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OBSERVATIONS OF THE SUN, MERCURY AND VENUS IN BOTH COORDINATES, MADE WITH THE LARGE MERIDIAN CIRCLE OF BELGRADE OBSERVATORY

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Visual observations of the Sun, Mercury and Venus in right ascension and declination, are carried out at the Belgrade Observatory by the Group for Relative Coordinates, since 1973. In the first two years the observations had but a preliminary character, whilst regular ones started in 1975.

The observations being performed by day, a special protection of the instrument against the solar radiation has been secured. An impregnated linen shield, whose width corresponds to that of the pavilion's opening (2.20 m), is fixed along the whole arc of the roof slit. The shield consists of two parts — north and south one — overlapping each other in the zenith by more then one meter. The south part bears five circular holes, 19 cm in diameter, at approximately equal distances along the shield. The holes are provided with covers from the same material as the shield. During the observation the observer is able to open the hole by means of strings, 12 m long, tied up to the covers. The cover is removed from the hole a few seconds before the appearance of the object to be observed.

The Sun is observed through the Suharev filter, acquired from the Pulkovo Observatory, while Mercury and Venus are observed through black filter. The Suharev filter is actually an aluminized plane — parallel glass plate, letting in no more than 0.0001 of the light. Placing a plate like this before the object glass means preventing the excessive energy to pass through the object glass. In this way the conditions under which the Sun is observed are approching those prevailing when the Moon or stars are observed. Investigations have shown that trembling of the Sun's edges is substantially reduced as compared to that found when the observation is made through diaphragm and solar eye-piece.

The sequence of measurements for the Sun is the following: first, the measurement is made of declination of the lower edge, then of right ascension of the front and back edges, and at last the declination of the lower edge. Venus is observed upon the edge illuminated by the Sun, when the former is in phase, and when „full" in the same way as the Sun. Mercury, when sharply visible, is observed like Venus, but most ofen by bisecting the centre of its disk.

In the Instructions of the XV Astrometric Conference held in Pulkovo, 1960, it is emphasized that the observations of the Sun, Mercury, Venus and Mars are essential for the determination of the zero-point of stellar catalogues as well as for the determination of the corrections of Earth's orbit elements. The observations are to be extended over a whole number of years (8), as evenly as possible distributed in time, at equal zenith distances, not trespassing the 75° limit. The observations should be carried out differentially, respecting thereby, as much as possible, the selection of reference stars and other conditions, adopted when composing differential catalogues. In the period of observation the principle should be followed not to change the observing team and personal errors should be investigated.

As the choice of reference stars for the observations by day is very limited, they take several hours. It is therefore recomended, in case the determination of the reduction quantities ($u + m$, n, equator point M) was impossible by stars, to use laboratory and physical methods (meridian marks, levels, mercury horizont, collimators). When the observation of stars is possible, then they should be as close in right ascension and declination to the observed planetary bodies, as possible, in our case the Sun, Mercury, Venus and Mars.

In Belgrade it is impossible to fulfill the last condition thus we were led to include in our programme of observations by day all fundamental stars with declinations from $-30°$ to $+90°$, striving however to satisfy requirements as to the proximity in right ascensions.

From the experience of other authors, engaged in this kind of work, we see that the values m and n, deduced from a small number of stars observed by day, are unreliable, and we decided to include in the evening series, observed whithin the *PZT* programme, also a few fundamental stars near the equator. All fundamental stars from the evening series, observed at upper as well as at lower transits, together with the clock correction, enable us to obtain more reliable values of these quantities. In that case, before and after observations by day or by night, a comparison is made of the clock and our chronograph, disposing of its own quartz oscillator for conversion into mean time.

Our observations by day last about four hours on the average. In the sommer period we have an inferior number of the observed fundamental stars than in the three remaining year's seasons. Then we are able to observe stars up $3^m.4$, while in sommer only up to $1^m.2$. We are therefore induced to observe a greater number of Kuestner series in sommer then in winter.

The transits of the Sun, Mercury and Venus are measured between the 7th and 9th wires, corresponding to a distance of three revolutions of the eye-piece micrometer, and the settings in declination are made between the 5th and 6th wires, five times consecutively, approximately equally spaced.

For the registration of the transits time there is a printing chronograph, 21-372 *P* type, driven, as already stated, by a quartz oscillator of its own. The mean time of transit is determined from 10 symetrically spaced contacts. The value of a revolution of the eye-piece micrometer is $2^s.700$. This value has been tested in 1975 from star observations and has proved unchanged as compared to the earlier examinations. The value of a revolution in declination is $20''.306$.

The ephemeries for the Sun, Mercury and Venus have been computed at GAO AN SSSR in Pulkovo for the period 1972—1980.

The right ascension and declination are computed according to formula:

$$\alpha_{app} = T' + R \sec \delta + (u + m) + n \operatorname{tg} \delta;$$

$$R = c + a \cos \varphi + \frac{\omega}{2};$$

$$\delta_{app} = M - M_0 \qquad / \; CE \;;$$

$$\delta_{app} = M_0 - M \qquad / \; CW \;;$$

$$M = M' + m r + \Delta \lambda + \rho + f \sin z;$$

where: T' — time of transit over mean wire,
c — collimation,
a — constant of diurnal aberation,
ω — wire width,
M' — circle reading,
m — reading of the eye-piece micrometer,
$\Delta \lambda$ — correction of the graduated circle,
f — flexure.

In the course of the observation, lasting, as already mentioned, about four hours, the collimation is measured in the middle of the series and the flexure before and after observing the Sun. In case only one edge of the disk-like body has been observed, a corection for its apparent semi-diameter has been applied in the reduction, while a correction for the distortion of the illumination of the disk in declination has been introduced.

In 1975 we have carried out 22 observations of the Sun, Mercury and Venus along with a total of 100 stars.

We are convinced that we shall complete this work succefully. The observations will be made regularly and the reduction will be carried out after the completion of the Catalogue of *PZT* programme stars. We are going to increase, if possible under these conditions, the number of daily observations, and especially every suitable day will be used around the vernal and autumnal equinox.

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