A statistical study of pulsating stars.

Thirteenth paper: *An analysis of galactic Cepheids.*

by E.A. KREIKEN and Rümeysa SÜSLÜ

Özet: C. Pagne ve S. Gaposchkin tarafından "Milton" alanlarında rasat edilen Cepheid ve RR Lyrae yıldızları tetkik edilmiştir. Keza tetkik edilmiş olan ortalama koordinatlardan ortalama ışık eğrileri elde edilmiştir. Yıldızların *c* sayısı küçüktür ve muhtelif basamaklar hakkında başka bir şey söylenemez. *a* yıldızları için iki basamağın mevcut olup olmadığı veya yalnız A (2) değerlerinin büyük dağılımı ile oldukça geniş bir bandın olduğu şüphelidir. Filhakika *a* basamakları, dönüm noktasına kadar, P = 10 gün civarında oldugu görünmektedir. *d* 1 basamaklarının, farklı fakat birbirine yakın iki basamaktan müteşekkil olduğu mümkündür. Fakat bir hüküme varmak için müteakip rasat materyaline ihtiyaç vardır, P = 10 ötesinde, küresel yıldız kümelerinden Cepheidlerden müteşekkil bir *d* 4 basamağının belirtisi vardır. Bu gün için, bütün basamaklar sıfır statistik olarak tetkik edilmelidir. Onların fiziksel gerçekleri, ancak müteakip ispatları mevcut olursa, bilinebilecektir.

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Abstract. The Cepheids and RR Lyrae stars are considered which *C. Payne — Gaposchkin* and *S. Gaposchkin* have investigated in the Milton fields. Also the light curves derived from mean coordinates have been studied. The available number of *c* stars is small and no further evidence about the *c* levels is obtained. It remains dubious whether the *a* levels are two separate closely adjacent levels or are to be considered as one broad belt having a large scatter of the values A(2). In any case the levels *a* can be traced up to nearly the reversal point around P = 10 days. It may be that the level *d* 1 consists out of two closely adjacent and parallel levels, but further evidence must be awaited. Beyond P = 10 days there is evidence of an additional level *d* 4 which seems to be connected with the Cepheids in globular clusters. For the present all sublevels must be considered as merely statistical. Their physical reality can only be proved from additional evidence.

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§ 1. Introduction

In the twelfth paper of this series the Cepheids in the Magellanic clouds were analysed. When considering the distribution of the values A(2) in the correlation plane A(2) and log P evidence was obtained which seemed to indicate that in the Magellanic clouds this distribution might be different from that prevailing in our own galactic system. No definite opinion could be expressed because in our own galactic system the determination of the systematic effects in the distribution of the points A(2) was poor. This latter determination is based upon the results obtained in the eighth paper of this series.

In that paper two groups of Cepheids were considered. The first group consists of the stars compiled by *E. Hertzsprung*[1]. The second group contains a number of Cepheids for which *A.H. Joy* [2] has determined the radial velocity. Only a part of the systems studied by *Joy* were used.

The systems compiled in the list of *E. Hertzsprung* were selected in such a way as to demonstrate the changing pattern of the light curve with increasing period. For each period it therefore contains systems which are or are thought to be representative for that period. Such a choice of systems might cause a certain prejudice. No such prejudice can affect the stars in the list by *Joy*, but, as stated before, only part of the stars in his list were considered. Not only does it now appear that a larger number of Cepheids should be analysed, but also for many of the systems in the list of *Joy*, newer light curves have been determined. Finally the subject of *Joy's* study was the radial velocity curve and the corresponding light curves are taken from various other authors. These authors used different instruments and different kind of plates, while there may also have been differences in the evaluation of the best way on how to reduce the observations and to construct the mean light curve. It does not seem probable that such differences will greatly affect the resulting light curves, but they may have the tendency to increase the scatter of the individual points in our diagrams and to increase the probable error in the determination of the intensities A(n) of the different overtones. It is therefore worth while in addition to the systems analysed in the previous papers of this series, to consider an homogeneous material in which all stars have been treated in the same way and which is free from any influence of pre - selection. Such a material is that published by *C. Payne — Gaposchkin* in her paper on "the Cepheid variables and R R Lyrae stars„ [3]. In this paper *C. Payne — Gaposchkin* has compiled data which have been obtained from a study of the "Milton„ fields by *C. Payne — Goposchkin* and by *S. Gaposchkin* [4].

