1930BAN.....6...65D

BULLETIN OF THE ASTRONOMICAL INSTITUTES
OF THE NETHERLANDS.

1930 December 13 Volume VI. No. 210.

COMMUNICATION FROM THE OBSERVATORY AT LEIDEN.

Photographic magnitudes of stars brighter than $7^{m}{\cdot}5$ between declination + 80° and the pole,

by *A. de Sitter.*

1. The aim of the present investigation is to obtain standard photographic magnitudes of stars brighter than $7^{m}{\cdot}5$ within 10° of the North Pole. The instrument used is the Zeiss double camera with moving plateholders. The objectives are astrotessars of Zeiss, $a = 10{\cdot}5$ cm, $f = 51$ cm, and Eastman 40 plates 20 cm × 20 cm, have been used. In front of each objective was put a grating, also made by Zeiss. The thickness of the wires of these gratings is about 0·2 mm, nearly equal to the width of the open spaces between them. In the preliminary computations the difference in magnitude between the first order spectra and the central image has been taken as unit. For the determination of the exact value of this difference see section **4.**

The movement of the plateholders was for this purpose so chosen that in an exposuretime of 225 sec. a star blackens uniformly a square of $^{1}/_{4}$ mm. × $^{1}/_{4}$ mm. The plates were taken 1 mm. within the focus. The general appearance of the images made us expect that a field of 10° radius could be used, and the exposuretime of 225 sec. proved to be sufficient to obtain measurable central images of stars down to $7^{m}{\cdot}5$. Therefore all stars photographically brighter than $7^{m}{\cdot}55$ and within 10° of the pole were included in the programme. Originally these stars were selected from the Greenwich catalogue 1), but since the limit of magnitude obtained in this way was somewhat uncertain, a few more stars were included which in BELJAWSKY's catalogue 1) are brighter than $7^{m}{\cdot}55$, though not in the Greenwich catalogue.

The plates were measured in the Schilt microphotometer and the galvanometer readings were reduced graphically to magnitudes in the preliminary scale as defined above.

2. Dr. N. W. DOORN has taken several photographs of the polar area with the special aim of obtaining an exact scale of magnitudes. On these plates there is an exposure with grating and one without, while the grating exposure of one camera is simultaneous with the exposure without grating on the other camera. Two such pairs of plates were measured by me. The use of these measures for obtaining the magnitude scale will be explained in section **4.** A comparison of the measures on these plates with the Greenwich and the Yerkes photographic magnitudes showed that there was a large systematic deviation depending on the distance of the star image from the optical axis. In order to determine the correction $\Delta m = f(r)$ (r being the distance from the optical axis) to be applied to each preliminary magnitude, plates were taken on which there is one exposure with the pole in the centre of the plate, and two with the centre at 84° decl., differing 180° in R. A. from each other. From the measures on these plates the "field correction" was found to be fairly well represented by the formula $\Delta m = -{\cdot}0082\ r^2$, r being expressed in centimeters. It was then decided to use only the field within $r = 3{\cdot}6$ cm. ($= 4°$) at the limit of which the correction is $-\ {}^{m}{\cdot}106$. By stopping down the objectives the extension of the field fit for use could have been increased. This however would require uniform atmospheric conditions during a longer time than is ordinarily offered by the climate in Leiden.

Each pair of plates contains in general three exposures, of which one with the pole in the centre (with the exception of plates 1048 and 1049, where all three exposures have the centre at 80° decl.) Table 1 is a catalogue of the measured plates. No plates accepted for measurement have been rejected later. In column 3 are given the exposures with the centre not at the pole. Plates 1044; 1045 and 1048; 1049 are exposed 100 sec without grating. All the other exposures are with grating and an exposuretime of 225 sec.

---

1) See section 5.

TABLE 1.

Date	plate n°.	centre α		δ	Sid. time		measured by
		h	m	°	h	m	
1928 July 17	568	0 12	0 0	84 84	20	39	dS
	569	6 18	0 0	84 84	21	40	dS
1929 March 28	655	6 18	0 0	84 84	12	50	dS
May 1	686 687	13 15	20 0	80 80	12	44	K
	690 691	1 13	30 30	84 84	16	44	dS
May 3	694	4 15	0 0	80 80	17	10	P
May 30	713 714	19 22	0 20	80 80	18	15	dS
Aug. 26	736 737	16 20	0 0	83 83	20	6	dS
	740 741	0 3	0 0	83 83	21	48	dS
	746	2 18	0 0	83 83	0	29	dS
Sept. 2	759	10 14	0 0	83 83	23	0	dS
Sept. 8	767 768	0 12	0 0	86 86	22	52	P
	772	8 20	0 0	86 86	0	16	P
	773	8 20	0 0	83 78	2	16	P
	776	10 10	0 0	83 83	2	50	P
Sept. 25	810	2 12	0 0	86 86	23	40	P
	812	6 18	0 0	86 86	0	40	P
	814	10 22	0 0	86 86	2	0	P
Sept. 27	835 836	4 16	0 0	86 83	1	10	P
	837 838	22 22	0 0	80 86	1	45	P
Sept. 27	839 840	10 22	0 0	83 83	2	32	P
	841 842	4 16	0 0	83 83	2	50	P
	843 844	6 22	0 0	83 83	3	48	P
Oct. 31	866 867	0 0	0 0	83 86	0	47	P
1930 Jan. 6	870 871	4 4	0 0	83 86	3	16	K
	872 873	16 16	0 0	83 86	5	2	K
Jan. 18	877	20	0	83	5	25	K
	878 879	8 8	0 0	83 86	5	44	K
Jan. 19	888 889	4 10 12 14	0 0 0 0	83 83 86 83	5	18	K
Febr. 8	908 909	14 14	0 0	80 83	5	4	K
	910 911	2 2	0 0	80 83	5	29	K
	912 913	0 12	0 0	80 83	6	5	St
	914 915	12 18	0 0	83 83	6	35	St
	916 917	6 18	0 0	80 83	7	26	St
	918 919	8 8	0 0	80 83	7	50	St
	924 925	8 8	0 0	83 86	13	22	St
Febr. 9	933 934	20 20	0 0	80 86	11	31	St
June 29	1044 1045	4 16	0 0	80 80	19	28	K
Aug. 19	1048 1049	3 17 20	0 0 0	80 80 80	19	5	K

