THE DISTRIBUTION OF THE STARS IN THE CEPHEUS-LACERTA REGION (*)

(With three figures and two tables)

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SVMMARIVM. — Fere trium millium stellarum regionis Cephei-Lacertae distributio in superficie coeli et in spatio ope analysis spectralis investigatur, speciali diligentia adhibita stellarum luce debiliorum, quae in constructione systematis localis atque totalis maximi sunt momenti.

In recent years our knowledge of the local system has been much advanced especially as a result of the Spectral Durchmusterung of the KAPTEYN fields carried out at BERGEDORF and POTSDAM. Our work contains a tentative extension of the Spectral Durchmusterung for some selected fields of the MILKY WAY. The purpose of our investigation is to determine the surface and the space distribution of the stars in these regions paying special attention to the fainter stars.

The present paper gives the results of our work on one of the fields, which lies in the Cepheus-Lacerta region. The available material being too small we do not intend to give all the details of our work and we do not as yet draw from it any definite conclusion. Our only purpose is to suggest how far we can get in such investigations and what results may be hoped for from them.

(*) Nota presentata dall'Accademico Pontificio Soprannumerario P. Johan Stein S. I., il 1° settembre 1937.

The method we followed is that used in Potsdam especially described in the last papers of F. BECKER (1) and H. BRÜCK (2).

The centre of the Cepheus-Lacerta field coincides with the star BD 52°.3167: $22^h\,14^m\,16^s$, $+53°\,30'\,21''$ (1900). Its galactic coordinates are: $\lambda = 69°.3$; $\beta = -2°.5$.

The spectra and the direct plates were taken with the Zeiss astrograph of the Vatican Observatory, its aperture being 40 cm, focal ratio $^4/_5$. With the four-lenses object-glass plates could be taken of a field of about 75 square degrees, but for the classification only four square degrees of its central part were used.

To derive the stellar magnitudes, following the method of Potsdam, we photographed one of the KAPTEYN fields, viz. the 18th, with the same exposure (10 minutes). Spectra were obtained with the objective prism of 4° refracting angle focussed at H_γ; exposure 4 hours. The scale of the original spectra is approximately 63 A/mm at H_γ.

The classification of the spectra was carried out in the HARVARD system combined with the empirical method of POTSDAM. In spectral classification we went on to the 14th magnitude inclusive, i. e. two classes further than in previous investigations. The number of the stars which were studied is 2996, but of these only 2189 (73 %) were classifiable. This latter number gives the totality of classifiable stars up to the 14th magnitude. The remaining 807 (27 %) stars we had to omit from the spectral classification. The most usual impediment to the classification was the mutual blending of the spectra. This obstacle is quite obvious in our field, for the Cepheus-Lacerta region is very rich in stars. Of course the frequency of the blendings was increasing as fainter stars were reached and beyond the 14th magnitude we got such an amount of blendings that the further classification was practically impossible. For this reason, it is our opinion, that the investigation by spectral analysis of stars beyond the 14th magnitude in the MILKY WAY is not feasible. Figure 1 shows the increasing of the blendings in different magnitude classes.

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(1) « Sitzungsb. d. Preuss. Akad. d. Wissenschaft. », 1932, p. 86.
(2) « Z. S. f. Astrophys. », 1937, Bd. 13, H. 4.

To compute the surface distribution the stars were divided into six groups following the method of POTSDAM. The first and the last group were omitted on account of the small number of stars belonging

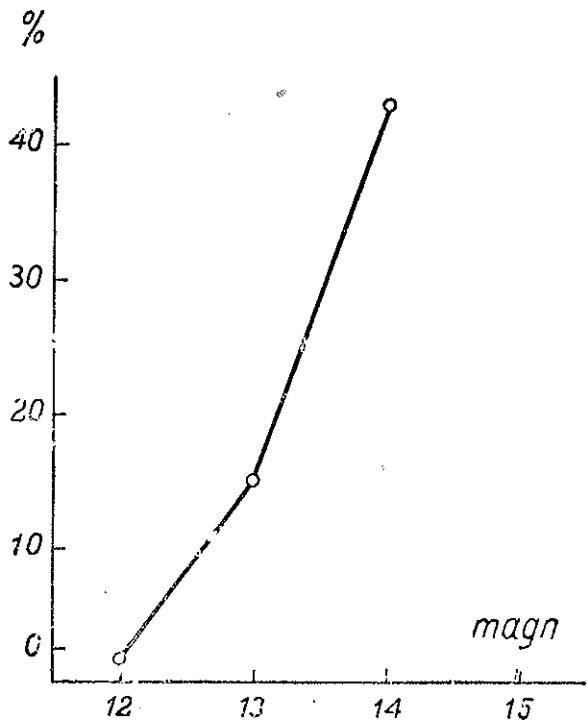

FIG. 1.

