2+2	
		75.436	**320.7**	**1.40**	**dm=1.2**	**3n**	
8887	Ho 260	76.344	69°.5	1″.13	9.5–10.2	2+2	Baize, 1968: –3°.3, +0″.08
13189–236N2945–14		76.363	65.8	1.00	dm=0.3	3+2	Popović, 69: –4.1, +0.20
9.6–9.8		76.382	63.8	1.09	dm=0.1	3+3	
		76.366	**66.0**	**1.07**	**dm=0.3**	**3n**	

ADS α, δ m	Disc. 1900−2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
8946	A 1792	76.363	313.1	0.50	**dm**=1.0	3+2	The angle has decreased by 33° since 1908.
13290−340N0878−47							
8.8−9.3							
8950	β 114	76.257	162.1	1.44	dm=−0.2	1+1	
13290−343S0806−37		76.262	165.7	1.45	dm=+0.1	1+1	Δm<0^m.5
7.9−8.4		76.358	165.5	1.45	dm= 0.0	1+1	
		76.292	**164.4**	**1.45**	**dm= 0.0**	**3n**	The angle has increased by 36° since 1842.
8974	Σ 1768	76.257	105.4	1.61	dm=2.0	1+2	
13330−375N3648−17		76.262	103.2	1.72	dm=1.5	1+2	
5.1−7.0	AB	76.358	101.2	1.71	dm=2.0	1+2	
		76.292	**103.3**	**1.68**	**dm=1.8**	**3n**	Jackson, 1921: +1°.0, −0″.04
9031	Σ 1785	76.350	157.8	3.29	9.0−9.5	3+2	
13445−492N2689−59		76.358	157.6	3.18	dm=0.2	2+2	
7.9−8.2		**76.354**	**157.7**	**3.24**	**dm=0.4**	**2n**	Strand, 1955: +0°.9, −0″.12
9084	A 569	76.363	134.5	0.58	dm=0.3	3+2	The angle has increased by 31° since 1903.
13566−602N2551−22							
9.9−10.2							
9182	Σ 1819	76.361	245.7	0.84	dm=0.0	1+2	Hopmann, 1945: −13°.2, −0″.20
14103−153N0336−08							
7.7−7.8							
9254	Σ 1837	76.257	283.7	1.08	dm=1.2	1+1	The angle has decreased by 44° since 1829.
14193−247S1113−40		76.262	282.2	1.19	8.0−9.0	1+1	
6.7−8.3		**76.260**	**282.8**	**1.15**	**dm=1.1**	**2n**	
9269	Ho 542	76.350	218.5	0.91	dm=−0.1	2+2	The angle has decreased by 55° since 1896.
14230−277N2064−37							
10.7−10.7							
9423	β 31	76.262	214.2	1.83	dm=2.0	1+2	The angle has increased by 32° since 1874.
14479−525N1869−44		76.344	213.3	1.94	9.0−10.5	1+2	
8.2−9.9	AB	**76.303**	**213.7**	**1.88**	**dm=1.8**	**2n**	
9497	β 119	76.262	280.5	1.93	8.7−9.2	1+2	The angle has decreased by 32° since 1875.
15002−055S0638−61		76.344	281.4	1.91	8.0−8.7	1+2	
8.0−8.5	AB	76.350	279.8	1.90	dm=0.5	1+2	
		76.319	**280.6**	**1.91**	**dm=0.6**	**3n**	
9496	Σ 1908	76.374	149.5	1.31	—	3+2	
15009−050N3451−27							
8.8−9.8							
—	GPO 12	75.367	169.3	—	—	1+1	The position of the pair related to
15081−121N3442−20		75.408	170.6	3.73	9.7−10.5	2+2	BD+34°2613, (9^m.2): Δα=−47s, Δδ=+4′.
9.6−10.4 (4n)		75.416	170.0	3.84	9.5−11.0	1+1	
		75.484	172.2	3.45	—	1+2	
		75.423	**170.7**	**3.66**	**9.6−10.7**	**4/3n**	
9647	Σ 1944	76.350	311°.8	0″.75	—	1+1	
15228−277N0627−05		76.361	314.9	0.79	—	2+2	
8.4−9.0		**76.357**	**313.9**	**0.78**	**—**	**2n**	
—	Brt 2420	76.262	143.5	7.24	dm=0.2	1+3	
15271−315N2132−11		76.615	142.5	6.90	dm=0.1	1+2	
10.7−11.1		**76.413**	**143.1**	**7.09**	**dm=0.2**	**2n**	Probably optical.
9742	A 2076	76.350	179.1	0.63	dm=0.0	2+2	The angle has increased by 33° since 1909, with increase in distance.
15360−405N1860−41							
8.4−8.4							
9925	β 812	76.344	104.1	0.69	dm=0.3	2+2	
16026−071N1670−54		76.361	101.5	0.63	dm=0.5	2+2	
9.2−9.3		**76.352**	**102.8**	**0.66**	**dm=0.4**	**2n**	

ADS α, δ m	Disc. 1900–2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
9952	A 1799	76.361	125.1	0.30	dm=0.0	3+3	The angle has decreased by 46° since 1908.
16069–115N1523–08							
9.2–9.3							
–	GP 1	74.488	185.4	2.29	9.5–10.5	1+1	GP 1=BD+34°2788, ($9^m.5$)
16235–271N3432–18		74.499	177.8	2.06	10.0–12.0	2+2	
9.7–11.6 (6n)	AB	74.502	180.4	2.16	10.0–11.5	1+1	
		74.497	**180.4**	**2.14**	**9.9–11.5**	**3n**	
–	GP 2	75.408	135.1	4.23	11.0–13.0	1+1	The position of the pair related to BD+34°2817, ($9^m.5$): $\Delta\alpha=-21s$.
16334–371N3363–50		75.416	135.2	3.71	dm=1.2	1+2	
11.0–12.9 (4n)		76.361	134.8	4.19	11.0–13.0	1+2	
		75.768	**135.0**	**4.02**	**dm=1.7**	**3n**	
–	GP 5	76.344	136.8	0,62	9.5–9.8	2+2	GP 5=BD+34°2834, ($9^m.3$)
16413–450N3366–53		76.361	139.0	0.60	dm=0.2	2+2	
9.7–10.0 (5n)		76.377	136.8	0.61	dm=0.3	1+1	
		76.357	**137.8**	**0.61**	**dm=0.3**	**3n**	
10312	Σ 2114	75.555	185.0	1.30	dm=1.0	1+2	The angle has increased by 50° since 1830.
16572–619N0836–27		76.607	187.1	1.39	dm=1.5	2+2	
6.5–7.7		**76.156**	**186.2**	**1.35**	**dm=1.3**	**2n**	
10345	Σ 2130	75.479	49.9	2.18	dm=0.0	1+2	Heintz, 1965: +2°.9, +0″.17
17033–054N5436–27		76.607	52.7	2.06	dm=0.0	2+2	
5.8–5.8	AB	**76.124**	**51.5**	**2.11**	**dm=0.0**	**2n**	
–	GP 76	75.493	114.6	1.99	11.5–12.3	1+1	The position of the pair related to BD+34°2928, ($7^m.0$): $\Delta\alpha=-53s$, $\Delta\delta=+6'$.
17111–148N3455–48							
11.8–12.5							
10429	A 2984	76.344	353.3	1.24	–	1+2	The angle has increased by 55° since 1915 with increase in distance. A component looks elongated in direction Θ ~ 121°.
17114–165S0020–27							
4.9–7.9							
–	GP 77	75.375	321.7	4.16	dm=4.0	1+2	The position of the pair related to BD+34°2930, ($9^m.2$): $\Delta\alpha=+9s$, $\Delta\delta=+1'$.
17129–165N3455–48							
10.0–13.3 (3n)							
10722	Σ 2203	76.344	300.2	0.73	dm=0.2	2+2	The angle has decreased by 33° since 1830.
17381–412N4142–40		76.702	300.7	0.64	dm=0.1	2+2	
7.6–7.9		**76.523**	**300.4**	**0.68**	**dm=0.2**	**2n**	
10743	Hu 1285	75.542	224°.3	0″.50	dm=0.0	2+2	
17394–436N2239–37		75.544	222.0	0.54	dm=0.0	2+2	
9.0–9.0		**75.543**	**223.2**	**0.52**	**dm=0.0**	**2n**	
10742	Ho 560	74.635	265.0	1.05	dm=0.2	1+2	
17398–434N3359–57		74.638	261.7	1.09	dm=0.2	1+1	
8.7–8.7		74.660	263.2	1.06	dm=0.2	1+2	
		74.645	**263.5**	**1.06**	**dm=0.2**	**3n**	The quadrant determined unequivacally.
10769	Σ 2205	75.555	339.5	1.49	dm=0.1	2+2	The angle has increased by 48° since 1830.
17413–458N1745–43		76.607	338.2	1.50	dm=0.2	3+3	
8.5–8.9		**76.186**	**338.7**	**1.50**	**dm=0.2**	**2n**	
10796	Hu 1288	75.542	153.2	0.41	8.7–9.5	2+2	The angle has increased by 38° since 1905.
17426–471N1504–02		75.545	153.9	0.55	dm=0.5	1+2	
8.7–9.2		**75.543**	**153.5**	**0.47**	**dm=0.7**	**2n**	
10800	A 697	76.623	109.2	0.51	dm=0.2	2+2	
17440–471N4217–15							
9.0–9.2							
10850	OΣ 338	75.556	357.4	0.91	dm=0.3	1+2	The angle has decreased by 47° since 1843
17475–520N1521–20		76.345	354.4	0.96	–	1+2	
6.8–7.1	AB	76.361	355.0	0.87	dm=0.0	1+2	
		76.377	355.0	0.85	dm=0.0	1+2	
		76.160	**355.5**	**0.90**	**dm=0.1**	**4n**	

