values fall within the pycnometric region at this altitude which was described earlier. The density implied by this atmosphere at the pycnometric level of 750 km is $1{\cdot}2\times10^{-16}$ g/cm^3.

The atmospheric density profile which follows Nicolet's theory and is adjusted to fit the 1958 β_2 data is shown in Fig. 3. This atmospheric model is consistent with the satellite observations made at the higher altitudes in the $68^{\circ}\!6$ latitude belt centered on the equator.

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13. ON BRIGHTNESS VARIATIONS OF ARTIFICIAL SATELLITES

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It is well known that the brightness of artificial satellites is variable.

Regular observations enable us to establish:

1. the rotation period;
2. the variation of the period;
3. the direction of the axis of the satellite;
4. the variations of this direction as a result of precession.

Many brightness observations of the second and third satellites have been obtained by Soviet astronomers. The preliminary results are as follows:

(1) Observations of the second sputnik were made at many stations, especially in Odessa, Gorky, and Leningrad. The treatment, by V. Grigorevsky, of a part of these observations has shown that the brightness variations resemble those of a diffuse scattering body. A large number of light-curves were obtained. Changes in the distance of the sputnik from the observer, as well as the effect of phase angle, were taken into account. After an exhaustive examination of these light-curves we expect to determine the direction of the axis of rotation.

The formula for the period of rotation is:

$$\text{J.D. of maxima} = 2\,436\,187{\cdot}654\,21 + 0^{\mathrm{d}}001\,208\,907\,56\,E + 0^{\mathrm{d}}000\,178\,9\,(E\times10^{-4})^2.$$

(2) The rocket of the third satellite changes its brightness very rapidly and with a large amplitude. Many times of light-maxima were obtained by us. These times are represented by the formula:

Times of maxima $= 1958$ July $23.\,032\,135 + 0^{\mathrm{d}}000\,101\,189\,2\,E + 0{\cdot}000\,068\,7\times10^{-8}\,E^2$. During each passage of the rocket there are some definite deviations from the formula

$$M = M_0 + P'.E,$$

where P' is a temporary value of the period. These deviations enable us to determine the direction of the axis.

We suppose that:

(*a*) the shape of the rocket is cylindrical;
(*b*) the axis of rotation is perpendicular to the cylinder axis;
(*c*) the rocket body does not scatter solar light, but reflects it.

We choose three systems of rectangular co-ordinates; in each case the centre of the rocket coincides with the origin of the co-ordinate system. The three systems are:

$O\xi\eta\zeta$: equatorial system;

$OXYW$: the rocket-body system, in which OW is the axis of rotation and OX is the direction of the cylinder axis.

$OUVW$: the system obtained by rotating $OXYW$ through an angle ϕ, about the axis of rotation OW.

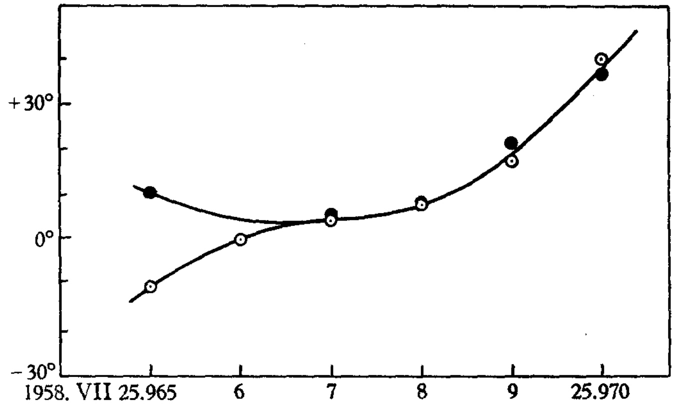

Fig. 4. Showing observed (open circles ⊙) and computed (filled circles ●) values of ϕ during the passage of the rocket of the third sputnik on 1958 July 25·96.

The equatorial 'rocketocentric' co-ordinates α_N, δ_N of the direction of the normal to the rocket body, at the moment of light-maximum, can be found from the bisection of the directions from the rocket to the Sun and to the observer. The angle ϕ may then be obtained from the relation:

$$\cot \phi = \sin I \cot (\alpha_N - K) - \cos I \tan \delta_N \operatorname{cosec} (\alpha_N - K),$$

where K and I are the equatorial co-ordinates of the axis of rotation OW.

During the passage of the rocket on 1958 July 25·96.

$$K = 167°; \quad I = 21°.$$

The observed and computed values of the angle ϕ are shown in Fig. 4.