The photographic light-curve of BL Herculis

Binnendijk, L.

TABLE 5

Phase	I m_{pg}	n	Phase	II m_{pg}	n
P	m		P	m	
·0032	+ ·542	40	·0023	+ ·516	40
·0095	+ ·437	40	·0068	+ ·488	40
·0163	+ ·361	40	·0114	+ ·424	40
·0227	+ ·252	40	·0158	+ ·366	40
·0289	+ ·150	40	·0201	+ ·286	40
·0355	+ ·071	40	·0243	+ ·222	40
·0429	+ ·031	40	·0285	+ ·164	40
·0511	+ ·004	40	·0330	+ ·128	40
·0584	− ·004	41	·0376	+ ·103	40
·0675	+ ·001	42	·0430	+ ·066	40
			·0480	+ ·032	40
			·0526	+ ·031	40
			·0589	+ ·005	40
			·0661	+ ·008	40

^{m}·56, that of the secondary ^{m}·52. The higher part of the branch of this secondary minimum looks somewhat too low, the duration being not in agreement with that of the photovisual one.

The author decided not to make an orbital solution. On the one hand we could get a better determination than VAN GENT derived. On the other hand both photographic and photovisual observations are affected by errors, due to the nearby position of the brighter components, which easily may have influenced the shape of the branches. There is also an indication that the maximum brightness before and after the minima is not exactly the same. Photo-electric observations of this star in various colours have been made by Dr G. E. KRON[1]) at the Lick Observatory, which promise to give a definite result. This system is very important because it is the cornerstone for the temperature scale for M dwarfs. Also we may hope to get some information on the difference in darkening at the limb within the same spectral class, since both components have the spectral type dM1.

I wish to express my thanks to Dr OOSTERHOFF, Dr WESSELINK, Dr BLAAUW and Mr KOOREMAN for putting part of the material and measurements at my disposal.

1) *A.J.* **54**, 190, 1949 (abstract).

THE PHOTOGRAPHIC LIGHT-CURVE OF BL HERCULIS,

BY L. BINNENDIJK

The variable BL Herculis was observed photographically. This Cepheid has a very unusual period of 1^{d}·307463, falling in the middle of the gap between short-period and classical Cepheids. The horizontal part on the decreasing branch was confirmed.

The variable star BL Herculis was discovered by C. HOFFMEISTER[1]). The period of 4^{d}·2 used by the earlier observers appeared to be spurious, giving a very peculiar light-curve. P. PARENAGO[2]) was the first to recognize that this was erroneous and that the true period is 1^{d}·31, being correlated with the apparent period P' by the relation $1/P + 1/P' = 1$. This new period is unusual because it falls in the middle of the gap between short-period and classical Cepheids.

The star was observed photographically with the 33-cm Leiden refractor during the years 1938—1946. Guilleminot Superguil plates, 9 cm × 12 cm, were used. The exposure time was one minute.

TABLE 1

Star	BD	α (1855)	δ	m_{pg}
		h m s	° ′	
BL	—	17 54 52·0	+ 19 15·6	—
a	+ 19° 3501	55 57·0	19 12·4	− 1^{m}·22
b	19 3491	53 41·9	19 7·6	− 0 ·10
c	19 3493	54 10·0	19 12·7	+ ·18
d	—	55 52·9	19 19·7	+ ·53
e	—	53 49·0	19 15·2	+ ·61

1) *A.N.* **236**, 235, 1929.
2) *I.A.U. Circ.* No. 801.

The plates were measured in the Schilt photometer. In Table 1 the data about the variable and the five comparison stars are given. The magnitude scale has been derived from a number of grating plates. The grating constant for this grating was adopted as ^{m}·97 in agreement with recent results. The galvanometer readings have been converted into provisional magnitudes by the aid of a table of WESSELINK[1]). The difference between the provisional magnitude of the variable and the mean provisional magnitude of the comparison stars was formed. These provisional magnitude differences have only to be divided by the gradation to obtain magnitudes in the usual magnitude scale. A correction of + ^{m}·50 was added to make the maximum brightness a zero-point for the magnitudes.

The Julian Day Heliocentric Mean Astronomical Time Greenwich was computed. The reduction to the sun was read off from a graph giving the light-time as a function of the calendar-date, constructed after the formula:

$$\text{Reduction} = +^{d}\cdot00003\ X + {}^{d}\cdot00462\ Y.$$

The determination of the period was made, using six

1) *B.A.N.* **8**, 331, 1939.