ADS α, δ m	Disc. 1900−2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
—	GPO 13	74.641	143.6	2.98	dm=0.1	1+1	GPO 13=BD+35°3127, (9^m.0)
17575−610N3558−58		74.660	142.7	2.50	14.0−14.0	1+1	A−BC: 1970.468, Θ=266°, ρ=78″, 1n, GP
12.8−12.8 (4n)	BC	**74.650**	**143.1**	**2.74**	**dm=0.0**	**2n**	
11010	β 1127	75.542	82.1	0.74	—	2+2	Popović, 1970: +0°.1, −0″.32.
17596−626N4414−13							1795. 542: A component apparently elongated
7.4−9.3							in direction Θ=34°.
—	GPO 21	74.641	294.9	2.14	—	1+1	The position of the pair related to BD
18025−081N3449−49		74.665	291.8	1.78	13.0−14.0	1+1	+34°3129, (9^m.5): Δα=−12 s.
12.5−13.5 (2n)		**74.653**	**293.3**	**1.96**	**13.0−14.0**	**2n**	
11110	Σ 2283	76.345	63.8	0.70	dm=0.5	1+2	Probably physical! If the pair optical ρ can
18047−096N0608−09		76.702	66.1	0.54	dm=0.5	1+2	not be < 0″.49.
8.1−8.6		**76.524**	**64.9**	**0.62**	**dm=0.5**	**2n**	
—	GP 45	75.416	278.4	6.49	12.0−12.0	1+2	The position of the pair related to BD
18389−425N3426−31							+34°3288, (8^m.3): Δα=+9s, Δδ=−2′.
12.0−12.0 (3n)							
—	GP 43	74.666	264.1	3.07	12.0−13.0	1+1	The position of the pair related to BD
18447−484N3425−32		74.673	271.7	3.03	13.0−14.0	1+2	+34°3323, (8^m.0): Δα=−17s, Δδ=+5′.
12.3−13.1 (3n)		**74.670**	**268.7**	**3.05**	**12.5−13.5**	**2n**	
11722	Σ 2402	76.615	207.0	1.39	dm=0.3	1+2	Since 1830 the angle without change and the
18450−496N1034−41							distance has doubled.
8.6−9.0							
11811	β 137	75.493	156.1	1.46	dm=0.5	1+2	The angle has increased by 30° since 1875.
18505−539N3715−22		76.610	151.9	1.54	dm=0.4	2+2	
8.2−8.7		**76.131**	**153.7**	**1.50**	**dm=0.4**	**2n**	
11869	Σ 2422	76.615	76°.6	0″.71	—	2+2	The angle has decreased by 29° since 1832.
18531−572N2558−65							
8.0−8.1							
—	GP 29	74.666	170.4	2.26	10.5−11.5	1+2	The position of the pair related to BD
18539−575N3446−54		74.673	169.1	2.67	10.0−10.7	1+2	+34°3370, (9^m.2): Δα=−19s, Δδ=−1′.
10.1−11.4 (6n)		74.717	170.7	2.20	11.0−12.0	2+2	
		74.688	**170.1**	**2.36**	**10.6−11.6**	**3n**	
12017	J 478	76.691	348.3	1.66	dm=0.1	1+1	
19004−050N1253−62							
11.2−11.1							
12040	Σ 2454	75.545	273.4	0.88	—	1+1	Baize, 1975: −0°.3, −0″.15
19023−062N3017−26		75.703	278.2	1.16	9.0−11.0	1+1	Olević, 1977 (rectilinear trajectory):
8.5−9.7	AB	75.711	279.5	1.10	dm=1.0	1+1	−0°.6, −0″.04
		75.653	**277.0**	**1.05**	**dm=1.5**	**3n**	
12228	Σ 2488	76.590	347.9	1.49	dm=0.8	2+2	The angle has increased by 30° since 1829.
19111−155N1951−61		76.593	347.1	1.47	dm=1.0	1+1	
8.4−9.6		76.604	348.2	1.53	—	2+2	
		76.596	**347.9**	**1.50**	**dm=0.9**	**3n**	
—	GP 32	74.641	164.7	3.81	dm=0.5	1+2	GP 32=BD+34°3499, (9^m.5)
19164−201N3425−35		74.660	165.8	3.27	9.5−10.5	1+2	
9.2−9.9 (5n)		74.666	165.5	3.18	9.5−10.0	1+2	
		74.656	**165.3**	**3.42**	**dm=0.7**	**3n**	
12447	Σ 2525	76.615	291.9	1.72	dm=0.1	2+2	
19225−265N2707−19		76.691	293.2	1.74	dm=0.2	1+2	
8.5−8.7		**76.648**	**292.4**	**1.73**	**dm=0.1**	**2n**	Finsen, 1937: +0°.5, +0″.08
—	GP 33	74.666	231.3	0.70	dm=0.2	1+2	GP 33=BD+34°3549, (9^m.4)
19231−268N3445−56		74.673	229.5	0.80	dm=0.0	1+1	
9.0−9.2 (3n)		**74.669**	**230.6**	**0.74**	**dm=0.1**	**2n**	
—	GP 34	75.408	66.1	3.00	9.5−13.0	1+2	GP 34=BD+34°3568, (9^m.5)
19252−289N3503−25		75.689	61.7	2.89	9.5−13.0	1+2	
9.5−12.9 (4n)		75.711	67.7	2.78	9.5−12.5	1+1	

ADS α, δ m	Disc. 1900–2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
		75.720	66.3	2.68	9.5–13.0	2+2	
		75.633	**65.3**	**2.83**	**9.5–12.9**	**4n**	Change in angle: 2°.3/year
12626	Σ 2553	76.615	122.0	0.84	—	1+2	The angle has increased by 43° since 1830.
19321–333N6150–63		76.692	120.3	0.90	—	1+1	
8.3–9.1		**76.646**	**121.3**	**0.86**	—	**2n**	
12965	OΣ 386	76.591	68.6	0.88	dm=0.1	2+2	
19446–482N3655–70		76.746	70.3	0.88	8.0–8.0	2+2	
8.2–8.5		**76.668**	**69.4**	**0.88**	**dm=0.0**	**2n**	
12972	OΣ 387	74.636	174.0	0.55	dm=0.7	1+2	
19450–487N3504–19		74.800	178.5	0.71	—	1+1	
6.9–7.9		74.822	182.9	0.79	dm=0.7	1+2	
		75.488	179.6	0.60	dm=0.5	1+2	
		75.690	179.6	0.76	8.0–8.2	2+2	
		75.146	**179.0**	**0.69**	**dm=0.5**	**5n**	Baize, 1961: +3°.5, +0″.10
13082	Σ 2596	74.685	306.7	1.90	7.5–9.0	1+2	The angle has decreased by 45° since 1831.
19494–540N1502–18		75.493	311.7	1.97	8.0–9.5	1+2	
7.3–8.7		75.711	306.9	1.85	8.0–9.7	1+2	
		76.702	306.8	1.77	dm=1.5	2+2	
		75.729	**307.9**	**1.86**	**dm=1.5**	**4n**	
13178	AC 12	75.703	305°.1	1″.34	dm=0.6	1+1	
19532–584S0230–14		75.747	306.2	1.34	8.0–9.0	1+1	
7.4–8.2		**75.725**	**305.6**	**1.34**	**dm=0.8**	**2n**	
13194	L —	74.685	299.8	2.23	10.0–12.5	1+1	
19542–585N2146–62		74.688	300.1	2.08	10.5–13.0	1+2	
10.2–11.2		**74.687**	**300.0**	**2.14**	**10.2–12.8**	**2n**	
13277	OΣ 395	75.703	116.9	0.85	dm=0.2	1+1	The angle has increased by 38° since 1844.
19578–618N2439–56		76.610	117.0	0.89	dm=0.2	1+2	
5.9–6.3		**76.247**	**117.0**	**0.87**	**dm=0.2**	**2n**	
13334	β 56	74.685	183.0	1.42	8.0–9.0	1+1	
19598–651S0436–19		74.688	181.7	1.62	7.5–9.0	1+2	
8.0–9.0		**74.687**	**182.2**	**1.54**	**7.8–9.0**	**2n**	
13894	A 610	75.542	327.6	0.42	—	2+2	Heintz, 1962: +14°.6, +0″.04
20242–291N0650–69							
9.2–9.4							
14016	OΣ 408	75.788	197.3	1.20	dm=3.0	1+2	
20301–340N3420–41		76.610	192.9	1.34	dm=3.5	1+2	
6.7–9.7		**76.199**	**195.1**	**1.27**	**dm=3.2**	**2n**	
14020	J 1143	75.788	269.9	3.10	10.5–11.5	2+2	The position of the pair related to BD +34°4084, ($9^m.5$): $\Delta\alpha=-6s$, $\Delta\delta=0'$. The distance has closed in.
20305–344N3452–73							
11.1–11.8							
14296	OΣ 413	76.703	17.8	0.77	dm=0,8	1+2	
20435–474N3607–29		76.741	18.8	0.83	dm=1.5	1+2	
4.8–6.1		76.746	19.5	0.86	dm=1.5	2+2	
		76.731	**18.8**	**0.82**	**dm=1.3**	**3n**	Rabe, 1948: +1°.7, –0″.02
14499	Σ 2737	76.604	284.0	0.95	dm=0.1	1+2	Van den Bos, 1933: –0°.5, –0″.11
20541–591N0355–78		76.741	286.4	0.96	8.0–8.5	1+2	
5.8–6.3	AB	**76.672**	**285.2**	**0.96**	**dm=0.3**	**2n**	
	A–C	76.604	67.9	10.27	mc=9.5	2+2	
		76.741	67.0	10.12	8.0–9.0	1+2	
		76.663	**67.5**	**10.20**	**m_c=9.3**	**2n**	
14505	OΣ 424	75.542	307.5	0.48	8.5–8.8	1+2	
20546–593N1511–34							
8.3–9.5	AB						

ADS α, δ m	Disc. 1900–2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
—	GP 27	74.666	154.2	1.01	—	1+1	GP 27=BD+34°4228, $(9^{m}.5)$
20552−593N3412−35		76.624	155.1	1.33	dm=0.3	1+1	
9.6−10.0 (1n)		76.703	157.7	1.24	—	1+1	
		75.998	**155.7**	**1.19**	**dm=0.3**	**3n**	Retrograde motion.
14558	Σ 2746	75.703	314.8	1.13	8.0−8.7	3+2	The angle has increased by 38° since 1830.
20580−619N3852−76		76.604	313.8	1.07	8.0−8.6	3+3	
8.0−8.6		**76.194**	**314.2**	**1.10**	**8.0−8.6**	**2n**	
14573	Σ 2744	75.711	127.7	1.39	dm=0.5	1+1	
20580−631N0108−32		75.747	133.3	1.23	dm=0.5	1+2	
7.0−7.5	AB	76.692	127.4	1.35	dm=0.5	1+2	
		76.092	**129.7**	**1.32**	**dm=0.5**	**3n**	Popović, 1964: +2°0, +0″.04
—	GP 22	75.711	94°.9	6″.24	dm=1.5	1+1	GP 22=BD+34°4283, $(9^{m}.5)$
21025−066N3412−56		76.741	94.4	6.53	9.5−10.5	1+1	
9.5−10.7 (2n)		**76.226**	**94.6**	**6.38**	**dm=1.2**	**2n**	
—	GP 26	75.695	242.3	3.98	11.0−12.5	1+2	The position of the pair related to BD+34°4304, $(9^{m}.5)$: Δδ=+4′.
21051−092N3507−31		75.711	242.2	4.50	9.5−11.0	1+2	
9.9−11.6 (5n)		**75.703**	**242.2**	**4.24**	**10.2−11.8**	**2n**	
14715	Σ 2765	75.747	78.5	2.71	dm=0.1	1+2	
21061−110N0908−33		76.610	78.8	2.68	dm=0.1	1+2	
8.4−8.6	AB	**76.178**	**78.6**	**2.70**	**dm=0.1**	**2n**	
14783	H I 48	76.689	249.8	0.64	dm=0.3	2+2	
21117−137N6400−25		76.746	249.3	0.74	—	1+1	
7.1−7.3		**76.708**	**249.6**	**0.67**	**dm=0.3**	**2n**	Baize, 1950: −1°.3, −0″.07
14829	Ho 153	75.703	125.3	0.98	8.0−9.0	1+2	
21135−176N3320−45		76.615	121.5	0.90	dm=1.0	1+2	
8.1−9.1		**76.159**	**123.4**	**0.94**	**dm=1.0**	**2n**	
14923	A 1696	76.703	231.7	1.28	9.6−9.5	2+2	
21191−223N5427−53		76.746	226.6	1.45	dm=−0.1	1+1	
10.1−10.1		**76.717**	**230.0**	**1.34**	**dm=−0.1**	**2n**	
15007	Σ 2799	76.692	268.4	1.62	dm=0.0	1+2	
21240−289N1039−65		76.741	269.8	1.63	dm=0.0	2+2	
7.5−7.5		76.785	269.1	1.69	dm=−0.1	1+2	
		76.400	**269.3**	**1.64**	**dm=0.0**	**3n**	The angle has decreased by 64° since 1831.
—	GP 88	75.703	242.4	3.04	12.5−13.5	1+2	The position of the pair related to БD +33°4383, $(9^{m}.3)$: Δα=−8s, Δδ=−2′.
21510−553N3410−38		76.741	245.2	2.91	10.0−11.0	1+1	
11.2−12.3 (3n)		**76.118**	**243.5**	**2.99**	**11.2−12.2**	**2n**	
15525	Σ 2850	76.604	263.2	2.56	8.5−12.0	2+2	
21552−598N2328−57							
7.0−11.2							
15556	A 780	74.882	144.4	1.43	8.7−9.0	1+1	
21573−613N4446−75		74.887	144.0	1.59	dm=0.7	1+1	
9.4−9.7	AB	**74.884**	**144.2**	**1.51**	**dm=0.5**	**2n**	
15579	J 289	75.542	140.2	1.71	10.5−11.5	1+1	The angle has incerased by 40° since 1910, and the distance has doubled.
21586−632N2329−58							
9.0−9.3	AB						
15769	Σ 2881	74.666	81.0	1.21	7.5−8.0	2+2	The angle das decreased by 31° since 1830.
22100−145N2905−35		76.615	79.5	1.30	dm=0.5	3+3	
7.6−8.1		**75.835**	**80.1**	**1.26**	**dm=0.5**	**2n**	
15895	Es 2070	74.688	165.3	3.46	—	1+1	
22189−233N3612−42							
10.6−11.2							
—	GP 39	74.816	91.1	0.54	dm=0.5	2+2	GP 39=BD+34°4710, $(9^{m}.3)$
22280−325N3429−60		74.879	86.5	0.64	dm=0.0	1+1	
9.5−9.7 (2n)		**74.837**	**89.5**	**0.57**	**dm=0.3**	**2n**	