The stars in the list of *C. Payne — Gaposchkin* are limited to the 10th magnitude.

§ 2. Analysis of the individual stars

The method used here is the same as that used in the previous papers of this series. In these previous papers it has appeared that in general the intensities of A(3) and A(4) of the second and third overtones are small. With a view to the probable error by which they are affected, their statistical value appears to be negligible. Therefore in the present paper the values A(3) and A(4) are dropped and only the values $\pi(1)$ and A(2) are determined. In the first place we have considered the stars in table 1 of the paper by *C. Payne — Gaposchkin*, which contains the Cepheids in the "Milton„ fields which are within a distance of 250 parsecs from the galactic plane. The results of our analysis appear in table 1 of this paper. The consecutive columns give the designation of the star, the logarithm of its period, to the nearest degree the galactic longitude and latitude, $\pi(1)$ the square of the intensity of the fundamental (that of a pure harmonic being 1), and finally A(2) the relative intensity of the first overtone. The systems are arranged in order of increasing period. In figure 1 the values A (2) are plotted against the corresponding values log P. In the figure all stars in table 1 are represented by black dots.

Next the Cepheids have been analysed which are given in table 2 of the paper by *C. Payne - Gaposchkin*. This table contains Cepheids which are not investigated in the Milton fields but which also are within a distance of 250 parsecs from the

TABLE 1

Cepheids within 250 parsecs from the galactic plane.

Star	log P	l	b	π (1)	A (2)
SW Tau	0.200	158	− 30	0.920	0.239
SU Cas	.290	100	+ 9	.788	.291
TU Cas	.330	86	− 10	.860	.295
U TrA	.410	291	− 9	.947	.170
VX Pup	.479	202	+ 1	.900	.241
RT Mus	.490	263	− 5	.857	.380
VZ CMa	.496	206	− 3	1.000	.151
AP Vel	.496	231	0	.896	.290
SZ Tau	.498	147	− 18	.953	.089
BK Cen	.501	263	0	.825	.338
UZ Cen	.522	262	0	.884	.316
R TrA	.530	285	− 8	.790	.387
Y Car	.561	234	− 6	.901	.316
SS Sct	.565	354	− 3	.946	.193
UX Car	.566	252	0	.908	.295
RT Aur	.572	151	+ 10	.951	.182
AG Cru	.584	269	+ 3	.826	.378
SU Cyg	.585	33	+ 3	.891	.303
Y Aur	.587	134	+ 5	.825	.370
BB Cen	.602	264	0	.934	.243
ST Tau	.605	161	− 7	.909	.285
BF Oph	.610	325	+ 8	.870	.265
AH Vel	.626	230	− 7	.875	.279
RZ CMa	.628	198	0	.862	.316
Y Lac	.635	67	− 5	.902	.274
V Vel	.640	244	− 4	.906	.265
GJ Car	.646	258	+ 2	.964	.071
T Vul	.647	40	− 10	.904	.285
FF Apl	.650	16	+ 5	.963	.055
T Vel	.666	234	− 3	.805	.303

TABLE 1 (continued)