The increasing of the blendings in different magnitude classes.

to them. Practically, therefore, the partition was made in four groups which correspond roughly to the A, F, G and K classes of the HARVARD classification. In accordance with this division table I was constructed which gives the surface distribution of the stars expressed in numbers and in percentages.

TABLE I. — *The surface distribution of stars in the Cepheus-Lacerta field expressed in numbers and in percentages.*

Magn. / Spectra	$0^m.0$-$9^m.0$		$9^m.1$-$10^m.0$		$10^m.1$-$11^m.0$		$11^m.1$-$12^m.0$		$12^m.1$-$13^m.0$		$13^m.1$-$14^m.0$	
	N	%	N	%	N	%	N	%	N	%	N	%
B8-A4	9	33	16	59	79	65	195	55	363	45	291	34
A5-F1	5	19	2	7	8	6	37	11	110	14	175	21
F2-G4	13	48	8	30	29	24	91	26	263	33	328	38
G5-K4			1	4	6	5	29	8	69	8	62	7
S	27		27		122		352		805		856	
Bl	1		1		1		7	2	142	15	655	43
Σ	28		28		123		359		947		1511	

S number of classified stars
Bl number of blended stars
Σ number of classified and blended stars.

The results which we obtained from the investigation of the stars brighter than the 14th magnitude in the main agree with the results obtained hitherto by studying the stars brighter than the 12th magnitude, namely that even in lower galactic latitude the maximum percentage of stars is shifting up from the A type to the G type according as the apparent magnitudes diminish.

The change of the maximum from A type is very slight in the area studied by us. The A type predominates up to the 13th magnitude inclusive. Only at the 14th does it show a small decrease and then for the first time its maximum is but slight. In the work of other investigators, this change of maximum from A type to G type is very noticeable even at the 11th magnitude. In figure 2 we iuxtapose our results with those of H. BRÜCK (1) and A. SCHWASSMANN (2).

(1) « Z. S. f. Astrophys. », Bd. 13, page 285.
(2) « Bergedorfer Spektral-Durchm. », 1935.

At the same time it becomes clear, that the numbers of the stars are very different in various parts of the MILKY WAY.

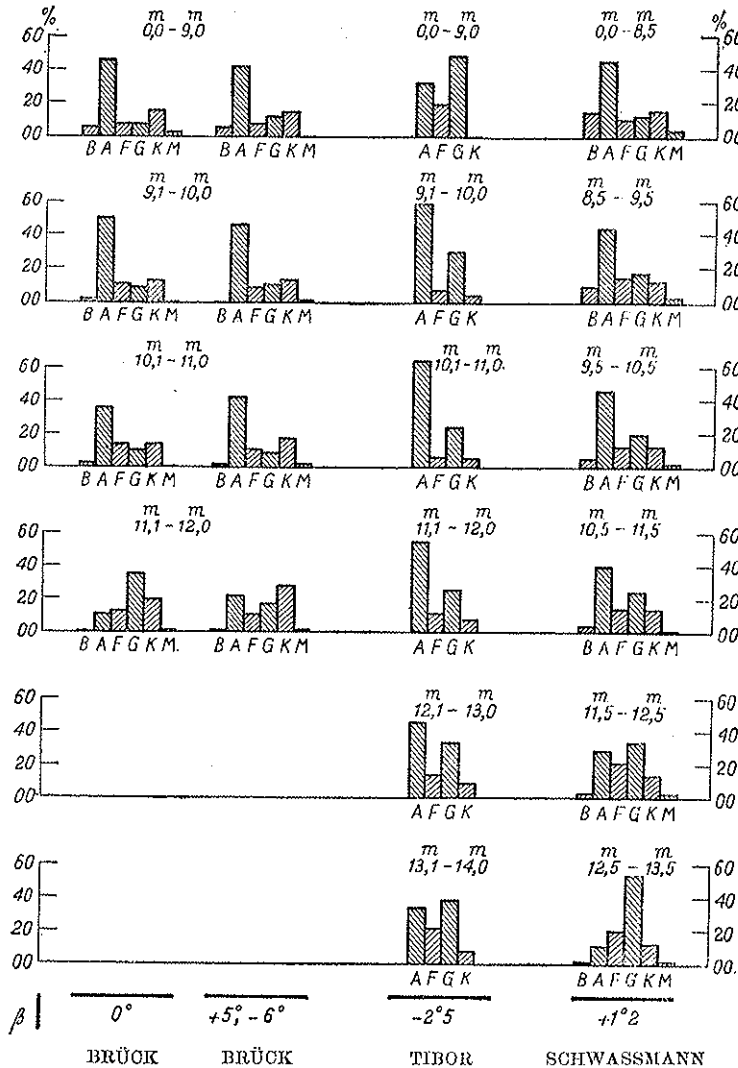

FIG. 2.

Comparison of surface distribution of stars for different regions of the Milky Way.