ADS α, δ m	Disc. 1900–2000 Mult.	Epoch 1900+	Θ	ρ	m	W	Notes
16205	Hu 395	75.542	83°.8	0″.52	dm = −0.2	2+1	The angle has decreased by 57° since 1901.
22380−428N2316−47							
10.0−10.2	AB						
16205	h 1800	75.542	239.5	8.77	m_c = 11.0	1+1	
22380−428N2316−47							
m_c = 11.6	AB−C						
16270	Σ 2944	75.695	283.2	2.28	dm = 0.2	1+2	The angle has increased by 36° and the distance has decreased ∼1″.8, since 1832.
22427−479S0445−13							
7.3−7.8	AB						
16435	Hn 56	75.542	99.0	1.21	dm = 0.0	3+3	
22551−597N4117−49		76.615	97.0	1.05	dm = 0.0	3+3	
9.3−9.4		**76.078**	**98.0**	**1.13**	**dm = 0.0**	**2n**	
16607	A 2299	74.666	62.6	0.86	11.5−11.7	1+1	
23085−136N0140−73							
10.5−11.0	BC						
—	GP 68	76.604	322.7	0.97	dm = 0.0	1+2	GP 68 = BD+35°5010, ($9^m.4$)
23158−205N3548−80		76.615	323.8	0.79	dm = −0.1	1+2	
9.5−9.5 (1n)		**76.610**	**323.2**	**0.88**	**dm = 0.0**	**2n**	
—	Cou 1347	75.788	103.6	0.49	10.0−10.0	2+2	Cou 1347 = BD+34°4919, ($9^m.4$)
23200−248N3448−81							
10.0−10.2 (4n)							
—	GP 21	74.879	210.9	0.68	dm = −0.2	2+2	GP 21 = BD+29°4929, ($9^m.5$)
23223−272N2953−86							
9.8−9.9 (2n)							
—	GP 3	74.879	117.3	3.61	12.0−12.0	1+2	The position of the pair related to BD+29°4929, ($9^m.5$): Δα = +3s, Δδ = −13′.
23224−272N2941−74							
12.6−12.6 (7n)							
16807	OΣ 497	76.624	217.3	1.40	8.5−9.3	1+2	
23258−309N0856−89		76.689	215.2	1.31	dm = 0.7	2+2	
8.7−9.4		**76.661**	**216.1**	**1.34**	**dm = 0.7**	**2n**	
16826	OL 84	76.624	328.4	1.86	dm = 0.3	1+2	The quadrant determined unequivocally.
23280−328N5036−69							
9.5−9.6							
16879	β 855	74.882	194.7	0.70	dm = 0.2	1+1	
23333−377N6740−73		74.887	191.3	0.73	8.7−9.4	1+1	
9.8−10.1		**74.884**	**193.0**	**0.72**	**dm = 0.4**	**2n**	
16921	β 857	74.887	290.1	1.25	8.5−9.5	1+1	
23359−405N6700−33							
8.4−8.8							
17149	Σ 3050	76.624	304.7	1.52	dm = 0.1	2+2	
23544−595N3310−43		76.689	303.7	1.37	dm = 0.2	2+2	
6.6−6.6	AB	**76.656**	**304.2**	**1.44**	**dm = 0.2**	**2n**	Franz, 1955: −1°.5, −0″.20

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MICROMETER MEASURES OF DOUBLE STARS

(Series 27)

D. J. ZULEVIĆ

(Received 10 October 1976).

SUMMARY:

Presented here are 214 measures of 100 double star,s made with the 26-inch refractor of Belgrade Observatory.

The present list is a continuation of those published earlier (D. Zulević 1976. Series 24) and the arrangement of the measures is the same. An asterisk in the first column of Table I indicares that there is a note at the end the table.

In the present work the distribution of 214 measures of distances is as follows:

Distances	measures
to 0″.50	28
0″.51 to 1″.00	98
1″.01 to 1″.50	58
1″.51 to 2″.00	12
2″.01 or greater	18
	214

Table I

Microneter measures of double stars

ADS	Disc. IDS	Mu.t.	Epoch 1900+	P	ρ	Est. Mag.	n	Notes
102	STF 2 00038N7910		76.78	26°.7	0″.53	6.8−7.1	1	Van Biesbroeck, 54: +0°.9, −0″.11.
207	STF 13 00106N7624		76.70	63.3	0.84	6.7−7.2	1	Heintz, 59: +5°.2, −0″.02,
220	STF 19 00115N3604		76.77	138.2	2.16	7.5−9.6	1	Changed 5° since 1836.
221	STT 4 00115N3556		76.77	182.8	0.58	8.2−8.9	1	
			76.77	179.0	0.54	8.4−9.0	1	
			76.77	180.9	0.56	8.3−8.9	2	Muller, 59: +5°.2, 0″.00.
283	HJ 1018 00154N6707		76.78	87.0	1.30	8.6−9.2	1	Muller, 56: +0°.8, −0″.10.
293	STT 6 00158N6627	AB	76.77	152.9	0.57	7.5−8.5	1	Muller, 54: +1°.1, −0″.02.
684	BU 232 00448N5005	AB	76.70	237.3	0.75	8.5−9.0	1	
			76.77	235.5	0.73	8.4−9.0	1	
			76.78	236.8	0.79	8.5−9.0	1	
			76.75	236.5	0.76	8.5−9.0	3	Baize, 63: +1°.8, −0″.04.

Table I

Micrometer measures of double star

ADS	Disc. IDS	Mult.	Epoch 1900+	P	ρ	Est. Mag.	n	Notes
1371	BU 453		76.70	60.3	ρ<0″.45	10.1−10.4	1	Florsch, 55: Orbite questionable.
	01384N5637							
2034	STT 43		76.77	13.0	0.96	8.3−9.9	1	Heintz, 61: +3°.0, −0″.07.
	02349N2612							
2173	A 1281		76.77	88.6	0.40	9.4−10.9	1	Heintz, 63: +10°.7, −0″.09.
	02449N4535							
2446	STT 53		76.78	264.8	0.79	7.7−8.5	1	Rabe, 48: −2°.4, −0″.07.
	03113N3816		76.78					
2980	A 1710		76.77	338.3	0.43	8.3−8.3	1	Heintz, 69: +11°.3, +0″ 01.
	03595N4309							
3038	BU 546		76.14	42.5	0.88	8.8−8.8	1	Changed 18° since 1878.
	04046N4136							
3062	A 1711		76.14	95.7	0.60	8.2−10.0	1	Changed 39° since 1908.
	04070N4220							
3082	STT 77	AB	76.78	273.4	0.76	8.2−8.2	1	Muller, 57: +4°.9 ,−0″.02.
	04096N3127							
3438	A 1544	AB−C	76.14	26.4	1.29	9.0−10.2	1	
	04404N4313		76.14	28.7	1.31	9.3−10.0	1	
			76.14	27.6	1.30	9.1−10.1	2	Changed 14° since 1907.
3614	HU 445		76.77	260.4	0.36	8.6−8.9	1	Baize, 56: −4°.0, −0″.04.
	04558N2041							
3749	ES 709		76.14	229.5	2.05	10.1−10.2	1	Unchangd since 1909.
	05042N5213							
3799	STT 517	AB	76.77	229.7	0.57	6.9−7.1	1	Ared, 57: +3°.1, +0″.04.
	05083N0151							
4075	A 849		76.77	113.1	0.55	9.0−10.2	1	Changed, 19° since 1905.
	05239S0151							
4208	STF 749	AB	76.21	327.4	0.97	7.2−7.3	1	Changed, 56° since 1829.
	05309N2652							
5186	A 2818		76.14	161.5	1.33	9.7−9.7	1	
	06281N1036		76.14	161.7	1.33	9.7−9.7	1	
			76.14	161.6	1.33	9.7−9.7	2	Unchanged sinice 1914.
5871	STF 1037	AB	76.26	321.2	1.28	7.2−7.2	1	Karmel, 40: +0°.1, −0″.05.
	07066N2724							
6117	STF 1093		76.26	180.6	0.74	8.8−8.8	1	Baize, 58: −6°.0, −0″.01.
	07227N4971							
6582	A 1971		76.14	21.4	0.80	9.1−9.2	1	
	08010S0029		76.14	20.4	0.78	9.0−9.2	1	
			76.14	20.9	0.79	0.1−9.2	2	Changed 84° since 1908.
6650	STF 1196	AB	76.26	300.3	0.93	5.6−6.0	1	
	08065N1757							
6650	STF 1196	AC	76.26	79.3	5.87	5.6−6.5	1	
	08065N1757							
7067	STF 1280	AB	76.26	107.6	1.45	9.3−9.4	1	Rabe, 54: +22°.7, −0″.28.
	08460N7071							