3. The plates were measured in the Schilt microphotometer by the observers mentioned in Table 1, where

K stands for C. J. KOOREMAN
P „ „ G. PELS
dS „ „ A. DE SITTER
St „ „ E. C. STOL

The galvanometer readings were reduced to magnitudes by a graphical method in which the difference in magnitude between the first order grating spectra and the central image is taken as unit, as mentioned above. On each plate an area of 4° = 3·6 cm. radius was measured round the centre of the plate. In this area are images of all the three exposures. The preliminary magnitudes were now first corrected for the "field correction" and for differential atmospheric extinction. The extinction has been taken to be twice as large as the Potsdam visual extinction. These corrections having been applied, it was supposed that there was no difference in zeropoint between the three exposures. This supposition could be controlled in many cases where two of the three exposures had stars in common within the measured area of the plate. A difference of zeropoint could be detected in a few cases and in these cases it has been applied.

The 10 stars of the North Polar sequence between the photographic magnitudes $4^{\rm m}{\cdot}0$ and $7^{\rm m}{\cdot}6$ are given in Table 2. The zeropoint of the Leiden magnitudes has been determined for each plate separately by the aid of the 5 stars marked with an asterisk, while for the zeropoint of the definitive mean photographic magnitudes (last column of Table 3) all ten stars have been used.

TABLE 2.

No.	B. D.	MW	L	MW-L	pg	MW-pg	I
		m	m	m	m	m	m
1	86° 269	4·40	4·38	+ ·02	4·39	+ ·01	— ·08
2	85 383	5·30	5·24	+ 6	5·22	+ 8	— ·10
3	86 344	5·83	5·73	+ ·10	5·75	+ 8	— ·14
4	86 272	5·93	5·93	0*	5·96	— 3	+ ·17
5	88 4	6·43	6·46	— 3*	6·46	— 3	+ ·05
2 *s*	88 71	6·45	6·50	— 5*	6·50	— 5	+ ·27
1 *r*	87 51	6·63	6·53	+ ·10	6·75	— 12	+1·67
3 *s*	87 107	6·63	6·64	— 1	6·64	— 1	+ ·36
6	89 13	7·12	7·12	0*	7·15	— 3	+ ·18
7	88 64	7·42	7·34	+ 8*	7·32	+ 10	— ·09

The Mount Wilson photographic magnitudes were taken from *M. W. Contr.* 235.

The plates 1044; 1045 and 1048; 1049 were taken without grating. They served for obtaining additional magnitudes of some insufficiently observed stars by connection with others of known magnitude.

The mean error of a magnitude derived from one exposure was found to be $\pm\,{}^{\rm m}{\cdot}070$. Thus the mean error of the mean magnitude of a star with 6 observations should be $\pm\,{\cdot}070/\sqrt{6} = \pm\,{}^{\rm m}{\cdot}029$.

This value was derived from the stars between 80° and 86° decl. only.

4. The magnitudes derived in this way are in the preliminary scale as defined above. We therefore have still to find the exact difference in magnitude between the first order grating spectra and the central image. This difference can be derived if we know $l/(l+d)$, where l is the width of the open spaces between the wires and d is the thickness of the wires. I have to thank Prof. L. S. ORNSTEIN of Utrecht for his kindness to allow me to investigate our gratings in his laboratory, and also Mr. VAN DER MEULEN for his invaluable assistance thereby. The grating was put in a nearly parallel bundle of light, the intensity of which was measured with the aid of a surface thermopile. The proportion of the intensity of the free light-bundle to that transmitted by the grating is $l/(l+d)$. The result was $l/(l+d) = {\cdot}495$ for both gratings. This gives:

$$\text{magnitude first order spectrum} - \text{magnitude central image} = {}^{\rm m}{\cdot}959$$

This value has been adopted in the present investigation. As a control we have the results of the plates taken by Dr. DOORN, mentioned in section 2. Let b be the difference in magnitude between the image of the exposure without grating and the central image of the grating exposure, and a the difference between the first order spectrum and the central image. We determine b/a from the observations. We know $b+a$ to be $2^{\rm m}{\cdot}484$ (which value is not seriously altered if l is not equal to d exactly), and thus we get a expressed in magnitudes.[1] The result is that $a = {}^{\rm m}{\cdot}97$, taking the mean of the two pairs of plates, in sufficient accordance with the adopted value.

5. Accurate photographic magnitudes of bright stars near the north pole have been published by the following observatories

Göttingen	(Gt)	(*Göttinger Aktinometrie*, Teil B, p. 42)
Yerkes	(Y)	(*Yerkes Actinometry*, *Ap. J.* 36, p. 169)
Greenwich	(Grw)	(*Phot. magn. of stars brighter than* 9·0 *between decl.* + 75° *and the pole*)
Simeis	(S)	(*Bull. observatoire central Nicolas à Poulkovo*, Vol. VI, n°. 12)

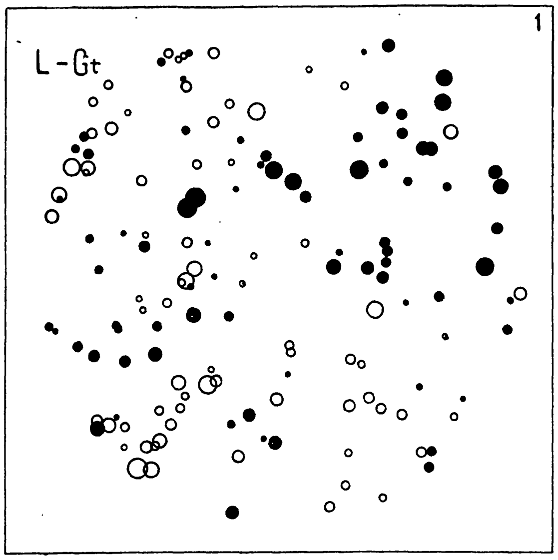
To these photographic magnitudes were added the Harvard visual magnitudes (H) of all A and F stars of our programme. They were taken from the Henry Draper catalogue.

