ON THE ABSOLUTE DETERMINATION OF THE BRIGHTNESS FACTOR OF THE SURFACE OF SATURN

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(Summary)

In September 1935 I carried out some photometric observations of the planet Saturn with the aid of a Rosenberg photometer installed on the 9" refractor of the Erevan Observatory. My purpose was to test and compare some of the methods proposed by me for the absolute determination of the brightness factor (diffusion factor) of the surface of celestial bodies.

The observations were made during 5 nights. The brightness of the central, most bright portion of the planet disc was measured. After performing the observations the photometer was compared to the laboratory standard of brightness which allowed to find the apparent brightness of the planet surface in laboratory units-stilbs. To find hence the true brightness of the planet we must introduce the correction to the atmospheric extinction. In this view were used the values of the transmission factor of the atmosphere, determined on the same date in the daytime from the measurements of the solar illumination with the wedge solar photometer, the calculations being based upon the hypothesis that the transmission of the atmosphere is the same at day and in the night. Of the values of brightness B (outside the atmosphere) obtained, was calculated the brightness factor r from formula:

$$r = \frac{\pi B}{E \odot} \Delta^2 h$$

where $E_\odot$ is the luminous solar constant, for which the value 13,5 phots was adopted, and $\Delta_\mathfrak{h}$ is the radius vector of Saturn at the moment of observation expressed in astronomical units.

The second method of determination of the brightness factor was based upon the comparison of the brightness of the planet to the brightness of the translucent diffuse screen. The paper screen was set on the objective of the refractor, directed upon the sun, and the brightness obtained in the field of sight was measured. The brightness factor r is found in this case with regard to the brightness of Saturn and the screen $B_\mathfrak{h}$ and B_s from the formula:

$$r = r_s \frac{B_\mathfrak{h}}{B_s} \frac{\tau_s}{\tau_\mathfrak{h}} \frac{\Delta^2_\mathfrak{h}}{\Delta^2_\odot}$$

where $\Delta_\odot$ is the radius vector of the Earth at the moment of the observation of the Sun $\tau_s / \tau_\mathfrak{h}$ is the ratio of the transmission of the atmosphere during the observation of the Sun and of Saturn, and r_s is the brightness factor of the screen. The latter was determined from laboratory tests and was found equal to 0.169.

The third method of determination of r consisted in comparing the brightness of the surface of Saturn B to the illumination from the Sun E, measured from the Earth. I used the measurements of the solar illumination carried out by me in Erevan with the wedge solar photometer. They are given in detail in another work.

The solar photometer was compared to the Rosenberg photometer by means of observations of the sky, which gave the factor k serving to reduce the results of both photometers to the same photometric system. The brightness factor r was then calculated on the basis of the equation:

$$r = k \frac{\pi B}{E} \frac{\Delta^2_\mathfrak{h}}{\Delta^2_\odot}$$

The results of all measurements are given in the table below.

Table.

№ №	Date	Hour	r			Mean
			Method of absolute brightness	Method of translucent screen	Method of comparison to illumination on the Earth	
1	Sept. 10	25h 28m	0,26	0,34	0,33	0,31
2	11	23 45	0,27	0,37	0,32	0,32
3	12	22 57	0,20	0,27	0,23	0,23
4	12	22 58	0,21	0,29	0,24	0.25
5	13	21 21	0,19	0.26	0,22	0,22
6	13	21 25	0,20	0,27	0,23	0,23
7	15	21 17	0,38	0,48	0,44	0,44
8	15	21 21	0.32	0,39	0,36	0,36
9	15	21 27	0,32	0,39	0,37	0,36
	Mean		0,26	0,34	0.30	0,30

This table shows that the different methods of determination of the brightness factor give results agreeing well inter se. Somewhat unexpected is the value—0,30 of the brightness factor itself, which does not agree with the planet albedo, having the value 0.60 according to Russell. Whether this difference is real, or it is due to systematic errors of observations it is impossibie to say at present, as the systematic errors may be rather great in this work of mine, being but of a preliminary character.