Star	log P	l	b	π (1)	A (2)
WW Car	0.669	256	0	0.838	0.335
RY CMa	.670	192	0	.829	.383
S Cru	.671	269	+ 5	.863	.283
SX Car	.687	254	+ 1	.844	.342
VZ Cyg	.688	60	− 9	.810	.410
V Lac	.697	74	− 2	.858	.370
AP Sgr	.704	335	− 4	.880	.249
V381 Cen	.706	278	+ 4	.874	.352
AP Pup	.706	222	− 5	.875	.286
V350 Sgr	.712	341	− 9	.920	.205
BR Vul	.716	26	0	.846	.367
UZ Car	.716	254	− 2	.859	.361
V386 Cyg	.721	53	− 5	.893	.324
BG Lac	.727	61	− 10	.896	.288
UW Car	.728	253	− 1	.791	.444
X Lac	.736	74	− 2	.906	.232
V Cen	.738	286	+ 2	.872	.357
UY Car	.743	254	− 2	.888	.329
GH Car	.758	259	0	.879	.395
Y Sgr	.761	341	− 3	.900	.277
R Cru	.766	267	+ 1	.806	.429
ST Vel	.768	237	− 4	.901	.302
MW Cyg	.775	41	+ 1	.864	.396
RV Sco	.783	318	+ 5	.921	.235
FM Aql	.786	11	0	.811	.405
X Cru	.794	270	+ 2	.802	.438
RS Cas	.799	73	+ 2	.818	.365
X Vul	.801	31	− 1	.860	.370
S TrA	.801	290	− 9	.815	.369
RR Lac	.807	74	− 3	.904	.295

TABLE 1 (continued)

Star	log P	*l*	*b*	π (1)	A (2)
XX Sgr	0.808	343	— 2	0.824	0.391
V378 Cen	.810	273	0	.973	.084
AW Per	.810	134	— 5	.828	.351
BB Sgr	.822	342	— 10	.872	.319
AT Pup	.823	221	0	.830	.411
V Car	.826	234	— 6	.883	.257
T Cru	.828	266	0	.812	.431
U Sgr	.829	341	— 6	.887	.355
U Aql	.846	359	— 13	.846	.351
r Aql	.856	8	— 15	.870	.339
V336 Aql	.864	1	— 2	.884	.298
BB Her	.876	11	+ 5	.856	.265
R Mus	.876	269	— 6	.958	.230
RS Ori	.879	164	+ 2	.915	.241
ER Car	.888	258	+ 1	.850	.382
RX Cam	.898	113	+ 6	.915	.253
W Gem	.898	165	+ 4	.827	.327
U Vul	.902	123	0	.927	.239
BK Aur	.904	127	+ 7	.866	.237
AC Mon	.904	174	+ 6	.801	.367
S Sge	.923	22	— 8	.924	.184
VX Pup	.951	202	+ 1	.979	.263
K Pav	.959	296	— 25	.974	.000
V339 Cen	.976	280	0	.935	.095
FN Aql	.977	16	— 4	.931	.114
Dor	.977	238	— 33	.929	.170
SX Vel	.980	232	— 1	.956	.130
YZ Sgr	.980	347	— 9	.939	.230
S Mus	.985	266	— 8	.933	.179
S Nor	.989	296	— 6	.960	.089

TABLE 1 (continued)

Star	log P	l	b	π (1)	A (2)
AQ Car	.990	253	−3	.967	.077
SY Aur	1.006	132	+3	.958	.141
Z Lac	1.037	74	−3	.882	.152
XX Cen	1.040	277	+4	.971	.148
SV Per	1.046	130	−2	.849	.245
RX Aur	1.065	133	−1	.971	.045
UU Mus	1.066	264	−8	.873	.237
RY Cas	1.084	83	−4	.918	.161
XY Car	1.095	259	−3	.948	.207
U Nor	1.095	294	0	.873	.365
AD Pup	1.133	210	0	.935	.170
TT Aql	1.138	4	−4	.881	.274
SV Vel	1.149	237	−4	.904	.182
VW Cen	1.177	275	−1	.772	.458
SV Mon	1.183	171	−3	.873	.230
XX Car	1.196	259	−4	.715	.387
X Cyg	1.215	45	−5	.905	.217
RW Cam	1.215	112	+5	.924	.211
XZ Car	1.221	258	0	.859	.266
CD Cyg	1.232	38	0	.799	.367
SZ Aql	1.234	3	−3	.849	.342
YZ Car	1.259	253	0	.867	.300
VY Car	1 278	254	+1	.916	.259
VX Cyg	1.303	50	−4	.856	.232
RY Sco	1.307	318	+5	.900	.283
RZ Vel	1.312	230	−1	.853	.307
WZ Sgr	1.338	340	−2	.879	.313
WZ Car	1.362	256	−1	.855	.313
SW Vel	1.371	234	−3	.726	.451
X Pup	1.415	203	0	.776	.423
T Mon	1.431	170	−2	.899	.292
RY Vel	1.449	250	+2	.867	.329
AQ Pup	1.476	213	0	.739	.460
l Car	1.550	250	−8	.932	.182
U Car	1.558	257	0	.827	.417
RS Pup	1.617	220	0	.785	.468
SV Vul	1.655	31	0	.867	.356

TABLE 2

Cepheids within 250 parsecs from the galactic plane but not investigated in the "Milton" fields.