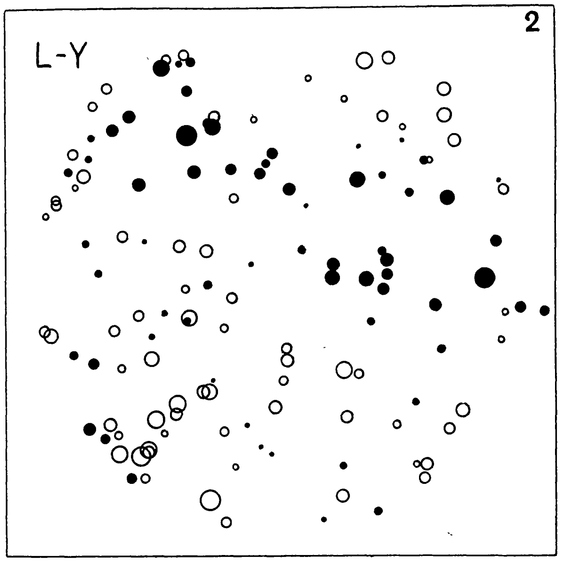
The following equations were found by least square solutions:

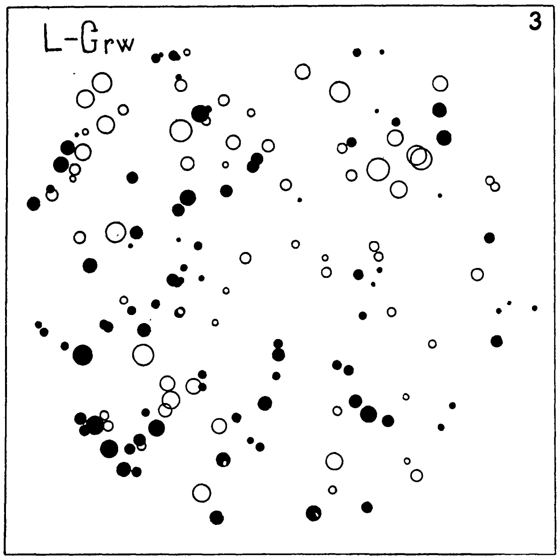
$$\begin{array}{lcrcrlrll}
m_{\rm L} - \overset{\rm m}{6{\cdot}828} & = & -\overset{\rm m}{{\cdot}0305} & + & \overset{\rm m}{{\cdot}9864} & (m_{\rm Gt} - \overset{\rm m}{6{\cdot}828}) & -\overset{\rm m}{{\cdot}1348} & ({\rm I} - {\cdot}471) & \\
 & & \pm\ 67 & \pm & 99 & & \pm\ 133 & & (\text{m. e.}) \\
m_{\rm L} - 6{\cdot}850 & = & -{\cdot}0497 & + & {\cdot}9241 & (m_{\rm Y} - 6{\cdot}850) & -{\cdot}1090 & ({\rm I} - {\cdot}466) & \\
 & & \pm\ 57 & \pm & 82 & & \pm\ 115 & & ” \\
m_{\rm L} - 6{\cdot}917 & = & +.0980 & + & 1{\cdot}1122 & (m_{\rm Grw} - 6{\cdot}917) & -{\cdot}0449 & ({\rm I} - {\cdot}441) & \\
 & & \pm\ 91 & \pm & 160 & & \pm\ 189 & & ”
\end{array}$$

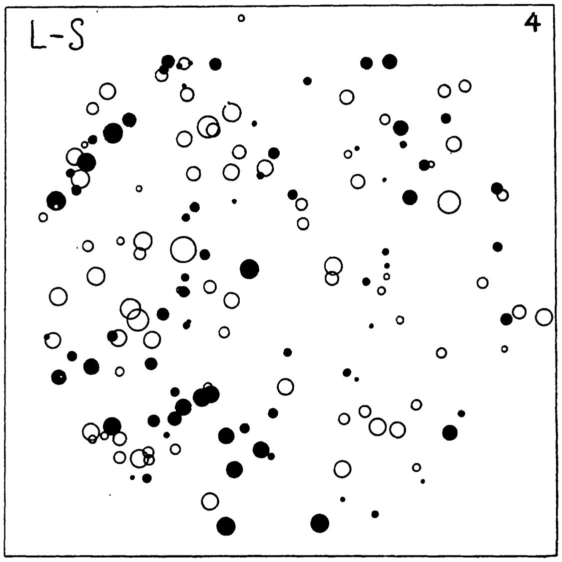
---

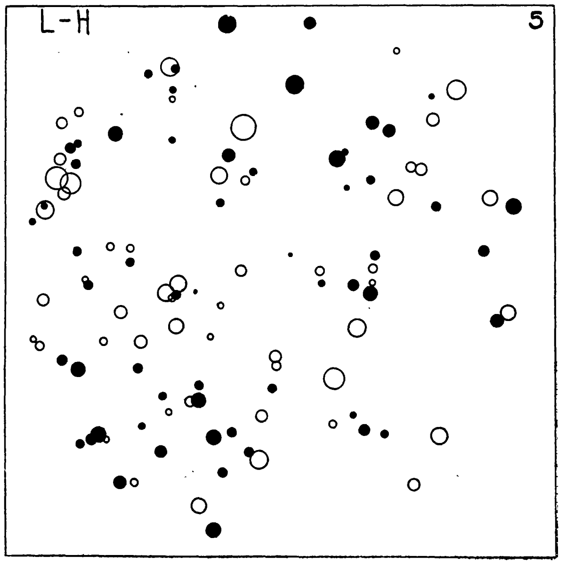
[1] See E. HERTZSPRUNG *A. N.* 4452.