Table I

Micrometer measures of double stars

ADS	Disc. IDS	Mult.	Epoch 1900+	P	ρ	Est. Mag.	n	Notes
7081	AG 08491N1659		76.14	193.0	1.39	9.3–9.4	1	
			76.14	191.9	1.43		1	
			76.26	192.0	1.39		1	
			76.18	192.3	1.40	9.3–9.4	3	Changed 45° since 1912.
7284	STF 3121 09120N2860		76.26	37.4	0.37	9.0–9.0	1	Van den Bos, 38: +0°.5, −0″.06.
7307	STF 1338 09147N3837	AB	76.37	248.2	1.10	6.6–6.8	1	
			76.37	248.4	1.08	6.3–6.8	1	
			76.37	248.3	1.09	6.4–6.8	2	Guntezl-Lingner, 54: −0°.8, +0″.10.
7433	A 2478 09292N1653	AB	76.14	37.4	0.98	8.9–10.0	1	
			76.14	36.4	0.95	9.0–10.2	1	
			76.26	36.1	0.97	9.1–10.1	1	
			76.18	36.6	0.97	9.0–10.1	3	C hanged 9° since 1912.
7601	A 2482 09545N1639		76.14	36.5	0.75	8.9–9.7	1	
			76.14	36.8	0.71	8.9–9.7	1	
			76.14	36.7	0.73	8.9–9.7	2	Changed 16° since 1912.
7704	STT 215 10108N1774		76.26	187.0	1.39	7.3–7.5	1	
			76.26	185.3	1.20		1	
			76.34	185.9	1.30		1	
			76.35	184.0	1.32		1	
			76.36	185.0	1.34		1	
			76.31	185.4	1.31	7.3–7.5	5	Zaera, 57: +3°.3, −0″.06.
7721	STF 1423 10137N2064		76.35	15.1	0.93	9.3–10.0	1	Heintz, 59: +1°.0, −0″.16.
7758	STF 1429 10195N2468		76.14	191.4	0.67	9.0–9.0	1	Changed 80° since 1829.
8032	A 1590 10576N5464		76.27	346.7	1.16	9.2–9.7	1	
			76.35	348.5	1.21		1	
			76.36	346.1	1.13		1	
			76.30	347.1	1.17	9.2–9.7	3	Heintz, 63: +2°.0, −0″.04.
8119	STF 1523 11128N3166		76.26	111.2	2.94	4.4–4.9	1	
			76.34	111.2	2.98		1	
			76.30	111.2	2.96	4.4–4.9	2	Heintz, 66: −1°.1, −0″.11.
8367	HU 733 11529N4836		76.27	161.7	—	9.3–11.1	1	Unchanged since 1904.
8539	STF 1639 12194N2568	AB	76.25	325.6	1.35	6.6–7.8	1	
			76.26	323.9	1.33		1	
			76.34	323.4	1.52		1	
			76.36	329.6	1.32		1	
			76.30	325.6	1.38	6.6–7.8	4	Aller, 51: −0°.8, −0″.08.
8553	STF 1643 12222N2735		76.35	13.3	2.39	9.2–9.5	1	
			76.36	14.4	2.33		1	
			76.37	13.6	2.43		1	
			76.37	13.9	2.40		1	
			76.36	13.8	2.39	9.2–9.5	4	Changed 57° since 1830.
8569	STT 251 12242N3157		76.37	48.7	0.54	8.3–10.6	1	
			76.37	49.2	0.55	8.3–10.0	1	
			76.38	51.2	0.57	8.8–10.0	1	
			76.37	49.7	0.55	8.5–10.2	3	Baize, 57: −2°.5, −0″.04.

Table I

Micrometer measures of double stars

ADS	Disc. IDS	Mult.	Epoch 1900+	P	ρ	Est. Mag.	n	Notes
8630	STF 1670	AB	76.35	299.3	3.73	3.6−3.7	1	Strand, 37: 0°.0, −″0.44.
	12366S0054							
8635	A 1851		76.26	216.5	0.46	10.2−10.6	1	Baize, 65: +9°.2, +0″.06.
	12372N2654							
8680	HU 640		76.26	139.4	0.56	10.1−10.0	1	
	12458N2065		76.37	139.4	0.70		1	
			76.38	138.6	—		1	
			76.44	137.3	—		1	
			76.36	138.7	0.63	10.1−10.1	4	Baize, 56: −3°.3, +0″.10.
8695	STF 1687	AC	76.34	125.4	28.65	5.2−8.0	1	
	12484N2147		76.35	125.3	28.76		1	
			76.35	125.4	28.70	5.2−8.0	2	Unchanged since 1830.
8705	A 1092		76.26	300.5	0.34	8.9−9.9	1	Baize, 59: −11.4, +0.01.
	12517N6986							Zulević, 75: −9.3, 0.00.
8887	HO 260		76.34	68.6	0.96	9.6−9.8	1	
	13189N2945		76.35	70.5	0.99		1	
			76.35	68.1	1.01		1	
			76.36	69.0	0.92		1	
			76.37	69.0	1.04		1	
			76.35	69.0	0.98	9.6−9.8	5	Baize, 67: −0°.3, −0″.01.
8901	A 1609	AB	76.55	75.3	0.30	9.0−9.0	1	Heintz, 67: −11°.5, +0″.06.
	13215N4461							
9031	STF 1785		76.35	156.5	3.21	7.9−8.2	1	
	13445N2689		76.35	156.5	3.40		1	
			76.35	156.2	3.37		1	
			76.36	156.5	3.39		1	
			76.35	156.4	3.34	7.9−8.2	4	Strand, 55: −0°.4, −0″.02.
9071	A 1614		76.36	134.7	1.02	9.4−9.5	1	
	13539N5229		76.51	134.8	0.98		1	
			76.37	136.9	1.14		1	
			76.41	135.5	1.05	9.4−9.5	3	Mourao, 63: −0°.3, −0″.16.
9084	A 569		76.36	132.3	0.55		1	Changed 30° since 1903.
	13566N2551							
9182	STF 1819		76.35	244.8	0.96	7.7−7.8	1	
	14103N0336		76.51	247.5	0.92		1	
			76.43	246.1	0.94	7.7−7.8	2	Hopmann, 45: −11°.8, −0″.10.
9229	STF 1834		76.25	284.3	1.17	7.9−8.0	1	
	14166N4858		76.26	282.2	1.25		1	
			76.37	281.8	1.21		1	
			76.53	282.0	1.11		1	
			76.53	282.2	1.13		1	
			76.39	282.5	1.17	7.9−8.0	5	Van den Bos, 38: −1°.0, −0″.03.
9324	A 347		76.36	98.5	0.56	8.5 −8.7	1	
	14334N4839		76.37	101.6	0.57		1	
			76.51	95.7	0.52		1	
			76.53	99.2	0.53		1	
			76.44	98.8	0.55	8.5−8.7	1	Guntzel-Lingner, 56: −1°.8, −0″.06.
9352	HU 575		76.53	7.5	0.36	10.1−10.6	1	Muller, 52: −5°.8, −0″.19.
	14380N1955							

Table I

Micrometer measures of double stars

ADS	Disc. IDS	Mult.	Epoch 1900+	P	ρ	Est. Mag.	n	Notes
9380	STF 1879	AB	76.25	94.2	1.44	7.6–8.6	1	
	14414N0965		76.35	95.2	1.42		1	
			76.51	93.4	1.38		1	
			76.37	94.3	1.41	7.6–8.6	3	Wierzbinski, 56: +3°.6, −0″.07.
9418	STT 287		76.36	343.8	1.01	8.5–8.6	1	
	14478N4480		76.50	345.9	0.98		1	
			76.43	344.8	1.00	8.5–8.6	2	Heintz, 62: 0°.0, −0″.10.
9578	STF 1932		76.51	247.7	1.31	7.1–7.6	1	Heintz, 64: −0°.8, −0″.02.
	15140N2672							
9617	STF 1937	AB	76.36	234.4	0.63	5.6–.61	1	
	15191N3039		76.51	239.4	0.59		1	
			76.54	238.8	0.69		1	
			76.47	237.5	0.64	5.6–6.1	3	Danjon, 38: −4°.1, +0″.20.
9626	STF 1938	BC	76.54	17.6	1.97	7.2–7.8	1	Baize, 51: +1°.0, −0″.21.
	15207N3742							
9716	STT 298	AB	76.54	207.5	0.82	7.4–7.7	1	Couteau, 65: +2°.2, −0″.08.
	15325N3968							
9769	STF 1989		76.51	32.1	0.60	7.3–8.0	1	
	15451N7917		76.53	33.3	0.58	7.3–8.3	1	
			76.52	32.7	0.59	7.3–8.2	2	Giannuzzi, 56: −4°.9, −0″.02.
9979	STF 2032	AB	76.54	231.1	6.41	5.8–6.7	1	Rabe, 54: −1°.3, −0″.20.
	16109N3367							
10075	STF 2052	AB	76.26	315.6	1.23	7.8–7.8	1	
	16245N1837		76.35	319.2	1.25		1	
			76.50	317.9	1.16		1	
			76.51	318.4	1.20		1	
			76.54	318.4	1.12		1	
			76.55	319.0	1.15		1	
			76.45	318.1	1.19	7.8–7.8	6	Siegrist, 52: +0°.1, −0″.13.
10158	A 349		76.51	179.2	0.39	10.6–11.2	1	Van den Bos, 59: +12°.7, −0″.04.
	16374N3018							
10188	D 15		76.26	326.2	1.23	9.1–9.1	1	
	16408N4340		76.35	326.5	1.06		1	
			76.46	327.1	1.06		1	
			76.50	328.6	1.11		1	
			76.51	324.7	1.19		1	
			76.51	327.3	1.11		1	
			76.43	326.7	1.13	9.1–9.1	6	Wierzbinski, 55: +2°.1, −0″.09.
10235	STF 2107	AB	76.35	86.7	1.16	6.7–8.2	1	
	16479N2850		76.35	87.2	1.20		1	
			76.51	84.2	1.21		1	
			76.51	86.3	1.22		1	
			76.53	84.8	1.25		1	
			76.54	84.6	1.28		1	
			76.47	85.6	1.22	6.7–8.2	6	Rabe, 27: −0°.3, −0″.13.
10279	STF 2118		76.54	70.8	1.07	6.9–7.4	1	Giannuzzi, 56: +1°.8, −0″.16.
	16559N6511							
10786	AC 7	BC	76.36	4.8	0.70	10.2–10.7	1	
	17425N2747		76.51	0.1	0.67		1	
			76.53	5.1	0.67		1	
			76.54	4.8	0.63		1	
			76.48	3.7	0.67	10.2–10.7	4	Couteau, 58: −2°.4, −0″.01.

Table I

Micrometer measures of double stars

ADS	Disc. IDS	Mult.	Epoch 1900+	P	ρ	Est. Mag.	n	Notes
11010	BU 1127 17596N4414		76.55	82.6	0.78	7.4–9.3	1	Popović, 70: +1°.1, −0″.28.
11186	STF 2294 18094N0009		76.35	97.2	0.97	8.5–9.8	1	
			76.50	98.8	1.02		1	
			76.55	99.6	0.94		1	
			76.69	95.2	0.95		1	
			76.69	95.5	0.94		1	
			76.56	97.3	0.96	8.5–8.8	5	Wilson JNR, 35: +3°.3, −0″.04.
11260	HU 197 18150N1014		76.69	154.0	0.46	8.5–9.6	1	Baize, 55: −33°.9, −0″.03.
11483	STT 358 18314N1654	AB	76.35	165.0	1.64	6.8–7.2	1	
			76.50	163.3	1.65		1	
			76.52	165.8	1.67		1	
			76.70	164.5	1.67		1	
			76.52	164.7	1.66	6.8–7.2	4	Heintz, 54: +2°.2, +0″.04.
11479	STT 359 18314N1654		76.73	10.6	0.62	6.4–6.7	1	Symms, 64: +0°.1, +0″.03.
11568	STF 2384 18385N6702	AB	76.51	312.5	0.62	8.6–9.1	1	
			76.52	311.2	0.72		1	
			76.70	311.1	0.76		1	
			76.58	311.6	0.70	8.6–9.1	3	Baize, 50: +2°.8, −0″.22.
11623	A 253 18400N3135		76.51	120.3	0.66	9.1–10.1	1	
			76.53	117.2	0.65		1	
			76.69	120.3	0.66		1	
			76.70	119.5	0.63		1	
			76.61	119.3	0.65	9.1–10.1	4	Muller, 55: +0°.3, −0″.09.
11692	HU 937 18456N6405		76.51	324.9	0.54	8.9–9.3	1	
			76.69	321.8	0.48		1	
			76.70	320.1	0.45		1	
			76.63	322.3	0.49	8.9–9.3	3	Baize, 55: −5°.8, +0″.08.
11897	STF 2438 18558N5805		76.51	5.1	0.81	6.8–7.4	1	
			76.54	4.2	0.75		1	
			76.53	4.6	0.78	6.8–7.4	2	Jastrzebski, 59: +1°.8, −0″.10.
12447	STF 2525 19225N2707		76.51	293.8	1.59	8.5–8.7	1	
			76.66	292.9	1.59		1	
			76.69	295.6	1.65		1	
			76.73	294.6	1.65		1	
			76.65	294.2	1.62	8.5–8.7	4	Finsen, 37: +2°.3, −0″.03.
12889	STF 2576 19418N3322	AB	76.66	1.6	1.71	9.3–9.3	1	
			76.69	3.0	1.59		1	
			76.68	2.3	1.65	9.3–9.3	2	Rabe, 48: +2°.6, −0″.27.
12972	STT 387 19450N3504		76.77	179.5	0.60	6.9–7.9	1	Baize, 61: +6°.8, 0″.00.
13169	A 606 19531N0440		76.69	305.9	0.42	9.5–9.5	1	Baize, 53: −5°.2, 0″.00.
13723	STT 406 20166N4503		76.51	117.6	0.53	7.4–8.3	1	
			76.66	126.2	0.50		1	
			76.69	121.2	0.48		1	
			76.77	123.9	0.57		1	
			76.66	122.2	0.52	7.4–8.3	4	Wierzbinski, 56: +9°.3, +0″.01.

