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Leiden XI. 3) amounts to 390 and 309 stars 10^m. The background light caused by the system stars II and IV is found 238 and 200 (238 corresponds to 2.0 on my scale, just the brightness observed in the faint Cygnus region); thus for the cloudstars there remains only a surface brightness of 152 (Cygnus) and 109 (Sagitta).

TABLE 7.

	I	II	III	IV	Cygnus. log *A*	*L*	*F*	Aqu. — Sagitta. log *A*	*L*	*F*
9.0	0.98	1.01	0.80	0.86						
10.0	1.43	1.45	1.29	1.33						
11.0	1.86	1.86	1.77	1.76						
12.0	2.33	2.23	2.26	2.16	1.64	7	22	1.57	6	18
13.0	2.86	2.58	2.82	2.53	2.54	22	7	2.51	20	5.5
14.0	3.44	2.90	3.52	2.87	3.29	49	3.1	3.41	65	1.7

This table shows that the stars between 11^m and 14.5^m produce already half or more than half the light of the clouds; the central magnitudes are found 14.5 and 13.9. The stars constituting these galactic clouds appear to be concentrated within an extremely narrow range of magnitudes, in the same way or still more so than in open clusters. The data are not sufficiently accurate to allow more exact deductions on the luminosity curve. If we might suppose that these stars are giant stars of the same absolute magnitude as in open clusters, we could derive some value for the distance; but the difference of these systems seems too great to allow such a deduction. While for an open cluster, a small dense agglomeration in a space of extremely small density, the scantiness of dwarf stars is easily understood as an equilibrium phenomenon, this is not the case with such a vaste cloud containing hundred-thousands of bright stars.

Still more remarkable than this great Cygnus cloud seems the region of Sagitta and the adjacent parts of Aquila. While the moderate brightness of the galactic light shows nothing particular, the number of small stars is as excessive as in the brightest parts. HERSCHEL and EPSTEIN counted here some of their richest fields *) and also the Carte du Ciel has some extremely rich charts here, partly at the border of the galactic stream, where its light becomes faint already. This abundance of stars extends only over very few magnitudes, indicating some kind of giant stars of one definite brightness. In this connection attention may be drawn to the great number of faint variable stars found by MAX WOLF 1905—06 just in this same region and in the southern part of the Cygnus cloud (*Astr. Nachr.* **165**, 199; **166**, 78, 363: **168**, 145; **169**, 407; **170**, 361; **172**, 349). They seem not to have been studied afterwards, and the wide intervals of date of the Heidelberg photographs do not allow to decide whether their periods are short; if many of them should prove Cepheids it is probable that they are part of the same agglomeration, whose distance could then be determined by their means.

*) The gauges of HERSCHEL surpassing 400 are: 612 and 480 in the Cygnus cloud, 424, 588, 600, 588, 440 in Aquila-Sagitta. EPSTEIN has only two fields > 600 per squ. degree, both in Sagitta.

New reduction of Von Zeipel's magnitudes in Messier 3,

by *A. Pannekoek*.

In 1908 H. VON ZEIPEL published a catalogue of 1571 stars in the globular cluster *Messier* 3, compiled from measures of three photographs taken 1905 with the astrographic refractor of the Paris observatory (*Annales de l'Observatoire de Paris, Mémoires* XXV). As at that time faint stars could not yet be standardized by the Polar Sequence, the magnitudes were computed from the diameters by a linear formula, derived from some brighter stars. Since these magnitudes deviate considerably from the international scale adopted in the Polar Sequence, a new reduction is necessary. It has been effected by comparing them with the very accurate magnitudes derived for the outer parts by HARLOW SHAPLEY from the Mount Wilson plates (Photometric Catalogue of 848 stars in Messier 3; *Aph. J.* **51**, 148—164; *Contrib. Mt Wilson* 176).

On the Paris plates (taken with exposure times 2^m, 1^m, $\frac{1}{2}^m$, and designated by these figures) VON ZEIPEL has not only measured or estimated the diameter, but also the blackness of the star images on a scale from 0 to 10; as a result of two measures $2d$ and $2n$ are given as varying from 2 to 20 ($2d$ of course for the brightest stars still higher). Comparing them with the Mt Wilson magnitudes it appeared that for fainter stars the blackness decreases far more regularly than the diameter, so that the magnitude depends much more on $2n$ than on $2d$. A reduction table was constructed, at first for the most numerous stars (470) of plate 2; an extract of

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it is given in Table 1.*) For plates (1) and ($\frac{1}{2}$) the smaller number of stars available (154 and 67) showed an analogous behaviour; for plate (1) a constant

TABLE 1.