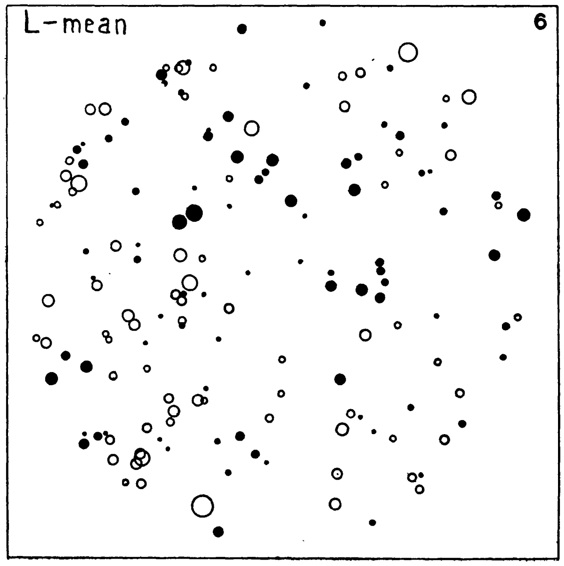

L-Gt
1


L-Y
2


L-Grw
3


L-S
4


L-H
5


L-mean
6

$$\begin{array}{lcrrlrrll}
m_L - \overset{m}{6{\cdot}949} & = & -\overset{m}{{\cdot}0884} & + \overset{m}{1{\cdot}0179} & (m_S & - \overset{m}{6{\cdot}949}) & - \overset{m}{{\cdot}1309} & (I - {\cdot}444) & \\
 & & \pm \; 89 & \pm \; 150 & & & \pm \; 181 & & (\text{m. e.}) \\
m_L - 6{\cdot}898 & = & +{\cdot}1009 & + {\cdot}9828 & (m_H & - 6{\cdot}898) & + {\cdot}6655 & (I - {\cdot}165) & \\
 & & \pm \; 91 & \pm \; 145 & & & \pm \; 510 & & ,,
\end{array}$$

Here I is the colour index taken from DOORN, *B. A. N.* 140, or derived from the same sources as used by DOORN.

The magnitudes of the different catalogues were reduced to the Leiden system by the aid of these equations. The diagrams on page 68 are intended to give an impression of the systematic deviations of these reduced magnitudes from the Leiden magnitudes, in dependence of the position of the stars. The black circles are positive differences in the sense L-Gt etc., open circles are negative differences, the area of the circles being proportional to the numerical difference. Zero differences were treated as if being ± $^{m}{\cdot}01$, half the number being taken positive, the other half negative. The most noticeable fact about these diagrams is the similarity of those for Gt and Y. There is no reason why the Gt and the Y magnitudes should have the same systematic errors. On the other hand the other diagrams do not show the same appearance.

6. Table 3 contains the B. D. number and the position for 1900, the colour index according to *B. A. N.* 140, the magnitude of the different catalogues reduced to the Leiden system, the Leiden magnitude with the number of observations, the weighted mean magnitude in the Leiden system, and finely the adopted photographic magnitude (m_{pg}) derived from the preceding column by the equation

$$m_{pg} = m_{mean} + {}^{m}{\cdot}060 + {}^{m}{\cdot}1348\ (I - {}^{m}{\cdot}423).$$

The adopted photographic magnitudes are thus as regarding to colour in the system of the *Göttinger Aktinometrie*, and the zero point is defined by the Mount Wilson photographic magnitudes of the 10 stars of Table 2.

The polar plates of the *Göttinger Aktinometrie* have kindly been sent from Potsdam to Leiden for measurement of additional stars, which have been marked by an asterisk in Table 3. The necessary measures and reductions have been made by Mr. C. J. KOOREMAN.

The weights of the individual catalogues were derived from the differences between the reduced magnitudes of the different catalogues, the result being

	m. e.	Weight
Gt	± $^{m}{\cdot}063$	5
Y	± ·059	6
Grw	± ·092	2
S	± ·097	2
H	± ·084	3
L	± ·044	10

The mean error found for Leiden is appreciably larger than that derived from the Leiden material alone (section 3). This may be explained by the common systematic deviations of Y and Gt from L.

The mean error of an adopted photographic magnitude, as derived from the figures just mentioned, was found to be ± $^{m}{\cdot}027$.

TABLE 3.

BD	α (1900)	δ (1900)	I	H 3	Gt 5	Y 6	Grw 2	S 2	L 10	number of obs.	mean	m_{pg}
°	h m	° ′										
83 9	0 29·8	84 7	+ ·48	7·43	7·42*	—	7·47	7·53	7·48	10	7·46	7·53
81 13	32·2	81 57	+ ·57	6·78	6·81	6·81	6·90	6·89	6·84	6·5	6·83	6·91
82 20	45·5	83 10	+ ·14	5·66	5·63	5·69	5·84	5·66	5·64	9·5	5·67	5·69
79 24	52·2	80 0	+ ·41	6·89	7·00	6·92	6·83	6·95	6·92	6·5	6·93	6·98
83 20	52·8	84 4	+ ·23	6·87	6·86	6·84	6·76	7·00	6·85	8	6·86	6·89
85 19	55·0	85 43	+ 1·34	—	5·41	5 43	5·38	5·70	5·38	12	5·42	5·61
88 4	55·6	88 29	+ ·05	6·51	6·47	6·45	6·51	6·24	6·46	31·5	6·45	6·46
86 17	59·1	86 37	+ 1·18	—	7·11	7·19	7·08	7 05	7·12	31	7·13	7·29
80 35	1 9·7	80 20	+ ·31	7·40	7·52	7·46	7·39	7·22	7·43	7	7·43	7·48
80 36	10·1	80 22	+ ·04	6·76	6·60	6·65	6·67	6·62	6·61	7·5	6·64	6 65
80 50	29·6	80 55	— ·05	7·06	7·01	7·01	7·00	6·94	6·99	8	7·00	7·00
80 55	38·8	80 23	+ ·01	7·23	7·11	6·94	6·83	6·93	6·97	7	7·00	7·01
80 57	39·8	80 53	+ ·15	7·58	7·46	7·45	7·42	7·52	7·37	7	7·44	7·46
79 61	55·7	80 11	+ ·14	7·58	7·49	7·56	7·40	7·66	7·52	7·5	7·53	7·55
80 64	57·1	80 49	+ ·08	6·06	6·07	6·08	6·24	5·91	6·12	7·5	6·09	6·10