Table I

Micrometer measures of double stars

ADS	Disc. IDS	Mult.	Epoch 1900+	P	ρ	Est. Mag.	n	Notes
13744	A 725		76.69	266.7	0.32	9.3−10.1	1	Muller, 55: +12°.6, −0″.14.
	20177N4417							
13894	A 610		76.50	328.2	0.39	9.2−9.4	1	
	20242N0650		76.51	329.4	0.41		1	
			76.50	328.8	0.40	9.2−9.4	2	Changed 139° since 1901.
14238	BU 64	AB	76.69	159.2	0.49	9.1−9.3	1	
	20403N1222		76.78	162.4	0.61		1	
			76.78	162.7	0.59		1	
			76.75	161.4	0.56	9.1−9.3	3	Baize, 57: −0°.2, +0″.01.
14333	J 194	AB	76.50	208.9	0.50	10.2−10.2	1	
	20446N1102		76.51	207.4	0.56		1	
			76.66	211.5	0.60		1	
			76.78	208.0	0.57		1	
			76.61	208.9	0.56	10.2−10.2	4	Baize, 57: +3°.2, −0″.01.
14424	BU 367	AB	76.51	116.8	0.43	8.6−9.0	1	
	20508N2743		76.78	116.5	0.38		1	
			76.64	116.7	0.40	8.6−9.0	2	Heintz, 61: +0°.9, +0″.09.
14499	STF 2737	AB	76.73	287.5	0.93	5.8−6.3	1	
	20541N0355		76.77	287.8	1.00	5.8−6.3	1	
			76.75	287.6	0.96	5.8−6.3	2	Van den Bos, 33: +1°.9, −0″.11.
14784	STF 2783		76.78	11.4	0.81	7.8−7.8	1	Changed 32° since 1831.
	21114N5753							
14783	H 48		76.51	252.2	0.77	7.1−7.3	1	
	21117N6400		76.69	252.4	0.66		1	
			76.60	252.3	0.71	7.1−7.3	2	Baize, 50: +1°.4, −0″.03.
14889	STT 437	AB	76.78	25.5	2.27	6.9−7.6	1	Changed 43° since 1845.
	21166N3202							
15267	Ho 166		76.77	281.5	0.38	8.8−8.8	1	
	21394N2723		76.77	279.9	0.41		1	
			76.78	281.4	0.38		1	
			76.77	280.9	0.39	8.8−8.8	3	Couteau, 58, −2°.1, 0″.00.
16185	STF 2934		76.77	81.3	0.86	8.7−9.7	1	
	22370N2054		76.77	78.7	0.86		1	
			76.77	80.0	0.86	8.7−9.7	2	Heintz, 60: +5°.6, −0″.02.
16326	A 632		76.70	173.6	0.94	8.2−9.0	1	
	22480N5712		76.77	174.1	0.82		1	
			76.78	173.6	0.87		1	
			76.75	173.8	0.88	8.2−9.0	3	Heintz, 62: +2°.3, 0″.00.
16345	BU 382	AB	76.78	200.0	0.80	5.8−7.8	1	Muller, 54: −2°.2, −0″.14.
	22492N4413							
16373	HU 987		76.70	97.3	0.63	9.1−9.3	1	
	22508N1515		76.77	96.2	0.59		1	
			76.66	101.8	0.86		1	
			76.78	97.3	0.68		1	
			76.73	98.1	0.65	9.1−9.3	4	Heintz, 65: +6°.8, 0″.00.
16836	BU 720		76.78	254.5	0.43	6.0−6.0	1	Widorn, 54: −7°.1, 0″.00.
	23290N3047							
17178	HLD 60		76.70	185.0	1.00	9.2−9.6	1	
	23563N3905		76.77	184.9	1.06		1	
			76.78	184.8	0.93		1	
			76.75	184.9	1.00	9.2−9.6	3	Heintz, 63: +0°.3, −0″.01.

Bull. Obs. Astron. Belgrade, No 128

OBSERVATIONS PHOTOGRAPHIQUES DE LA PETITE PLANETE 433 EROS, FAITES A L'OBSERVATOIRE ASTRONOMIQUE DE BELGRADE,

par M. B. PROTITCH et V. PROTITCH-BENIŠEK

Au cours de l'apparition en 1974/75, la petite planète 433 Eros fut observée plusiues fois à Belgrade. Deux instruments étaient utilisés: équatorial photo--visuel Askania de 12.5/100 cm (AK) et astrographe Zeiss de 16/80 cm (AZ). Les positions précises suivantes sont obtenues avec un rattachement à trois étoiles de repères, dont, les coordonnées sont tirées soit du catalogue Yale, ou bien du catalogue AGK2. Pour les étoiles de ce dernier, les mouvements propres sont empruntés au EBL. Les réductions des positions sont effectuées partiellement à la calculatrice électronique Wang 2200, un programme convenable étant d'abord préparé.

Il nous parait intéressant de noter ici, qu'afin de pouvoir vérifier d'une manière indépendante, la précision de nos positions astrographiques, l'un de nous (Protitch-Benišek V., 1975) avait tenté la déterminaion de la parallaxe solaire, d'après deux positions isolées, obtenues à deux stations différentes. L'essai, qui reposait sur les observations faites à Belgrade, et presque simultanément à Uccle, le 6. février 1975, date ou la planète était stationnaire en α, avait donné un résultat très satisfaisant.

Tableau I

Observations photographiques de la petite planète 433 Eros

No	1974/75	TU	1950.0		fact. par.		Instr.	Obs.
			h m s	° ′ ″	s	″		
1	Nov.	10.92816	6 43 18.04	+ 55 08 16.2	− 0.608	+ 0.70	AK	Pr
2	Nov.	10.95039	6 43 21.83	+ 55 08 28.2	− 0.546	+ 0.13	AK	PB
3	Nov.	12.89552	6 49 07.62	+ 55 25 35.1	− 0.632	+ 1.77	AK	Pr
4	Nov.	13.93580	6 52 09.32	+ 55 34 07.6	− 0.589	+ 0.38	AZ	PB
5	Nov.	16.91218	7 00 42.40	+ 55 55 58.0	− 0.650	+ 0.92	AZ	Pr
6	Déc.	10.92707	7 54 18.30	+ 55 51 01.0	− 0.526	− 0.19	AZ	PB
7	Déc.	31.79335	8 02 04.76	+ 48 08 34.8	− 0.603	+ 2.88	AZ	Pr, PB
8	Janv.	11.83464	7 52 51.79	+ 38 52 54.7	− 0.389	+ 2.10	AZ	PB
9	Janv.	13.80512	7 50 51.20	+ 36 47 26.8	− 0.425	+ 2.77	AK	PB, Pr
10	Janv.	17.81345	7 46 49.03	+ 32 12 10.6	− 0.359	+ 2.94	AZ	Pr
11	Janv.	17.83776	7 46 47.29	+ 32 10 33.3	− 0.303	+ 2.60	AZ	PB
12	Janv.	18.85998	7 45 48.11	+ 30 56 43.2	− 0.234	+ 2.47	AZ	Pr
13	Janv.	23.87316	7 41 30.32	+ 24 41 54.5	− 0.141	+ 3.12	AZ	PB
14	Févr.	6.82662	7 36 08.47	+ 08 09 09.3	− 0.141	+ 5.27	AZ	Pr
15	Févr.	6.84051	7 36 08.38	+ 08 08 19.5	− 0.106	+ 5.25	AZ	PB
16	Févr.	6.85440	7 36 08.27	+ 08 07 29.3	− 0.070	+ 5.22	AZ	Pr
17	Mars	3.86200	7 53 55.22	− 08 30 04.0	+ 0.096	+ 7.00	AZ	Pr, PB
18	Avril	30.82027	9 51 25.95	− 14 59 35.8	+ 0.190	+ 7.41	AZ	PB, Pr

No	Etolies de repères				Dépendances			Rem.
1	Yale 27	4688	4695	4741	0.30885	0.30125	0.38991	1
2	Yale 27	4688	4695	4741	0.31004	0.28848	0.40148	
3	Yale 27	4741	4762	4779	0.26841	0.36049	0.37110	2
4	Yale 27	4766	4777	4836	0.31826	0.35799	0.32375	3
5	Yale 27	4833	4880	4893	0.26559	0.43270	0.30171	
6	Yale 27	5294	5300	5335	0.46920	0.30203	0.22877	
7	AGK2	+48°737	+46°689	+48°747	0.41121	0.25474	0.33405	
8	AGK2	+38°862	+39°939	+38°867	0.28855	0.36839	0.34306	
9	AGK2	+36°792	+37°880	+36°797	0.38832	0.35654	0.25514	
10	AGK2	+32°797	+31°814	+32°812	0.30420	0.29380	0.40200	
11	AGK2	+32°797	+31°814	+32°812	0.29620	0.33756	0.36625	
12	AGK2	+31°807	+31°814	+30°850	0.40727	0.23927	0.35346	
13	AGK2	+25°899	+24°874	+24°887	0.35793	0.34314	0.29893	
14	Yale 22_1	3961	Yale 22_2 Yale 22_1	4002 4013	0.22696	0.28363	0.48940	
15	Yale 22_1	3961	Yale 22_2 Yale 22_1	4002 4013	0.22992	0.27223	0.49785	
16	Yale 22_1	3961	Yale 22_2 Yale 22_1	4002 4013	0.23296	0.26075	0.50629	
17	Yale 16	2928	2942	2973	0.25226	0.41262	0.33512	
18	Yale 12_1	3981	Yale 11 Yale 12_1	3789 4010	0.35254	0.28659	0.36087	

Observateurs: Pr – M. B. Protitch; PB– Mme V. Protitchtch-Benišek.

Remarques: 1 – 433 près de l'étoile anonyme; 2 – image de 433 diffuse; 3 – image de 433 allongée. –

Bull. Obs. Astron. Belgrade, No 128

OBSERVATIONS PHOTOGRAPHIQUES DES COMETES 1973 f (KOHOUTEK) ET 1975 h (KOBAYASHI-BERGER-MILON) FAITES A L'OBSERVATOIRE ASTRONOMIQUE DE BELGRADE,

par M. B. PROTITCH et V. PROTITCH-BENIŠEK

Les condiions d'observations des deux comètes étaient tout à fait différentes. La comète 1973 f etant visible seulement aux crépuscules, bas sur l'horizon, avant et après son passage au périhélie, n'apparaissait que comme objet de faible éclat; de sorte qu'il a fallu recourir à la méthode de Mettcalf de poursuite. Mais une pose assez prolongée avait pour conséquence un fort noircissement des clichés et en méme temps la réduction du nombre des étoiles visibles. Ceci explique pourquois on a du parfois choisir les étoiles des repères trop distantes. Néanmoins, on espère que la précision des positions déduites, ici données, ne descend au-dessous des limites tolérables.