Star	log P	*l*	*b*	π (1)	A (2)
VZ Pup	0.366	221	− 2	.760	.516
AD Gem	.579	161	+ 9	.898	.322
CS Ori	.590	166	− 3	.812	.349
SY Cas	.610	86	− 4	.661	.515
X Sct	.625	347	− 3	.902	.318
UZ Cas	.629	93	− 1	.809	.474
SX Per	.633	127	− 5	.874	.321
CG Cas	.639	85	− 1	.824	.431
XY Cas	.653	90	− 2	.756	.474
UX Per	.659	101	− 2	.913	.333
WW Mon	.668	170	+ 2	.919	.085
CR Ori	.691	164	− 2	.824	.444
AS Per	.696	122	0	.887	.285
WZ Pup	.702	210	+ 4	.962	.173
WY Pup	.721	210	+ 4	.856	.397
UY Per	.730	104	− 1	.864	.336
SW Cas	.736	77	− 2	.750	.500
WW Pup	.741	205	+ 2	.917	.268
RZ Gem	.743	155	+ 1	.816	.432
VY Per	.743	108	− 1	.885	.283
RW CMa	.758	200	− 3	.828	.405
VW Cas	.777	92	− 1	.867	.378
VV Cas	.793	98	− 2	.861	.298
BX Sct	.807	357	− 3	.867	.310
AY Sgr	.818	341	− 4	.904	.332
AO Aur	.830	145	+ 3	.953	.212
VY Cyg	.895	51	− 5	.907	.079
TX Mon	.949	182	+ 1	.911	.265
BZ Cyg	1.006	52	+ 1	.955	.205
AN Aur	1.012	133	0	.982	.105

TABLE 2 (continued)

Star	log P	*l*	*b*	π (1)	A (2)
Y Sct	1.014	352	− 2	.994	.032
VX Per	1.037	101	− 2	981	.000
TY Sct	1.043	356	− 1	.975	.145
AA Gem	1.053	152	+ 4	.952	.117
SS CMa	1.092	207	− 3	.958	.118
Z Sct	1.111	354	− 2	.983	.084
TX Cyg	1.167	52	− 3	.946	.071
UZ Sct	1.169	347	− 3	.917	.235
RW Cas	1.170	97	− 4	.828	.405
SZ Cas	1.193	102	− 1	.966	.045
AN Aur	1.260	133	0	.982	.105
RY Sco	1.308	324	− 5	.906	.270
RU Sct	1.308	356	− 1	.906	.270
VZ Pup	1.365	211	− 2	.760	.516

TABLE 3

Cepheids over 250 parsecs from galactic plane. Variables not in "Milton" fields are indicated by an asterik.

Star	log P	*l*	*b*	π (1)	A (2)
BL Her	0.117	11	+ 20	0.847	0.305
UY Eri	.344	160	− 50	.888	.574
TX Del	.790	18	− 23	.945	.268
AL Vir	1.013	300	+ 45	.957	.182
W Vir	1.238	292	+ 61	.892	.213
RU Cam	1.346	113	+ 28	.952	.205
TW Cap	1.456	357	− 25	.786	.457
AU Peg	.380	36	− 24	.888::	.332::
V410 Sgr*	1.140	346	− 13	.917	.239
V377 Sgr*	1.210	342	− 10	.975	.089
MZ Cyg*	1.326	51	− 10	.868	.228
RX Lib*	1.396	317	+ 26	.986	.084

TABLE 6

Distribution of the differences between the values A (2) derived from the light curves taken from different sources. The column Δ GJ indicates the difference between the A (2) values derived from the curves by *C. Payne-Gaposchkin* and *S. Gaposchkin* and those by different authors in the list compiled by *A. H Joy*. The column Δ GH indicates the differences between the values A (2 obtained from the curves by *C. Payne-Gaposchkin* and *S. Gaposchkin* and those by different authors in the list compiled by *Hertzsprung*.

limits	Δ GJ	Δ GH
<		
	5	2
— .125		
	4	1
— .075		
	8	5
— .025		
	7	5
+ .025		
	4	2
+ .075		
	3	1
+ .125		
	1	2
>		

§ 4. The probable error in the determination of A (2).