BD	α (1900)	δ (1900)	I	H 3	Gt 5	Y 6	Grw 2	S 2	L 10	number of obs.	mean	m_{pg}
°	h m	° ′										
80° 65	1 57·9	81 0	+ ·22	6·91	6·99	6·92	6·96	6·90	6·95	7·5	6·94	6·98
85 41	58·8	85 16	+ ·97	—	7·52*	—	7·64	7·69	7·72	6·5	7·66	7·79
82 51	2 1·4	83 5	+ ·95	—	7·27	7·14	7·16	7·24	7·23	13·5	7·21	7·34
80 70	8·6	80 16	+ ·18	7·56	7·59*	—	7·62	7·63	7·63	6·5	7·61	7·64
85 45	23·4	85 22	+ ·16	—	7·57*	—	7·64	7·72	7·78	6	7·70	7·73
80 86	33·4	81 1	+ 1·35	—	7·01	6·85	7·08	6·70	6·94	10	6·92	7·11
79 86	41·8	79 42	+ ·04	7·24	7·24*	7·24	7·35	7·26	7·21	7	7·24	7·25
80 97	56·2	81 5	+ ·16	6·07	6·03	5·92	6·06	5·90	6·02	10	6·00	6·02
79 94	3 1·4	79 45	+ 1·00	—	7·51*	7·51	7·66	7·59	7·48	9	7·52	7·65
84 59	8·6	84 33	+ 1·02	—	6·44	6·31	6·48	6·49	6·41	10·5	6·40	6·54
83 91	33·7	83 14	— ·08	7·45	7·45	7·23	7·71	7·58	7·48	10	1)	
86 51	33·9	86 20	+ ·36	6·08	6·11	6·15	6·04	6·12	6·12	40	6·11	6·17
80 123	50·7	80 42	+ ·12	—	—	—	7·70	7·89	7·82	4·5	7·81	7·83
80 125	53·3	80 25	+ ·50	5·61	5·62	5·49	5·60	5·60	5·64	6·5	5·60	5·67
80 127	4 1·1	80 17	+ 1·01	—	7·21	7·21	7·18	7·07	7·18	6·5	7·18	7·32
81 147	2·0	81 43	+ ·06	7·35	7·38	7·27	7·40	7·42	7·34	6·5	7·34	7·35
81 150	3·6	81 23	+ ·03	7·50	7·52*	—	7·51	7·52	7·53	6·5	7·52	7·53
83 104	5·0	83 34	— ·29	5·21	5·39	5·20	5·38	5·42	5·35	12	5·32	5·28
85 63	5·1	85 17	+ ·52	7·04	6·93	6·85	6·93	7·03	6·92	9·5	6·93	7·00
82 113	8·0	83 6	+ ·76	—	6·23	6·15	6·04	6·43	6·21	12·5	6·20	6·31
80 133	9·6	80 35	+ 1·33	—	6·58	6·46	6·42	6·46	6·47	6·5	6·48	6·67
80 134	12·0	80 42	+ ·17	7·27	7·26	7·16	7·10	7·18	7·12	6·5	7·17	7·20
80 140	19·2	80 40	+ ·24	7·42	7·45	7·42	7·47	7·46	7·46	6·5	7·45	7·48
84 88	33·4	84 42	— ·01	7·50	7·60*	—	7·70	7·69	7·61	7·5	7·61	7·61
82 125	37·0	83 1	+ ·01	—	7·49*	—	7·50	7·61	7·46	8	7·49	7·49
80 155	41·6	81 2	+ 1·43	—	6·34	6·34	6·27	6·21	6·30	6·5	6·31	6·50
85 74	56·3	85 50	+ ·32	6·75	6·70	6·65	6·63	6·69	6·72	13·5	6·70	6·74
85 78	5 9·9	85 35	+ ·02	6·55	6·55	6·55	6·51	6·71	6·59	11·5	6·57	6·58
83 141	11·8	83 47	+ ·08	7·30	7·12	6·99	7·01	6·97	6·99	8·5	7·05	7·06
79 173	16·7	79 46	— ·30	7·04	—	—	7·35	7·25	7·24	3·5	7·22	7·18
85 80	29·9	85 9	+ 1·61	—	7·34	7·42	7·55	7·41	7·49	8	7·44	7·66
86 79	6 8·0	86 46	+ 1·19	—	7·45	7·49	7·63	7·52	7·58	24·5	7·53	7·70
79 208	23·1	79 41	+ ·08	6·57	—	6·74	6·73	6·64	6·76	2	6·72	6·73
82 177	23·4	82 12	+ ·13	6·48	6·69	6·69	6·78	6·64	6·68	7	6·67	6·69
79 212	29·2	79 40	+ ·40	5·88	5·81	6·12	5·78	—	5·97	2	5·95	6·01
87 51	53·7	87 12	+ 1·67	—	6·48	6·53	6·54	6·59	6·53	34·5	6·53	6·75
81 242	7 6·4	81 26	— ·10	6·13	6·15	6·28	6·20	6·08	6·17	7	6·18	6·17
82 201	10·0	82 36	+ 1·67	—	6·48	6·46	6·65	6·55	6·46	10·5	6·49	6·71
81 252	16·4	81 6	+ 1·07	—	7·32	7·45	7·29	7·25	7·33	7·5	7·35	7·49
80 238	39·8	80 31	+ ·73	—	7·05	7·20	7·12	7·01	7·13	6·5	7·12	7·22
84 168	45·8	84 41	— ·09	7·30	7·40*	—	7·50	7·49	7·47	8	7·44	7·43
79 265	49·1	79 45	— ·05	5·32	—	5·53	5·44	—	5·31	4·5	5·39	5·38
84 169	53·0	84 21	— ·02	6·38	6·37	6·40	6·35	6·40	6·41	12	6·39	6·39
89 13	58·0	88 56	+ ·18	7·11	7·14	7·08	7·14	7·18	7·12	30·5	7·12	7·15
82 235	8 5·2	82 44	— ·04	6·14	6·18	6·30	6·24	6·29	6·25	11·5	6·24	6·24
85 128	25·3	85 24	+ ·38	7·64	7·50	7·52	7·71	7·74	7·66	7·5	7·61	7·66
82 253	28·3	82 36	— ·06	6·65	6·70	6·76	6·70	6·61	6·74	10·5	6·72	6·71
80 272	40·8	80 24	— ·12	7·37	7·26	7·47	7·49	7·46	7·39	7	7·39	7·38
83 233	44·5	83 8	+ ·30	—	7·19	7·24	7·35	7·21	7·23	11	7·23	7·28
79 294	51·8	79 44	+ ·05	7·85	—	7·74	7·64	7·73	7·67	5·5	7·71	7·72
84 196	54·5	84 35	+ ·29	6·45	6·47	6·47	6·75	6·49	6·50	14	6·50	6·54
81 282	56·3	81 14	+ ·29	6·72	6·52	6·74	6·53	6·59	6·65	8	6·64	6·68
83 256	9 20·5	83 22	+ ·33	7·33	7·21	7·25	7·48	7·23	7·29	9·5	7·28	7·33
81 302	22·8	81 46	+ 1·51	—	5·77	5·75	5·55	5·78	5·69	8	5·72	5·92
83 262	26·4	82 49	+ ·08	7·53	7·39	7·49	7·70	7·49	7·47	6	7·48	7·50
84 234	10 15·2	84 46	+ ·21	5·80	5·66	5·65	5·83	5·57	5·69	13	5·69	5·72
83 297	18·9	83 4	+ ·26	5·53	5·56	5·47	5·58	5·83	5·59	8·5	5·57	5·61
81 343	25·7	81 1	+ 1·03	—	7·24	7·31	7·35	7·25	7·32	6·5	7·30	7·44
81 349	33·6	80 57	+ ·10	6·77	6·57	6·71	6·70	6·72	6·67	7	6·68	6·69
80 347	50·7	80 13	+ ·44	7·51	—	7·57	7·66	—	7·66	3·5	7·61	7·68