Au contraire, la comète (1975 h) avec sa position boréale très favorable, puis étant un objet suffisamment brillant, ne présentait aucune difficulté pour étre observée avec succès. Malheureusement, l'information attardée sur sa découverte et un certain nombre des nuits du mauvais temps rétrécirent nos observations de cette comète intéressante. Vers la moitié du mois d'août, s'évanouissant dans les brumes de l'horizon, elle devint péniblement accessible pour nous, malgré son éclat encore intensif.

Tableau I

Observations photographiques de comète 1973[f]

No	1973/74	TU	1950.0		fact. par.		Instr.	Obs.
			h m s	° ′ ″	s	″		
1	Nov.	19.17709	12 34 35.37	− 14 22 40.2	− 0.311	+ 7.04	AZ	Pr
2	Nov.	21.18195	12 43 19.07	− 15 13 58.5	− 0.305	+ 6.97	AZ	PB
3	Nov.	22.17779	12 47 52.49	− 15 59 59.7	− 0.313	+ 7.10	AZ	Pr
4	Nov.	23.17848	12 52 36.14	− 16 06 28.4	− 0.313	+ 7.13	AZ	PB
5	Nov.	24.18334	12 57 31.09	− 16 33 34.4	− 0.307	+ 7.16	AZ	Pr
6	Déc.	1.19549	13 36 59.21	− 19 50 28.5	− 0.305	+ 7.34	AK	PB
7	Déc.	6.19931	14 12 09.40	− 22 11 48.9	− 0.336	+ 7.28	AK	PB
8	Janv.	10.68479	21 27 36.69	− 10 55 56.5	+ 0.347	+ 6.73	AZ	Pr
9	Janv.	11.69104	21 39 38.27	− 09 59 14.2	+ 0.347	+ 6.70	AZ	PB
10	Janv.	14.69834	22 14 06.32	− 07 04 19.7	+ 0.332	+ 6.59	AZ	Pr
11	Janv.	15.69523	22 25 13.89	− 06 05 40.5	+ 0.315	+ 6.58	AZ	PB
12	Janv.	22.71527	23 37 33.11	+ 00 29 09.8	+ 0.362	+ 6.14	AZ	Pr
13	Janv.	27.76388	00 21 11.85	+ 04 26 41.7	+ 0.350	+ 5.88	AZ	PB
14	Janv.	29.72880	00 36 12.54	+ 05 45 59.2	+ 0.282	+ 5.66	AZ	Pr

Tableau II

Observations photographiques de comète 1975[h]

No	1975	TU	1950.0		fact. par.		Instr.	Obs.
			h m s	° ′ ″	s	″		
1	Juill.	21.84825	18 45 20.42	+ 48 14 160	− 0.177	+ 0.62	AZ	Pr
2	Juill.	21.87950	18 44 28.91	+ 48 20 58.4	− 0.055	− 0.55	AZ	Pr
3	Juill.	22.84790	18 16 38.29	+ 51 39 49.5	− 0.139	− 0.98	AZ	Pr
4	Juill.	24.83818	17 10 33.80	+ 56 36 20.1	+ 0.119	− 1.76	AZ	Pr
5	Juill.	24.85137	17 10 07.22	+ 56 37 48.6	+ 0.150	− 1.73	AZ	Pr
6	Juill.	29.84442	14 36 22.16	+ 58 01 00.0	+ 0.622	+ 0.75	AZ	Pr
7	Juill.	30.89720	14 13 16.26	+ 57 10 46.5	+ 0.703	+ 2.28	AK	Pr
8	Aout	1.83053	13 38 59.88	+ 55 20 58.0	+ 0.662	+ 1.30	AK	Pr
9	Aout	14.83398	11 56 35.66	+ 44 18 07.0	+ 0.564	+ 5.48	AK	Pr
10	Aout	15.81315	11 52 34.25	+ 43 42 08.2	+ 0.570	+ 5.10	AK	Pr

No	Étoiles de repères						Dépendances			Rem.
1	Yale 11	4547	Yale 12_1	4837	Yale 11	4585	0.23206	0.41280	0.35514	
2	Yale 12_1	4882		4883		4887	0.35446	0.43331	0.21222	1
3	Yale 12_1	4894		4909		4920	0.44670	0.32579	0.22752	
4	Yale 12_1	4923		4931		4943	0.40580	0.33408	0.26012	
5	Yale 12_1	4943		4950		4968	0.21401	0.46806	0.31793	
6	Alg AG	5763	Yale 13	5769	Yale 12_2	5821	0.29798	0.31655	0.38546	2
7	Yale 13	5946		5981	Yale 14	10366	0.37079	0.33244	0.29678	3
8	Yale 11	7587		7595		7677	0.20813	0.42013	0.37174	4
9	Yale 11	7677	Yale 16	7787		7818	0.39510	0.24028	0.36462	
10	Yale 16	7970		7983		7993	0.56166	0.16004	0.27830	
11	Yale 16	8002	Yale 17	7818	Yale 16	8040	0.31963	0.35513	0.32524	
12	Yale 21	5855		5876		5880	0.37704	0.18854	0.43442	
13	Yale 20	56	Yale 22_1	125	Yale 20	79	0.42479	0.21648	0.35872	
14	Yale 22_1	185	Yale 20	125		165	0.30351	0.31974	0.37675	

No	Étoiles de repères				Dépendances			Rem.
1	AGK2	+47°1356	+48°1438	+48°1442	0.38782	0.29807	0.31411	5
2	AGK2	+48°1432	+48°1433	+48°1442	0.26039	0.37859	0.36102	5
3	AGK2	+52°1183	+51°1212	+51°1228	0.38772	0.31313	0.29914	5
4	Yale 27	9146	9172	9188	0.31828	0.36667	0.31505	5
5	Yale 27	9134	9172	9188	0.28167	0.39797	0.32036	
6	Yale 27	8050	8059	8071	0.37678	0.38974	0.23348	5
7	Yale 27	7858	7898	7927	0.38680	0.30509	0.30811	
8	Yale 27	7620	7647	7701	0.24691	0.35192	0.40117	
9	AGK2	+43°1057	+45°0979	+44°1043	0.23462	0.35460	0.41078	3
10	AGK2	+43°1049	+43°1054	+44°1043	0.29004	0.38135	0.32861	

Observateurs: Pr — M. B. Protitch; PB — Mme V. Protitch -Benišek.

Remarques: 1 — près du bord de la plaque; mesure difficile; 2 — étoiles distantes; mesure difficile; 3 — mesure difficile; 4 — étoiles distantes; 5 — comète brillante, mesure assez difficile.

Bull. Obs. Astron. Belgrade, No 128

OBSERVATIONS PHOTOGRAPHIQUES DES PETITES PLANETES FAITES A L'OBSERVATOIRE ASTRONOMIQUE DE BELGRADE,

par M. B. PROTITCH et V. PROTITCH-BENIŠEK

No	Date TU			Équin. 1950.0		O−C		Instr.	Obs.
				1 Ceres					
				h m s	° ′ ″	s	″		
1	1970	Sept.	03.97334	02 36 18.64	+ 02 39 12.1	− 0.04	− 0.2	AZ	Pr
2		Oct.	30.77365	02 04 54.95	− 00 18 29.5	− 0.01	+ 0.7	AK	Pr
3	1975	Nov.	27.74296	04 31 04.54	+ 18 06 58.7	− 0.15	− 2.3	AK	Pr
				2 Pallas					
4	1970	Sept.	25.77540	21 40 39.28	+ 00 35 43.0	− 0.07	− 0.4	AZ	Pr
5	1975	Oct.	25.73048	23 33 35.03	− 12 33 56.4	+ 0.07	+ 0.2	AK	Pr
6		Oct.	26.73047	23 33 11.66	− 12 43 06.5	− 0.12	− 1.3	AZ	Pr
				4 Vesta					
7	1970	Mars	06.84889	09 09 24.74	+ 24 19 21.0	− 0.06	− 0.9	AZ	Pr
8		Mars	08.81034	09 08 08.94	+ 24 25 17.6	+ 0.07	+ 1.3	AZ	Pr
9	1975	Oct.	25.73048	23 32 01.36	− 14 36 32.7	+ 0.05	− 0.8	AK	Pr
10		Oct	26.73047	23 31 43.52	− 14 34 54.2	+ 0.17	+ 1.1	AZ	Pr
				6 Hebe					
11	1970	Janv.	29.82324	07 06 19.62	+ 12 49 36.0	+ 0.06	− 0.7	AZ	Pr
12		Févr.	04.97392	07 02 05.06	+ 13 48 23.8	+ 0.04	− 0.5	AZ	Pr
13	1975	Avr.	08.91370	15 18 11.37	+ 03 37 46.5	+ 0.12	− 1.7	AZ	PB
15		Juill.	04.83335	14 25 41.75	+ 04 45 20.7	+ 0.05	+ 0.7	AZ	Pr
				7 Iris					
16	1975	Mai	29.88133	13 27 20.90	− 14 32 46.4	− 0.11	+ 3.0	AK	Pr
				12 Victoria					
						m	′		
17	1975	Oct.	25.76103	01 50 26.96	+ 17 55 46.4	− 0.1	− 1	AK	Pr
18		Oct.	26.75270	01 49 30.33	+ 17 45 32.1	− 0.1	− 1	AZ	Pr
				14 Irene					
19	1974	Déc.	10.94929	06 37 15.90	+ 24 16 26.2	− 0.1	0	AZ	PB
20	1975	Janv.	11.79957	06 03 50.78	+ 26 36 00.7	− 0.2	0	AZ	PB
				27 Euterpe					
21	1975	Oct.	25.78742	23 54 49.25	− 03 27 13.8	− 0.1	0	AK	Pr
22		Oct.	26.76936	23 54 17.52	− 03 29 43.7	0.0	− 1		
				39 Laetitia					
						s	″		
23	1974	Dec.	31.77738	06 29 03.77	+ 09 28 19.3	+ 0.12	+ 0.2	AZ	Pr
24	1975	Janv.	11.81519	06 19 17.24	+ 10 07 45.4	− 0.09	− 0.5	AZ	PB
				40 Harmonia					
25	1975	Fevr.	10.86515	08 48 29.08	+ 22 41 27.6	+ 0.30	+ 1.4	AK	PB
26		Mars	01.77729	08 32 43.86	+ 23 47 44.3	+ 0.42	+ 2.0	AK	PB
				42 Isis					
						m	′		
27	1975	Oct.	28.80166	03 30 48.33	+ 09 14 58.3	− 0.1	0	AK	Pr
				51 Nemausa					
28	1975	Juill.	04.85072	17 10 24.42	− 06 10 58.7	+ 0.1	0	AZ	Pr
				103 Hera					
29	1975	Oct.	28.80166	03 13 26.73	+ 09 04 30.5	− 1.0	− 5	AK	Pr
				196 Philomela					
30	1975	Nov.	13.78811	02 16 05.13	+ 07 33 47.3	− 1.2	− 7	AK	Pr