Many of the variables investigated by *C. Payne - Gaposchkin* and *S. Gaposchkin* also appear in the lists compiled by *Joy* and by *Hertzsprung*. The light curves used by *Joy* and *Hertzsprung* were taken from a number of different sources. Table 6 gives a comparison between the values A (2) as derived from the light curves given by *Payne - Gaposchkin* and *Gaposchkin* and those used by *Joy* and by *Hertzsprung* respectively.

As appears from table 6 in several instances large differences occur. There is a tendency of the negative differences to be more frequent than the positive ones. This may be due to the fact that the older authors placed greater confidence in the deviations from normal curves they observed and considered this deviation as being real. The newer determinations are based on more extensive series of observations in which many accidental deviations are smoothed out. It is evident that if accidental deviations are considered as being real, the resulting light curve will more strongly deviate from a symmetric sinus curve with the result that A (2) will increase. This might explain the preva lence of the negative values in table 6.

When the individual differences are considered it appears that the probable errors of an individual differencebetween the values A (2) derived from the light curves for the same star but taken from different lists are as follows:

$$p_{GJ} = \pm 0.068; \quad p_{GH} = \pm 0.077 \quad \text{and} \quad p_{JH} = \pm 0.086.$$

The indices GJ, GH and JH indicate that the lists by *Gaposchkin* and *Joy*, those by *Gaposchkin* and *Hertzsprung* and those by *Joy* and *Hertzsprung* respectively have been compared.

From these sets of values we find the probable errors which affect the individual values A (2) derived from the light curves taken from the lists of *Gaposchkin, Joy* or *Hertzsprung* The results are:

$$p_G = \pm 0.039; \quad p_J = \pm 0.050 \quad p_H = \pm 0.067$$

These values not only indicate the greater reliability of modern light curves, but also proves that in statistical investigations of this kind it is advisable to use material which is as homogeneous as possible. That is to say, as far as possible light curves should be used, which all have been treated in a uniform way. It should be noted that the probable errors as given above contain all possible sources of errors including those which might arise from different ways in which various authors evaluate their observations and construct mean light curves. Therefore the values p certainly represent maximum values of the probable error. Presumably if different light curves by one and the same same author were intracompared, smaller values of the p.e. might turn out.

§ 5. Discussion of results.

In figure 1 the different values A (2) are plotted against the corresponding values log P. The black dots and the crosses indicate the variables within 250 parsecs from the galactic plane.

The black dots are stars contained in the "Milton" fields, while the crosses are stars not investigated in those fields. The variables over 250 parsecs from the galactic plane are indicated by small open circles (those contained in the Milton fields). The large open circles represent the values A(2) which correspond to the light curves obtained from mean coordinates. Where this was thought advisable, the consecutive circles have been connected by a full drawn line, so as to demonstrate the slightly irregular way in which the value A(2) varies.

In addition to these groups we have plotted in this figure all the variable stars in globular clusters with a period $\log P \geq 0.900 - 1$ which have been analysed in the previous papers of this series.

From the diagram it is evident that the *a* levels are not limited to the very short periods. There is a continuous sequence which starts around $\log P = -0.5$ and which can be traced up to nearly the point of reversal at $\log P = 1.0$.

We think that the diagram proves that a small group of Cepheids is directly related to the R R Lyrae stars and are in effect R R Lyrae stars of unusual long period. The reversal of all trends near $\log P = +1.000$ appears as clearly as in all previous cases. Before $P = 10$ days the general trend is that the symmetry of the light curve increases with increasing period.