BD	α (1900)	δ (1900)	I	H 3	Gt 5	Y 6	Grw 2	S 2	L 10	number of obs.	mean	m_{pg}
°	h m	° ′										
86 161	11 2·5	86 11	+ ·21	7·30	7·31	7·30	7·40	7·33	7·36	33	7·33	7·36
88 64	4·2	88 11	— ·09	7·36	7·31	7·25	7 33	7·48	7·34	33	7·33	7·32
81 373	24·8	81 41	+ ·19	6·26	6·28	6·27	6·27	6·28	6·34	7	6·30	6·32
86 170	28·3	86 10	+ ·27	7·53	7·46	7·41	7·53	7.49	7·51	26·5	7·48	7·52
86 176	59·7	86 8	+ ·51	6·72	6·66	6·64	6·69	6·71	6·70	37·5	6·68	6·75
82 356	12 6·5	82 16	+ 1·42	—	7·18	7·10	7·41	7·39	7·34	7·5	2)	
80 380	11·8	80 41	+ .16	—	—	—	6·81	6·79	6·96	6	6·91	6·94
80 381	11·9	80 41										
87 107	13·9	86 59	+ ·36	6·57	6·57	6·53	6·58	6·61	6·64	37·5	6·59	6·64
88 71	14·4	88 15	+ ·27	6·47	6·39	6·37	6·54	6·57	6·50	38	6·46	6·50
81 400	31·1	80 48	+ ·29	7·54	7·51	7·38	7·44	7·52	7·45	7·5	7·46	7·50
80 389	34·1	79 46	+ ·57	—	—	7·40	7·43	7·57	7·45	7	7·44	7·52
86 182	34·6	86 17	+ ·19	7·18	7·24	7·23	7·30	7·32	7·30	35·5	7·26	7·29
81 402	41·9	81 10	+ ·10	6·32	6·39	6·42	6·39	6·33	6·41	6·5	6·39	6·41
84 289	48 3	83 58	+ ·18	—	4·81	4·77	5·10	—	4·85	9	4·84	4·87
84 290	48·4	83 57										
81 416	13 11·5	81 0	+ ·98	—	7·04	7·08	7·00	7·09	7·08	7	7·07	7·20
85 222	18·6	85 17	+ ·43	—	7·57	7·57	7·60	7·59	7·57	7.5	7·57	7·64
83 397	45·2	83 15	+ 1·00	—	6·78	6·75	6·80	6·82	6·78	13	6·78	6·92
86 201	59·4	86 14	+ ·38	7·67	7·65	7·49	7·49	7·52	7·52	23	7·55	7·60
81 482	14 33·0	81 15	+ ·82	—	7·42	7·50	7·40	7·40	7·43	8·5	7·44	7 55
80 448	36·4	80 6	+ 1·46	—	7·41	7·37	7·71	7·23	7·43	8	7·42	7·62
81 495	55·0	81 9	+ ·04	7·22	7·11	7·14	7·06	6·96	7·09	9	7·11	7·12
83 431	57·0	82 55	+ ·64	—	6·19	6·18	6·21	6·25	6·22	11·5	6·21	6·30
80 480	15 35·0	80 47	+ ·38	—	6·75	6·84	6·68	—	6·79	8·5	6·78	6·84
80 481	35·2	80 47										
82 463	38·2	82 36	+ ·32	7·12	7·20	7·18	7·07	7·26	7·16	13	7·17	7·21
85 263	42·5	85 9	+ 1·03	—	7·68	7·69	7·59	7·65	7.65	7	7·66	7·80
81 523	43·0	80 56	+ ·98	—	7·68	7·65	7·65	7·66	7·64	7	7·65	7·79
80 487	45·1	80 18	+ ·35	7·15	7·04	7·14	7·15	7·08	7·09	7·5	7·10	7·15
83 453	53·8	83 15	+ ·22	7·45	7·56	7·52	7·36	7·66	7·53	12	7·52	7·56
85 269	57·4	85 35	+ ·15	7·13	6·96	7·03	6·86	6·88	6·92	11	6·97	6·99
84 351	16 1·0	83 55	+ ·43	7·33	7·41*	—	7·25	7·42	7·36	12·5	7·36	7·42
84 361	33·6	83 55	+ ·22	7·19	7·23	7·23	7·20	7·22	7·17	10·5	7·20	7·23
80 519	37·8	80 0	+ ·60	—	7·46*	7·41	7·37	7·42	7·44	6·5	7·43	7·51
82 498	56·2	82 12	+ ·79	—	5·15	5·10	5·26	5·25	5·12	9	5·14	5·25
81 568	17 4·8	81 0	+ 1·05	—	7·49	7·52	7·48	7·45	7·45	7·5	7·48	7·62
80 544	27·2	80 13	+ 1·69	—	7·15	7·10	6·97	6·92	7·11	8·5	7·09	7·32
86 269	18 4·6	86 37	— ·08	4·42	4·42	4·45	4·29	—	4·38	33	4·40	4·39
85 294	7·2	85 41	+ ·26	7·66	7·70	7·73	7·67	7·82	7·71	8	7·71	7·75
79 570	7·5	79 59	—	—	—	—	—	—	5·63	6·5	5·63	
79 571	7·6	79 59										
86 272	7·8	87 0	+ ·17	5·98	5·95	5·96	5·86	5·88	5·93	37	5·94	5·96
82 540	22·9	82 54	— ·18	7·39	7·16	7·24	7·19	7·21	7·23	9	7·23	7·21
84 412	24·6	84 37	+ ·36	7·60	7·61	7·61	7·43	7·49	7·55	9·5	7·57	7·62
83 536	37·4	83 6	— ·01	6·14	6·18	6·19	6·17	6·05	6·20	8	6 18	6·18
79 604	52·7	79 49	+ ·27	6·52	6·57*	6·69	6·54	6·46	6·65	7	6·61	6·65
83 547	19 4·0	83 46	+ ·07	6·85	6·83	6·91	6·85	6·85	6·91	8·5	6·88	6·89
82 572	4·7	82 14	— ·04	6·79	6·91	6·85	6·73	6·70	6·85	9·5	6 84	6·84
80 609	15·5	80 35	+ ·17	7·60	7·91	7·69	7·65	7·63	7·50	6	7·64	7·67
83 552	28·0	83 16	+ ·14	6·44	6·55	6·60	6·67	6·43	6·58	10	6·56	6·58
84 451	20 14·0	84 23	+ ·15	6·70	6·88	6·93	6·78	6·65	6·83	9	6·83	6·85
81 699	15·6	81 55	+ ·44	7·65	7·84	7·71	7·70	7·78	7·74	4·5	7·74	7·80
80 650	20·2	80 13	— ·13	6·70	6·78	6·71	6·62	6·63	6·68	7	6·70	6·68
84 462	24·5	84 14	+ ·31	7·36	7·47	7·39	7·43	7·14	7·33	6·5	7·36	7·41
84 463	24·5	84 49	+ ·54	7·46	7·51	7·50	7·46	7·53	7·50	6	7·50	7·57
81 706	28·7	82 2	+ ·50	—	7·38	7·33	7·18	7·31	7·33	7·5	7·33	7·40
79 675	30·6	79 53	— ·15	7·30	7·59*	7·34	7·28	7·40	7·40	6	7·40	7·38
80 657	33·2	81 6	+ 1·11	—	7·53	7·41	7·38	7·40	7·35	6·5	7·41	7·56
82 617	34·4	82 51	+ 1·08	—	7·51	7·54	7·56	7·37	7·49	7	7·50	7·65