No	Étoiles de repères						Dépendances			Rem.
1	Yale 20	729		733		743	0.35968	0.26420	0.37612	
2	Yale 21	422		430		438	0.41483	0.28978	0.29539	
3	Yale 18	1194		1224		1235	0.29897	0.22595	0.47508	
4	Yale 21	5503		5509		5518	0.30307	0.28118	0.41576	
5	Yale 11	8215		BD −13°6436	Yale 11	8236	0.21322	0.43990	0.34688	
6	Yale 11	8218		AG Cambr. M 8228	Yale 11	8235	0.22953	0.34776	0.42271	
7	Yale 25	3669	Yale 24	4878	Yale 25	3691	0.42783	0.22806	0.34411	
8	Yale 24	4831	Yale 25	3669		3691	0.29946	0.28942	0.41111	
9	Yale 12_1	8691		8694		8710	0.34357	0.38414	0.27229	
10	Yale 12_1	8674		8703		8710	0.33249	0.34775	0.31976	
11	Yale 19	2723		2742		2743	0.41691	0.31310	0.26999	
12	Yale 19	2656		2697		2706	0.41588	0.29025	0.29387	
13	Yale 20	5189		BD+ 4°3002	Yale 20	5191	0.37550	0.31458	0.30992	
14	Yale 22_1	6764		6768		6783	0.46975	0.28861	0.24164	
15	Yale 22_1	6694		6709		6723	0.25032	0.48106	0.26862	
16	Yale 12_1	5084	Yale 11	4810	Yale 12_1	5103	0.27871	0.32797	0.39333	1
17	Yale 18	529		530		548	0.30752	0.29956	0.39292	
18	Yale 18	529		530		546	0.36018	0.44250	0.19732	
19	Yale 25	2503		2510		2524	0.24181	0.42290	0.33529	
20	Yale 24	2900		2973		2994	0.35094	0.29007	0.35899	
21	Yale 17	8168		8181		8186	0.36387	0.24819	0.38794	
22	Yale 17	8168		8181		8186	0.46399	0.27292	0.26309	
23	Yale 22_2	2952	Yale 22_1	2990	Yale 19	2329	0.31536	0.27645	0.40819	1
24	Yale 19	2171	Yale 22_2	2837	Yale 19	2235	0.34425	0.35539	0.30035	
25	Yale 25	3552	AGK2	+23°975	Yale 25	3583	0.31311	0.31844	0.36845	
26	Yale 25	3424	AGK2	+23°955	Yale 25	3456	0.32081	0.34703	0.33215	
27	AGK2	+8°366		+9°328		+9°329	0.50068	0.16206	0.33727	2
28	Yale 17	5833	Yale 16	5857		5872	0.30355	0.24061	0.45584	
29	Yale 22_2	1208	Yale 22_1	1209		1235	0.24806	0.47166	0,28028	2
30	Yale 22_1	851		861		871	0.29892	0.36410	0.33698	

Instruments: AZ — Zeiss astrographe de 16/80 cm; AK — Askania équatorial photo-visuel de 12.5/100 cm. — Observateurs: Pr — M. B. Protitch; PB — Mme V. Protićtch-Benišek.
Remarques: 1 — mesure difficile; 2 — près du bord de la plaque.

No	fact. par.		No	fact. par.		No	fact. par.	
	s	″		s	″		s	″
1	− 0.289	+ 5.95	11	− 0.153	+ 4.72	21	− 0.151	+ 6.50
2	− 0.335	+ 6.19	12	+ 0.278	+ 4.85	22	− 0.187	+ 6.49
3	− 0.420	+ 5.32	13	− 0.288	+ 5.87	23	− 0.355	+ 5.53
4	− 0.158	+ 6.10	14	+ 0.122	+ 5.35	24	− 0.213	+ 5.12
5	− 0.253	+ 7.11	15	+ 0.185	+ 4.51	25	− 0.153	+ 3.42
6	− 0.247	+ 7.13	16	+ 0.165	+ 7.41	26	− 0.220	+ 3.44
7	− 0.056	+ 3.06	17	− 0.378	+ 4.90	27	− 0.389	+ 5.70
8	− 0.147	+ 3.18	18	− 0.318	+ 4.11	28	− 0.064	+ 6.79
9	− 0.254	+ 7.24	19	− 0.140	+ 3.17	29	− 0.375	+ 5.64
10	− 0.247	+ 7.26	20	− 0.247	+ 3.13	30	− 0.256	+ 5.46.

Les positions données sous les Nos: 1, 2, 4. 7, 8, 11 et 12 sont revisées à la demande de Mme V. Orelskaya, de l'Institut d'Astronomie théorique à Lenigrade.

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

No	Étoile	Équin. 1950.0		Ep. 1900+
		h m s	° ′ ″	
1	BD +25°2054	09 08 00.94	+ 24 48 09.1	70.2
2	CC Tacubaya, $10^h28^m.0$ −13°.50	10 27 31.77	− 12 51 12.0	70.2
3	BD +4°3002	15 18 18.66	+ 03 51 43.3	75.3
4	BD −13°6436	23 33 56.38	− 12 46 49.5	75.8

OCCULTATIONS OF STARS BY THE MOON OBSERVED AT THE BELGRADE ASTRONOMICAL OBSERVATORY 1974–1975

V. M. PROTITCH-BENIŠEK, M. B. PROTITCH

The occultations of stars by the Moon during 1974 and 1975 were observed at the Belgrade Astronomical Observatory with Askania refractor 135/1600 and Zeiss astrograph 160/800 simultaneously.

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

ZC — Zodiacal Robertson Catalog number

Telescope (Tel) N°4 — Askania refractor 135/1600
,, N°5 — Zeiss astrograph 160/800

Observer (Obs) 4 — M. B. Protitch
,, 22 — V. Protitch - Benišek

Phenomenon (Ph) 1 — Disappearance at Dark limb
2 — Reappearance at Dark limb

Accuracy (A) 1 — excellent
2 — good
3 — fair
4 — poor
5 — very poor
6 — star faint
7 — perhaps early
8 — perhaps late
9 — uncertain (tens of seconds)

Conditions (C) 1 — good conditions
2 — thin clouds
3 — clouds
4 — difficult conditions
5 — not instantaneous
6 — dark limb visible
7 — by averted vision

Timing Metod (MT) 2 — eye-and-ear
3 — chronograph

(O—C) — results given by HMNO.

Table I.

Occultation observations in 1974

Mth	Day	Hr	Min	Sec	ZC	Tel	Obs	PH	A	C	MT	(O—C)
												″
01	04	17	16	48.88	0472	4	4	1	3	4	2	−0.33
01	04	20	37	52.17	0486	4	4	1	3	2	2	+0.05
01	26	17	22	30.49	3340	4	4	1	3	6	2	−0.25
01	27	17	14	22.58	3464	4	4	1	3	6	2	—
01	29	20	13	37.22	0177	4	4	1	1	6	3	—
02	01	16	31	56.96	0573	4	4	1	1	6	3	−0.60
02	01	19	29	38.38	0582	4	22	1	3	6	3	−0.56
02	11	23	19	04.32	1967	4	22	2	3	6	3	+0.04
02	27	18	06	51.30	0397	4	4	1	4	6	3	+0.76
02	27	18	06	56.99	0397	4	4	1	2	6	3	+1.30
03	01	20	26	43.20	SAO 76720	4	4	1	5	6	2	−1.67
03	01	20	27	49.30	0709	4	4	1	4	6	2	−0.29
03	02	19	58	03.57	0861	4	4	1	3	3	3	−0.42
07	02	22	35	49.95	2523	4	22	1	3	3	3	+0.11
07	04	19	56	32.80	2797	4	22	2	8	2	3	—
09	27	16	59	21.57	3163	4	22	1	2	1	3	+0.34
09	27	23	15	05.44	3184	4	4	1	5	2	3	−0.74
09	27	23	18	35.79	3185	4	4	1	2	2	3	−0.58
09	28	20	08	32.04	3290	4	4	1	3	2	3	—
10	28	00	14	53.37	3501	4	22	1	3	2	3	−1.54
11	30	21	28	21.50	0851	4	4	2	8	2	3	+2.98
12	19	16	49	28.03	3272	4	22	1	3	6	3	—
12	21	16	29	39.26	3501	4	4	1	1	3	3	−1.33
12	23	16	37	43.43	SAO 92373	4	22	1	4	1	2	+0.62
12	25	19	14	43.47	0460	4	22	1	3	2	3	−0.01
12	27	16	05	09.53	0752	4	4	1	2	2	3	−0.38
12	27	18	16	53.14	0766	4	22	1	2	2	3	−0.02

Table II.

Occutations observations in 1975

												″
01	16	16	03	42.68	3340	4	22	1	3	6	3	+0.05
01	18	20	14	13.22	0045	4	22	1	6	6	3	—
01	21	17	15	56.49	0402	5	4	1	3	3	2	−0.90
01	21	17	15	56.70	0402	4	22	1	2	3	3	−0.90
01	21	20	47	39.77	0415	5	4	2	6	4	2	−0.72
01	23	23	30	38.55	0725	4	22	1	2	2	3	+0.19
02	17	17	14	36.86	0363	4	22	1	3	6	3	−1.53
02	18	17	06	43.34	0480	5	4	1	3	6	3	−0.01
02	18	17	06	43.20	0480	4	22	1	3	6	7	−0.15
02	22	17	28	37.43	1101	5	4	1	3	2	3	—
02	23	21	09	55.15	1257	4	22	1	8	3	3	+0.06
02	23	21	09	55.23	1257	5	4	1	3	2	3	+0.05
03	03	01	51	03.02	2172	4	22	2	3	2	3	—
03	03	01	51	03.02	2172	5	4	2	2	2	3	—
03	04	02	40	10.76	2319	4	22	2	3	2	3	—
03	16	18	09	33.70	0332	4	4	1	9	4	2	+0.26
03	18	18	00	32.20	0595	4	22	1	2	2	3	−1.05
03	18	18	00	32.43	0595	5	4	1	2	2	3	−1.04
03	25	22	28	04.14	1582	4	22	1	3	2	3	−0.37
04	20	18	29	51.89	1397	5	4	1	3	6	3	−0.03
04	20	22	11	40.73	1412	4	22	1	3	5	3	−0.22
04	20	22	11	40.79	1412	5	4	1	3	6	3	−0.23
04	21	23	13	57.59	1543	4	4	1	3	2	3	−0.16
05	18	21	10	01.09	1495	4	22	1	2	3	3	−0.23
05	21	18	51	19.70	1845	4	22	1	3	4	3	+0.08
06	27	23	57	12.96	3185	5	4	2	3	2	3	+0.80
06	28	00	02	01.37	3184	5	4	2	3	2	3	+0.15
07	17	20	43	57.61	2172	4	4	1	2	6	3	+0.01
07	17	21	07	40.13	2175	4	4	1	3	2	3	−0.45
07	26	22	00	37.06	3370	4	4	2	8	2	3	−0.01
08	15	19	04	18.88	2415	4	4	1	3	2	2	+0.24
09	10	17	55	11.61	2217	4	4	1	5	4	3	−0.32
09	13	19	01	45.02	2666	4	4	1	2	6	3	−0.14
09	14	18	09	09.29	2814	4	4	1	2	6	3	−0.40
09	14	18	33	59.64	2816	4	4	1	3	6	3	−0.91
09	23	00	55	44.64	0240	4	4	2	2	3	3	−0.19
09	23	01	16	01.40	0241	4	4	2	3	3	3	+0.33
09	27	22	26	48.64	0888	4	4	2	3	2	3	−0.79
09	30	04	03	28.26	1197	4	4	2	1	6	3	−0.21
10	08	16	22	29.10	2307	4	4	1	2	2	3	−0.07
10	08	16	43	01.01	2310	4	4	1	2	2	3	−0.61
10	29	03	25	34.82	1397	4	4	2	1	6	3	−0.05
11	13	22	41	12.32	3482	4	4	1	2	2	3	−0.82
11	21	19	30	52.13	0947	4	4	2	2	2	3	+1.03

OBSERVATIONS À LA LUNETTE ZÉNITHALE (DE 110 mm) DU SERVICE DE LATITUDE DE L'OBSERVATOIRE DE BEOGRAD EN 1975

par R. GRUJIĆ, M. DJOKIĆ

Recu le 2 juin, 1976

RÉSUMÉ

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

Les valeurs observées de φ (Tableau I) sont reduites à la manière déjâ signalée (Ševarlić, B., Teleki, G.) mais sans tenir compte des erreurs progréssives et périodiques et de coefficient de température de tour de la vis micrometrique (Milovanovié, 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 (Grujié, R. et les autres).