Only with the transition from the type *c* to the type *a* variables is there a sudden jump. The new type, in this case the type *a*, sets in with light curves which are strongly assymmetric.

At the same period the light curves of the *c* type variables are almost completely symmetrical.

In the other parts of the diagram no sudden transitions occur. With the periods < 10 days all separate sequencies start in the left upper side of the correlation plane and can be traced to near the point of reversal around $P = 10$ days.

In various papers in which the systematic changes in the pattern of the light curves with period are described, several discontinuities are mentioned. As appears from our figure this is an erroneous impression, which arises from the unequalities in the density of the population on the different levels.

While on the left side of the point of reversal with all levels there is a decrease of A(2) with increasing period, on the right side of the point of reversal with all levels there is a regular increase of A(2) with the period.

This is also clearly reflected in the distribution of the great circles representing the light curves based on mean coordinates. Of these latter only one is on the *c* level. For the R R Lyrae stars all further large circles are first on the sublevel *a* 1 later on the sublevel *a* 2. It should be remarked that when deriving mean coordinates for the R R Lyrae stars, *C. Payne - Gaposchkin* not only has used the variables investigated in the «Milton» fields, but has included a large number of fainter ones. On the other hand the individual R R Lyrae variables plotted in figure 1 are only those from the «Milton» fields. With the R R Lyrae stars therefore there is no one to one relation between the two sets of points. For the periods log P = — 0.100 to + 0.300 no light curves based on mean coordinates are available. The first circle available beyond this gap still definitely is on the *a* level, but the transition to the higher levels occurs almost at once. Next the open circles indicate a gradual decrease of A (2) with increasing period. Around the point of reversal there is a striking discontinuity. Near P = 10 days the mean coordinates first yield a very small value for A (2), e. g., the mean light curve is almost sinusoidal. Next a continuous increase of A(2) with increasing period sets in.

§ 6. The various sublevels

The present writers think that the various conclusions obtained in section 5 can be considered as being fairly definite. Concerning the various sublevels the situation is far less satisfactory. The sublevels *c* 1, *c* 2, *c* 3, *a* 1 and *a* 2 as indicated in figure 1 are borrowed from the previous papers of this series. It is at once apparent that with the *c* levels the number of individual points which is available is far too small to allow any conclusion at all. With the *a* levels especially at the upper end there is a tendency of both the individual points and of the open circles to cluster either along the sublevel *a* 1 or along the sublevel *a* 2.

But there are so many intermediate points that we hesitate definitely to say that there are two different but closely adjacent sublevels. The result therefore is very much the same as with the different globular clusters.

In some of these the majority of the stars were on the *a* 1 level while in others there occurs a preference for the *a* 2 level. With all clusters however a fairly large number of intermediate variables is present.

Probably the best way to describe our results is to state that there is a fairly broad sequence of stars, starting with small periods and large values A (2) and continuing up till periods around 10 days with steadily decreasing values of A (2). This sequence or belt which contains the variables of the R R *a* and R R *b* types is roughly limited by the sublevels *a* 1 and *a* 2, On closer inspection it might appear to be necessary to split up this belt into two closely adjacent parallel sequences.

With the galactic R R Lyrae stars the irregular variables which all may be of RW Draconis type and which in figure 1 are indicated by double pointed arrows nearly all are in the belt between the sublevels *a* 1 and *a* 2. At least two of them are above this belt. It should be remembered that the irregular variables in the globular clusters mostly are below the level *a* 1. The available number of systems is small and no general conclusion can be drawn from this One system with irregular light curve is between the levels *c* 1 and *c* 2.

It is extremely dubious whether it can be directly connected with the other irregular systems and therefore also can be considered as a star of the R. W. Draconis type.

We next consider the Cepheids with periods from about log P = + 0.5 to log P = + 1.0 and with large values of A (2). These should largely be Cepheids belonging to the group which is frequently denoted as «the classical» Cepheids. Apparently this group is very inhomogenoeus and in figure 1 for the original level *d* 1 we have substituted the two possible sublevels δ 1 and δ 2. This because there seems to be a tendency of the individual points to cluster along these two lines. In this case also there are many systems having an intermediate value A(2). For the present therefore levels δ 1 and δ 2 must be considered as purely statistical and as a convenient mean to indicate the situation of a Cepheid in the diagram. As yet it is not possible to state whether these levels have any physical meaning. In other words the situation may either be actually so that we have to deal with two separate sequences, or so that there is a broad belt of Cepheids with a large scatter of the individual values A(2), this belt roughly being limited by the sublevels δ 1 and δ 2.