BD	α (1900)	δ (1900)	I	H 3	Gt 5	Y 6	Grw 2	S 2	L 10	number of obs.	mean	m_{pg}
°	h m	° ′										
80 659	20 34·5	81 5	+ 1·13	—	6·34	6·43	6·23	6·35	6·32	7	6·35	6·50
80 660	35·2	80 44	+ 1·03	—	6·83	6·84	6·71	6·92	6·78	7·5	6·81	6·95
83 588	39·1	83 17	+ ·18	6·28	6·29	6·39	6·41	6·10	6·26	8	6·29	6·32
81 718	49·8	82 10	·00	5·70	5·76	5·86	5·69	5·64	5·73	8	5·75	5·75
80 672	52·1[1]	80 11	+ 1·30	—	6·44	6·55	6·25	6·49	6·43	7	6·45	6·63
83 596	59·0	83 33	+ ·26	7·38	7·51*	—	7·51	7·37	7·42	6	7·44	7·48
80 679	21 8·1	80 45	+ ·27	7·10	7·13	7·12	7·14	7·18	7·10	7·5	7·12	7·16
80 688	16·8	80 23	+ ·06	7·23	7·46*	7·32	7·17	7·39	7·37	7	7·35	7·36
80 690	17·5	80 49	+ ·12	6·10	6·17	6·25	6·21	6·00	6·18	7·5	6·17	6·19
86 319	19·6	86 37	+ ·03	7·36	7·31	7·37	7·35	7·40	7·35	37	7·35	7·36
79 701	21·5	79 55	+ ·52	7·64	7·59*	—	7·62	7·71	7·69	7	7·66	7·73
79 707	27·8	80 5	+ ·84	—	6·83*	6·70	6·70	6·92	6·78	8·5	6·78	6·89
83 618	50·4	83 34	+ ·21	7·15	7·12	7·29	7·42	7·12	7·20	11	7·21	7·24
82 673	22 1·8	82 23	+ ·52	—	6·89	6·97	7·13	6·98	6·95	8·5	6·96	7·03
82 674	1·9	82 23										
83 630	20·9	84 0	+ ·08	7·53	7·43	7·45	7·36	7·59	7·47	9	7·47	7·48
85 383	21·3	85 36	— ·10	5·33	5·20	5·20	5·17	5·20	5·24	10	5·23	5·22
85 384	21·7	85 43	+ 1·25	—	7·46	7·66	7·57	7·54	7·55	7	7·56	7·73
81 775	23·7	81 26	+ ·36	7·23	7·29*	7·35	7·11	7·21	7·35	7·5	7·30	7·35
87 205	24·2	87 34	+ ·07	7·40	7·39	7·43	7·40	7·49	7·39	35·5	7·41	7·42
79 739	26·2	80 11	+ 1·13	—	—	7·56	7·64	7·52	7·66	3	7·61	7·77
80 731	39·2	80 52	+ ·69	7·35	7·38	7·38	7·38	7·36	7·42	7	7·39	7·49
82 700	43·9	82 45	+ ·04	7·47	7·41*	—	7·38	7·57	7·44	9	7·44	7·45
82 703	47·9	82 37	+ 1·47	—	5·94	6·02	5·91	5·90	5·97	9·5	5·97	6·17
84 517	53·5	84 50	+ 1·37	—	7·11	7·06	7·03	7·00	7·08	9	7·07	7·26
83 640	55·2	83 49	+ 1·62	—	6·04	6·07	5·98	6·25	6·02	8·5	6·05	6·27
79 761	59·5	80 15	+ ·22	6·82	6·78	6·88	6·75	6·90	6·79	7	6·82	6·85
79 769	23 5·5	80 2	+ ·12	7·25	7·22	7·29	7·22	7·23	7·24	7	7·25	7·27
83 647	13·2	83 42	— ·15	7·64	7·58*	—	7·59	7·76	7·57	7·5	7·60	7·58
85 399	24·4	85 52	+ ·25	6·77	6·86	6·77	6·71	6·68	6·75	12	6·77	6·80
85 401	27·5	86 0	+ ·30	7·44	7·47*	—	7·47	7·49	7·49	11·5	7·48	7·52
86 344	27·8	86 45	+ ·14	5·73	5·73	5·69	5·71	5·80	5·73	35·5	5·72	5·75
85 403	30·4	85 38	+ ·11	7·25	7·14*	—	7·03	7·13	7·12	10	7·14	7·15
80 780	38·8	80 45	— ·09	7·78	—	—	7·68	7·87	7·72	3·5	7·74	7·74
82 743	51·8	82 38	+ ·07	6·47	6·60*	—	6·65	—	6·53	8·5	6·55	6·56
85 409	54·8	86 9	+ ·15	6·80	6·78*	—	6·65	6·64	6·68	32·5	6·71	6·74
82 748	57·6	82 25	+ ·11	7·26	7·23	7·23	7·14	7·40	7·25	8·5	7·25	7·26