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

Tableau I

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

Date		τ	OBS.	Tz	Ti	Tv	Bo	GR.	φ_a	φ_b	φ_d
1975				°	°	°			″	44° 48′+ ″	″
I	4	1975.010	RG	− 1.4C	− 1.6C	− 1.7C	747.7	I	10.209	10.299	
		011	RG	− 1.8	− 2.2	− 2.2	747.6	II	10.135	10.174	10.204
	6	.016	MD	9.8	5.4	7.6	739.8	I	10.256	10.218	10.237
	11	.030	MD, RG	3.2	1.8	2.0	746.0	I	10.250	10.224	
		.030	RG, MD	3.4	1.4	2.5	746.1	II	10.251	10.124	10.212
	14	.038	RG, MD	4.4	3.4	3.6	749.1	I	10.323	10.212	
		.038	MD, RG	4.3	3.0	3.4	748.9	II	10.080	10.196	10.203
	18	.049	RG, MD	5.9	4.2	4.6	739.4	II	10.251	10.210	
		.049	MD, RG	4.4	3.0	3.2	738.8	III	10.046	10.069	10.144
	27	.074	MD, RG	1.2	1.1	1.0	737.2	II	10.241	10.210	
		.074	RG, MD	0.3	0.6	0.4	735.0	III	10.140	10.122	10.178
II	6	.101	MD, RG	− 1.0	− 1.4	− 1.6	749.6	II	10.140	10.297	
		.101	RG, MD	− 0.9	− 2.0	− 1.6	748.0	III	10.091	10.103	10.158
	10	.112	RG, MD	2.5	− 0.7	− 0.5	742.2	II	10.189	10.254	
		.112	MD, RG	1.8	− 0.3	− 0.2	741.9	III	10.104	10.170	10.179
	17	.131	RG	− 3.6	− 2.0	− 2.9	754.0	II	10.279	10.288	
		.131	RG	− 4.4	− 3.6	− 4.0	753.3	III	10.194	10.143	10.226
	18	.134	MD	− 1.4	− 1.2	− 2.0	748.3	II	10.249	10.271	
		.134	MD	− 1.5	− 2.6	− 2.7	747.1	III	10.136	10.156	10.203
	27	.158	RG, MD	0.1	− 0.4	− 0.6	749.2	II	10.203	10.148	
		.159	MD, RG	− 1.6	− 1.6	− 1.8	748.2	III	9.964	10.039	10.088
III	1	.164	MD, RG	8,6	4.4	5.0	741.7	II	10.259	10.167	
		.164	RG, MD	8.0	4.3	5.8	741.0	III	10.021	10.088	10.134
	8	.183	RG	14.9	12.2	12.6	735.6	III	10.210	10.196	10.203
	12	.194	RG	11.0	11.4	11.0	736.1	III	10.179	—	10.179
	16	.205	RG	9.8	9.8	9.6	734.6	III	10.188	—	10.188
	18	.210	RG	9.2	9.2	8.7	736.0	III	10.156	10.170	
		.211	RG	8.0	8.0	7.7	736.3	IV	10.190	10.289	10.201
IV	8	.268	RG	6.7	10.8	9.0	737.2	III	10.251	10.223	10.237
	9	.270	MD	10.4	11.3	10.5	736.3	III	10.177	10.080	10.128
	12	.279	RG	5.6	7.7	7.0	740.5	III	10.214	—	10.214
	15	.287	MD	15.7	14.0	14.0	731.8	III	10.194	—	10.194
	20	.301	RG, MD	11.3	10.8	10.4	740.9	III	10.335	10.216	
		.301	MD, RG	8.4	8.6	8.4	741.1	IV	10.348	10.193	10.273
	29	.326	MD	12.0	10.4	9.9	738.6	IV	10.264	10.416	10.340

DATE		τ	OBS.	Tz	Ti	Tv	Bo	GR.	φ_a	φ_b	φ_d
V	4	.339	RG	11.0	11.3	10.6	740.0	IV	—	10.310	10.310
	7	.348	RG	16.0	16.6	16.3	736.1	IV	—	10.369	
		.348	RG	15.0	15.4	15.2	735.7	V	10.323	10.327	10.340
	10	.356	RG	14.3	14.2	13.4	739.2	IV	10.308	10.393	
		.356	RG	13.2	12.8	12.5	738.8	V	10.384	10.374	10.365
	18	.378	RG	17.6	18.4	17.6	742.6	IV	10.151	10.291	
		.378	RG	17.0	16.6	16.2	742.6	V	10.406	10.445	10.323
	19	.380	MD	19.0	18.6	18.1	741.6	IV	10.266	10.252	10.259
	21	.386	RG, MD	18.4	18.0	17.5	739.4	IV	10.251	10.242	
		.386	MD, RG	17.4	16.7	16.4	738.9	V	10.182	10.393	10.267
	29	.408	MD, RG	18.8	18.6	18.6	736.0	IV	10.168	10.253	
		.408	RG, MD	17.8	17.8	17.7	735.6	V	10.310	10.338	10.267
VI	9	.438	RG	13.4	13.6	13.6	736.4	V	10.354	10.297	10.326
	11	.443	RG	16.7	16.4	16.3	741.2	IV	—	10.381	
		.444	MD	15.3	15.2	15.1	741.1	V	—	10.280	10.330
	15	.453	RG	22.2	21.8	21.6	736.3	IV	—	10.275	10.275
	26	.484	RG	21.6	21.0	20.0	738.6	IV	—	10.404	10.404
	28	.490	RG	22.8	21.8	21.4	738.4	V	10.385	10.388	10.386
	29	.493	MD	18.4	19.8	18.7	739.7	V	10.412	—	10.412
VII	3	.504	MD	16.1	16.9	16.6	736.9	V	—	10.376	10.376
	8	.518	MD	18.5	18.5	18.0	741.0	VI	10.522	—	10.522
	9	.520	RG	20.0	19.0	18.4	741.0	V	10.481	10.499	
		.520	RG	19.2	18.2	18.0	740.7	VI	10.478	10.412	10.468
	13	.531	RG	19.4	20.7	19.8	742.7	V	10.420	10.384	
		.531	RG	17.5	18.8	18.2	742.1	VI	—	10.525	10.443
	14	.534	MD	21.4	21.4	20.9	743.2	V	10.489	10.412	
		.534	MD	20.4	20.1	19.9	744.1	VI	10.551	—	10.484
	15	.536	RG	22.4	21.9	21.4	739.7	V	—	10.336	10.336
	17	.542	MD, RG	21.2	21.4	20.6	738.2	V	10.519	10.475	
		.542	RG, MD	19.8	19.8	19.0	738.4	VI	10.571	10.407	10.493
	21	.553	RG	19.8	21.0	20.0	736.8	V	10.312	—	10.312
	26	.567	RG	13.4	15.3	14.2	743.6	VI	10.536	10.440	10.488
	29	.575	RG	19.0	20.2	19.5	740.0	V	—	10.437	
		.575	RG	18.1	18.8	18.4	739.6	VI	10.470	—	10.454
VIII	11	.610	MD	21.9	22.6	21.6	739.4	V	—	10.355	
		.610	MD	21.3	21.0	19.9	739.2	VI	10.486	—	10.420
	22	.641	MD	17.3	18.2	17.8	736.8	VI	10.447	10.436	10.442
IX	6	.681	RG	18.4	19.7	18.8	740.6	V	—	10.426	
		.682	RG	17.5	18.0	17.4	740.6	VI	10.620	10.582	
		.682	RG	16.6	16.9	16.6	740.2	I	10.667	10.537	10.566
	10	.692	MD	13.2	13.1	12.8	741.8	VI	10.470	10.553	
		.693	MD	12.6	12.2	12.0	741.5	I	10.531	—	10.518
	11	.695	RG	15.0	15.0	14.8	738.6	VI	10.541	10.493	
		.696	RG	14.6	14.2	14.4	737.9	I	10.631	10.425	10.522
	14	.703	MD	16.2	16.0	16.4	739.2	VI	10.567	10.610	10.588
	15	.706	RG	18.2	18.0	17.9	742.2	VI	10.552	10.492	10.522
	18	.714	MD	15.8	17.7	16.5	747.7	VI	10.581	10.450	
		.715	RG	14.6	16.0	15.8	747.4	I	10.493	10.418	10.486
	20	.720	MD	16.4	16.8	16.4	745.0	I	10.588	10.387	10.488
	25	.733	RG	18.8	18.5	18.2	740.3	VI	10.530	10.604	10.567
X	15	.788	RG	8.8	8.4	8.2	741.9	VI	10.514	10.505	
		.788	RG	8.6	7.8	7.8	741.9	I	10.398	10.390	10.452
	25	.815	RG	6.9	8.4	8.0	749.0	VI	10.509	10.479	10.494
	27	.821	RG	8.0	8.0	7.8	750.5	I	10.386	—	10.386
	28	.824	MD	11.8	10.1	10.4	749.1	VI	10.457	10.450	
		.824	MD	10.2	9.0	9.2	749.6	I	10.600	10.357	10.466
XI	1	.834	RG	6.7	7.0	7.0	743.6	VI	10.386	—	
		.835	RG	6.6	6.5	6.6	744.0	I	10.550	—	10.468
	2	.837	MD	8.6	9.0	8.7	746.4	VI	10.427	10.477	
		.838	MD	7.1	7.3	7.4	747.2	I	10.420	10.280	10.401
	6	.849	RG	7.4	6.8	6.9	745.6	I	—	10.430	10.430
	25	.900	RG	− 6.2	− 3.6	− 4.2	745.2	I	10.373	10.241	
		.901	RG	− 7.5	− 5.1	− 5.9	744.8	II	10.294	10.319	10.307
XII	2	.920	RG	1.8	1.9	2.2	740.2	I	10.457	10.142	
		.920	RG	1.9	1.6	2.1	739.7	II	10.398	10.330	10.332
	23	.977	RG	1.4	0.8	0.8	749.3	I	10.351	10.248	
		.977	RG	− 0.2	− 0.1	− 0.2	749.0	II	10.432	10.205	10.309
	29	.993	RG	2.5	2.0	1.9	746.0	I	10.437	10.211	
		.994	RG	0.0	0.5	0.0	746.2	II	10.318	—	10.322

LA LÉGENDE:

Date: Année, mois et date d'observation.

τ Partie d'année tropique.

OBS.: Observateurs R. Grujić (RG), M. Djokić (MD). Dans les cas où le même groupe a été observé par tous deux observateurs, le premier observateur a observé le sousgroupe **a** (φ_a) et le second le sousgroupe **b** (φ_b).

Tz: Température **a** 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 cous-groupe **a**, resp. **b**.

φd: La valeur moy. de la latitude de la nuit.

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2. Milovanović, V., et les autres, „Bulletin de l'Obs. Astr. de Beograd, Vol. XXVIII, No 124, p. 159, 1970."
3. Grujić, R. et les autres, „Bulletin de l'Obs. Astr. de Beograd No 126, p. 22, 1975".

TABLE DES MATIÈRES