An effect of circular objective diaphragms in photographic photometry

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An effect of circular objective diaphragms in photographic photometry,

by *L. Binnendijk.*

The present note is a by-product of a yet unpublished investigation of photographic magnitudes of stars in the Pleiades.

The exposures used were made with the Leiden refractor, slightly extrafocally (1·5 mm).

On plates (Imperial SS and Eastman 40) containing two exposures of the same duration (30 minutes), of which one was taken with an objective grating ($d = l = 3{\cdot}6$ mm) and the other with free objective, the gradation of the grating exposure was found to be smaller than that obtained with the free objective.

It was suggested to me by Dr. A. J. Wesselink that this effect might be due to the diameter of the grating (29·4 cm) being smaller than the aperture of the objective (32·3 cm).

Table 1.

Plate	b
1120	— ·043
1125	+ ·003
1205	— ·051
1206	— ·071
1215	— ·135
1218	— ·073
1222	— ·041
1235	+ ·018
1302	— ·029
1574	— ·050
1579	— ·069
1580	— ·055
1605	— ·090
1607	— ·102
1625	— ·030
1927	— ·029
1931	— ·059
3873	— ·023
Mean:	— ·052 ± ·008

In fact the gradations of the two exposures were found equal in the case a new grating covering the whole objective was used.

By means of the grating exposure a curve for the relation between galvanometer reading and provisional magnitude (see *B.A.N.* No. 318) was constructed for each plate. With the aid of this relation the magnitude of the central image (m_c) was determined for each star. The same relation was used for the determination of the magnitude of the image corresponding to the exposure taken without grating (m_o).

Then a least squares solution was carried out of the form

$$m_c - m_o = a + b\,(m_c + m_o).$$

The values of b thus obtained for each plate are contained in Tables 1 and 2 for the smaller resp. larger grating, in case at least 8 normal points are present. Each normal point contains about ten values.

The ratio of the gradations of the exposures with and without grating is approximately $1 + 2b$.

The values b in Table 1 are systematically negative, whereas those in Table 2 do not deviate systematically from zero, in accordance with the statement made above. The dispersion in the values of b is chiefly due to the differences in seeing.

An additional proof of this phenomenon was obtained from a plate taken with the larger grating in combination with various diaphragms. The same effect as in Table 1 was found. The influence of the diffraction rings is very small.

Different diaphragms leave the distribution of the energy in the stellar image as a function of the distance from the centre and of the wavelength the same, apart from the linear scale, which is proportional tc the size of the diaphragm.

Table 2.

Plate	b
4198	+ ·006
4243	— ·023
4255	+ ·002
4271	— ·020
4342	+ ·015
4585	+ ·029
4597	— ·015
4598	— ·024
4600	+ ·026
Mean:	·000 ± ·007

This change of size of the image with the size of the diaphragm apparently gives rise to the variation of the gradation, when the images are measured in the Schilt photometer.