2n \ 2d	5	8	11	14	17	20
20				14.43	14.05	13.71
17			15.09	14.87	14.67	14,45
14		15.63	15.42	15.29	15.23	
11		15.87	15.76	15.69	15.68	
8	16.29	16.17	16.10	16.06	16.06	
5	16.57	16.49	16,44	16.42	16.42	
2	16.84	16.80	16.77	16.75	16.75	

TABLE 2.

2n \ 2d	3	5	8	11	14	17	19
20					13.08	12.85	12.71
17					13.48	13.33	
14			14.10	13.94	13.85	13.79	
11			14.32	14.23	14.20	14.19	
8		14.86	14.59	14.55	14.53		
5	15.24	15.08	14.91	14.87	14.86		
2	15.41	15.30	15.21	15.19	15.18		

difference 1.06^m was found, so that the same table could be used. For plate ($\frac{1}{2}$), however, the differences were somewhat systematically different, and a separate reduction table (Table 2) of the same general type was constructed; such differences are not surprising as also the brighter stars $2d > 20$ have a greater diameter on ($\frac{1}{2}$) than on (1). Still the representation of the magnitudes by these tables seems for the last named plates not so satisfactory as for the first one; the mean value of a residual (difference $P-W$) for plate (2) is only 0.18^m, for the others 0.24^m and 0.26^m. That in these $2n$—$2d$ diagrams the curves representing equal magnitudes run at last (at the left bottom side) horizontally, may seem strange, as it means that for increase of diameter with constant blackness the brightness of the star does not increase. The observational data even indicate (though they are not numerous on this side of the diagram) a decrease of magnitude for increasing diameter. As it is not well conceivable how a greater silver deposit ($2d$ and $2n$ both greater) could be caused by a fainter star, we must assume that the same degree of grayness is in greater star discs estimated blacker than in small discs.

The reason why stars of the same magnitude may show a series of different aspects, from great dull discs ($2n$ small, $2d$ great) varying continuously to small black images. ($2n$ great, $2d$ small) must be sought for in the secondary spectrum of the objective. Comparing the cases of great differences between $2d$ and $2n$ with the colour indices given by SHAPLEY, it is seen at once that stars with $2d > 2n$ have chiefly intermediate colours, stars with $2n > 2d$ have extreme colours. Among the first named (great and dull) 67°/₀ have *C. I.* 0.6 — 0,9, 10°/₀ have *C. I.* < 0 or > 1.0; among the last named (small and black) 25°/₀ have *C. I.* 0.6 — 0.9, 50°/₀ have *C. I.* < 0 and > 1.0. Among the stars with *C. I.* < 0 we find 15 having $n > d$ against 8 having $d > n$; for *C. I.* > 1.0 these numbers are 45 and 9, for *C. I.* 0.6 — 0.8 they are 27 and 46. If the objective is achromatized for the effective wavelength of intermediate star colours and the plates are put in the common focus of white and yellow stars, the former ones must show large, the extreme colour classes must show small discs.*)

In his catalogue SHAPLEY has omitted the dense central parts; it is complete only outside $r = 1',8$ and contains few stars within this circle. Near the centre increasing accidental and systematic errors must be feared, as the combined images of adjacent stars or groups are not resolved on small scale negatives and the blackening of the background in the densest centre vitiates the photographic magnitudes. While small impressions are strengthened by a faint background illumination (the stars thus appearing brighter) a stronger blackening of the background weakens the star images by the EBERHARD effect. In order to controll the Paris results and to get an estimate of the systematic errors to be feared, the results deduced by F. KÜSTNER from two Bonn plates (Der kugelförmige Sternhaufen Messier 3; *Veröff. der Univ. Sternw. Bonn* Nr. **17**. 1922) have been used. The Bonn magnitudes have been determined directly by exposing one plate to the Polar Sequence and comparing the other with this one; linear formulae were used to transform estimated diameters into magnitudes. Still the magnitudes are systematically different from the Mount Wilson magnitudes; as these are the most accurate I have derived reductions for the Bonn results to the Mt Wilson system:

$W-B = +0.36\,(m - 14.0)$ from 14.0 — 15.5		plate I + II
„ $= 0$ for $m < 14.0$		
„ $= +0.62 - 0.20\,(m - 15.0)\,(r > 2'.5)$		plate I
„ $= +0.50 - 0.17\,(m - 15.0)\,(r < 2'.5)$		
„ $= +0.33\,(m - 14.6)$ from 14.6 — 15.3		plate II
„ 0	for $m < 14.6$	central parts

*) For *P* 263 a printer's error for $2d$: 3 in stead of 13 is assumed.

*) If the objective is achromatized for an ultraviolet λ lying beyond the effective wavelength of white stars (as is the case with the Zeiss triplet at Potsdam) the regular increase of size and dullness of the image with increasing colour might afford a rough means of sorting the faintest stars according to colour.

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