1) BD 83° 90 α = $3^h\ 33^m\ 14^s$ δ = 83° 15′ $9^m{\cdot}80$ (Grw) disturbing the measures.

2) BD 82° 357 α = $12^h\ 7^m\ 2^s$ δ = 82° 16′ $8^m{\cdot}27$ (Grw) disturbing the measures.

7. Of the variable U Cephei = B. D. 81°25 the following observations were obtained on the Leiden plates (exposure time 225 sec.)

plate	J. D. hel. M. astr. T. Grw.	m_L
		m
568	2325445·529	6·75
690	5733·578	6·82
740	5850·466	6·75
746	5850·578	6·71
866	5916·409	7·85
910	6016·332	6·90
912	6016·357	6·83

and on the Göttingen plates (exposure time 33^m45^s)

plate	J. D. hel. M. astr. T. Grw.	m_{Gt}
		m
637	2418080·419	6·82
750	8325·343	7·05
953	8559·464	6·77
955	8560·460	6·70
958	8567·444	7·51

No variation was found in the star V Cephei = 82°743, which has been included in Table 3. The individual observations are on the Leiden plates

plate	J. D. hel. M. astr. T. Grw.	m_L
		m
690	2425733·578	6·59
740	5850·466	6·51
746	5850·578	6·65
767	5863·475	6·47
839	5882·575	6·45
843	5882·627	6·50
866	5916·409	6·53
912	6016·357	6·55

and on the Göttingen plates

plate	J. D. hel. M. astr. T. Grw.	m_{Gt}
		m
637	2418080·419	6·58
651	8118·482	6·54
750	8325·343	6·69
919	8525·410	6·68
924	8527·427	6·62
953	8559·464	6·50
955	8560·460	6·56
958	8567·444	6·50

I want to thank Prof. HERTZSPRUNG for his advice during my work. Mr. C. J. KOOREMAN has done a considerable part of the computations.