TABLE II. — *The mean distances, the mean volumes and the space densities computed for the stars of the Cepheus-Lacerta field.*

Spectra	Apparent magnitudes	Log of mean dist. in parsecs	Mean volumes in 10^4 cubic parsecs	Num. of stars per square degree	Log D(r)
F9-G4	$10^m.1$-$11^m.0$	1.96	0.01	2	2.18
	11 .1-12 .0	2.16	0.04	8	2.26
	12 .1-13 .0	2.36	0.19	17	1.96
	13 .1-14 .0	2.56	0.74	16	1.32
F2-F8	9 .1-11 .0	2.02	0.02	2	2.00
	10 .1-11 .0	2.22	0.07	7	2.02
	11 .1-12 .0	2.42	0.27	23	1.93
	12 .1-13 .0	2.62	1.06	66	1.79
	13 .1-14 .0	2.82	4.38	82	1.28
A5-F1	8 .1- 9 .0	2.18	0.05	1	1.40
	9 .1-10 .0	2.38	0.20	1	0.40
	10 .1-11 .0	2.58	0.82	2	0.36
	11 .1-12 .0	2.78	3.34	9	0.45
	12 .1-13 .0	2.98	13.80	28	0.30
	13 .1-14 .0	3.18	52.40	44	9.90
B8-A4	8 .1- 9 .0	2.50	0.49	2	0.71
	9 .1-10 .0	2.70	1.89	4	0.32
	10 .1-11 .0	2.90	8.26	10	0.38
	11 .1-12 .0	3.10	31.50	49	0.20
	12 .1-13 .0	3.30	170.00	91	9.70
	13 .1-14 .0	3.50	491.00	73	9.18

The variation of the other types i. e. of the F type and K type is very gradual and agrees almost completely with the most recent results of H. Brück.

Computing the space densities we used the same values of the absolute magnitudes for given groups as in Potsdam. The mean dis-

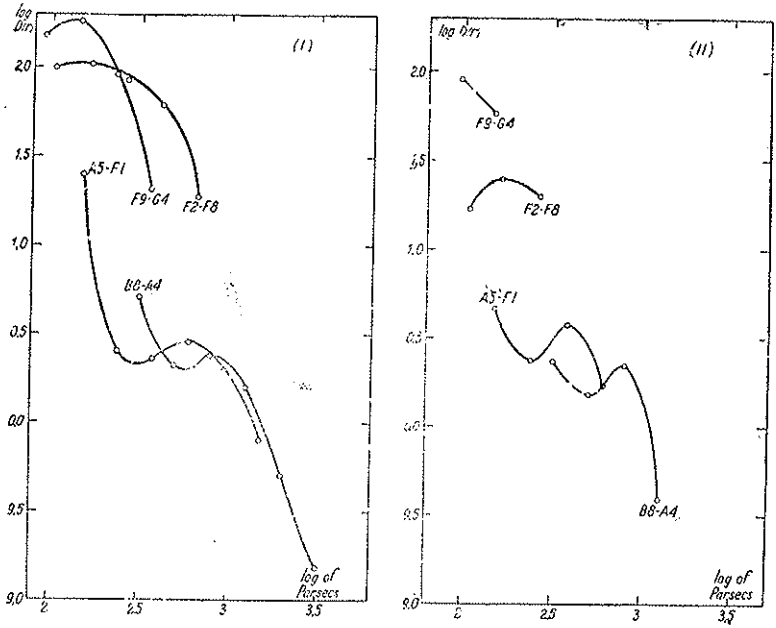

Fig. 3.

The density function of the Cepheus-Lacerta field (I) compared with the results of H. Brück obtained in the region of Scorpius (II).

tances, the mean volumes and the space densities were calculated in the same way. Table II contains the data used in density computation and the final results of the space densities.

To make the results more easily understood we repeat these results in figure 3, and compare them with the final results of H. Brück (1).

(1) Z. S. f. Astrophys. (1937), Bd. 13, p. 291.

The similarity is very striking especially in the curves of the B8-A4 and A5-F1 types. The trend of the curves is very similar in both cases. With regard to this character of the density function H. BRÜCK suggests that the result found in the Scorpio region is probably not a real density decrease, but may be due to an effect of a local interstellar absorption. The curves, however, of the Cepheus-Lacerta field show a noticeable and continuous diminution even after the 12th magnitude. It seems possible, therefore, that this general drop indicates a real density decrease.

At present we refrain from making any assumptions, waiting till the results can be confirmed by those of the other fields. The only conclusion we make is, that our first results corroborate and complete those previously obtained by Spectral Durchmusterung and we venture to hope that our further investigations will render useful data to enlarge our knowledge of the stellar system.

Grateful acknowledgment is made to Dr. H. BRÜCK for his helpful advice and valuable suggestions during his stay at Castel Gandolfo.