With the periods $>$ 10 days, the situation is even more complicated. There seems to be two levels d 2 and d 3 which largely coincide with the levels d 2 and d 3 which were previously obtained.

But the two levels are neither very well defined nor are they well separated.

We now however find an additional level d 4, which did not show up in our previous investigations and which clearly seems to be connected with the globular clusters. Most of the Cepheids occurring in the clusters are on or near the sublevel d 4. But in additional several galactic Cepheids occur on it.

With the levels d 2, d 3 and d 4 also it must emphatically be stated, that their physical reality can not be considered as definitely established. They are more in the nature of a possibility or perhaps a probability, but before they can be accepted more evidence must be given. Perhaps either positive or negative evidence can be obtained from a consideration of radial velocities and proper motions. It is obvious that one should consider the possible connection of these different levels with the different types of stellar population. Many observers think that the Sagittarius cloud represents a typical type II population while the population of the Carina cloud is of type I.

Therefore in figure 2 we have separately plotted the values. A (2) of the Cepheids in or near Sagittarius and in or near Carina.

As the number of available stars is rather small, we have used rather wide limits, e.g. for the Sagittarius region the limits 300 — 360° galactic longitude and for the Carina region $l = 210 - 270°$. In additon to this in the diagram for the Sagittarius region we have included all Cepheids with a distance over 250 parsecs from the galactic plane and which according to *C. Payne - Gaposchkin* [3] are connected with the population II type.

The resulting differences in this case are not very convincing. With the periods $<$ 10 days the diagram for the Carina region is far more complete than with Sagittarius and especially the level δ 1 is far more populated.

With the periods P > 10 days the results also are indecisive. In the Carina region the level *d* 3 is well developed while the other levels are almost absent. In the Sagittarius region mainly the levels *d* 2 and *d* 4 are represented. However, the total number of stars is so small, that it is dangerous to generalise these conclusions, before additional evidence has been obtained.

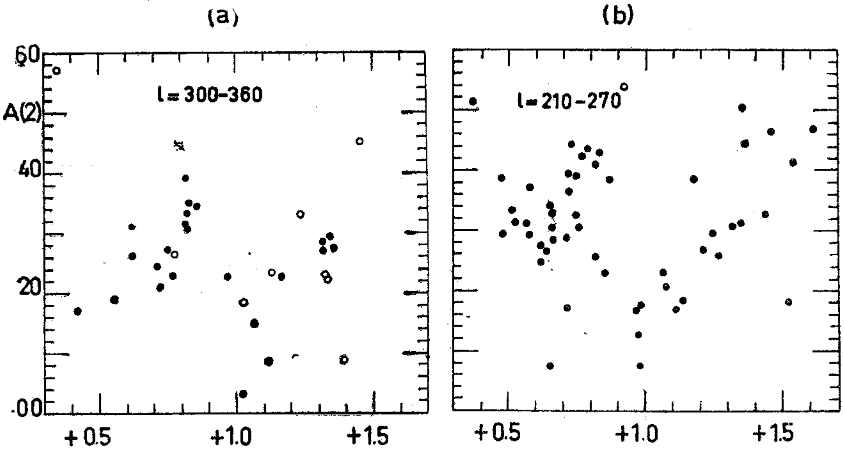

Fig. 2

E. A. Kreiken
Rümeysa Süslü
Department of Astronomy of
Ankara University
March 22 nd 1956.

Literature

[1] Hertzsprung, E : B. A. N. 3, 95, 1926.
[2] Joy, A. H. : Apj. 86, 409, 1937.
[3] Payne - Gaposchkin, C. : H. A. 113, 3, 1954.
[4] Gaposchkin, S. and Payne - Gaposchkin, C. : H. A. 115, 118, 1958.