TABLE 2

Plate	J.D. 242	Phase	m_{pg}	n	Plate	J.D. 24	Phase	m_{pg}	n	Plate	J.D. 243	Phase	m_{pg}	n
	d	P	m			d	P	m			d	P	m	
4464	9041·4954	·2973	+ ·37	8	5412	29915·3214	·6344	+ ·97	10	6142	0572·4511	·2335	+ ·18	16
	·5037	·3037	+ ·41	8	5413	·3394	·6482	+ ·96	10	6143	·4760	·2525	+ ·30	16
4465	·5250	·3200	+ ·43	9		·3574	·6620	+ ·96	10	6161	0590·4148	·9729	+ 1·10	13
4546	9152·4362	·1493	·00	13	5427	9923·2725	·7157	+ 1·06	10	6162	·4491	·9991	+ 1·06	14
4547	·4529	·1621	+ ·05	13		·2863	·7263	+ 1·07	10	6172	0599·3758	·8266	+ 1·16	10
4863	9406·4797	·4519	+ ·58	11		·3015	·7379	+ 1·06	11	6173	·3986	·8440	+ 1·22	10
	·4915	·4610	+ ·59	11	5633	30093·5513	·9518	+ 1·14	10	6174	·4201	·8605	+ 1·29	10
4889	9416·4365	·0673	+ ·57	13		·5645	·9619	+ 1·14	9	6189	0613·3882	·5438	+ ·84	15
4890	·4593	·0847	+ ·37	13		·5783	·9724	+ 1·10	9	6190	·4111	·5613	+ ·88	14
4891	·4787	·0996	+ ·19	13	5634	·5970	·9867	+ 1·05	10	6197	0614·3578	·2854	+ ·37	14
4970	9489·4026	·8747	+ 1·25	15		·6102	·9968	+ ·98	9	6738	1672·4807	·5801	+ ·90	15
	·4182	·8866	+ 1·21	15		·6226	·0063	+ ·95	9	6961	1978·4368	·5876	+ ·93	15
4971	·4386	·9022	+ 1·25	15	5644	0094·5070	·6827	+ 1·01	16	6971	1993·4615	·0791	+ ·43	10
	·4542	·9142	+ 1·27	15	5645	·5340	·7034	+ 1·01	13		·4753	·0896	+ ·29	10
4972	·4739	·9292	+ 1·18	15	5647	·5929	·7484	+ 1·06	14		·4892	·1003	+ ·20	10
	·4895	·9411	+ 1·18	15		·6130	·7638	+ 1·06	15	6972	·5148	·1199	+ ·03	10
4982	9491·3736	·3822	+ ·38	10	5652	0101·5508	·0701	+ ·49	14		·5287	·1305	+ ·02	10
	·3840	·3901	+ ·34	10		·5695	·0844	+ ·34	13		·5432	·1416	+ ·01	11
	·3944	·3981	+ ·37	10	5676	0117·4265	·2125	+ ·13	10	6973	1994·4276	·8180	+ 1·18	14
4983	·4096	·4097	+ ·40	10		·4403	·2230	+ ·18	10		·4519	·8366	+ 1·20	14
	·4201	·4177	+ ·47	10		·4535	·2331	+ ·23	10	6974	·4720	·8520	+ 1·23	10
	·4304	·4256	+ ·47	10	5682	0118·4703	·0108	+ ·89	9		·4858	·8625	+ 1·22	10
4984	·4456	·4373	+ ·47	10		·4828	·0204	+ ·82	9		·5003	·8736	+ 1·26	11
	·4557	·4450	+ ·53	10	5696	0132·4806	·7265	+ 1·03	14	6975	·5225	·8906	+ 1·23	9
	·4661	·4529	+ ·49	10		·5013	·7423	+ 1·04	14		·5356	·9006	+ 1·23	9
4985	·4812	·4645	+ ·55	9	5697	·5325	·7662	+ 1·12	11		·5495	·9112	+ 1·23	10
	·4900	·4712	+ ·50	8		·5470	·7772	+ 1·13	10	6987	2009·4420	·3016	+ ·38	10
5009	9495·4319	·4861	+ ·61	13	5792	0265·3400	·3426	+ ·38	9		·4558	·3122	+ ·39	10
	·4454	·4965	+ ·66	13		·3531	·3527	+ ·41	8		·4696	·3227	+ ·37	10
5010	·4608	·5082	+ ·65	10	5803	0270·2981	·1348	+ ·03	13	6988	·4918	·3397	+ ·39	10
	·4717	·5166	+ ·74	11	5804	·3244	·1549	— ·06	15		·5057	·3503	+ ·41	10
5352	9752·5008	·1027	+ ·25	8	5990	0463·5152	·9150	+ 1·25	10		·5195	·3609	+ ·42	10
	·5091	·1091	+ ·19	8		·5297	·9261	+ 1·23	11	6989	2010·4115	·0431	+ ·75	10
5353	·5238	·1203	+ ·04	11		·5456	·9382	+ 1·17	12		·4246	·0532	+ ·69	11
	·5352	·1290	— ·03	11	5991	·5629	·9514	+ 1·15	9		·4412	·0658	+ ·55	11
	·5480	·1388	·00	11		·5760	·9615	+ 1·14	8	6990	·4600	·0802	+ ·43	10
5403	9904·2981	·2034	+ ·11	10	6024	0467·5474	·9990	+ 1·08	10		·4745	·0913	+ ·33	11
	·3126	·2144	+ ·20	11		·5613	·0096	+ ·97	10		·4897	·1029	+ ·23	11
	·3292	·2271	+ ·27	14		·5751	·0201	+ ·94	10	6991	·5098	·1183	+ ·06	10
	·3514	·2441	+ ·31	12	6027	0475·5074	·0871	+ ·38	15		·5251	·1300	+ ·02	10
5411	9915·2769	·6004	+ ·91	10	6028	·5323	·1061	+ ·12	15		·5382	·1400	+ ·04	9
	·2900	·6104	+ ·97	10	6141	0572·4012	·1953	+ ·08	16		·5507	·1496	+ ·03	9
5412	·3075	·6238	+ ·89	10		·4254	·2138	+ ·20	11					

observational sequences near magnitude $+^{m}\cdot30$ on the increasing branch. Assuming that the maximum brightness occurs $^{P}\cdot0560$ or $^{d}\cdot0732$ later we find from a least-squares solution:

$$\text{Max.} = 2430475^{d}\cdot5881 + 1^{d}\cdot3074630\,E.$$
$$\pm\ 24 \pm\ 25 \text{ m.e.}$$

The period derived by PARENAGO[1]) from four epochs of maximum determined by PARENAGO, ESCH and JACCHIA, which cover an interval of nearly 9000 days, is $1^{d}\cdot307473$, which is somewhat larger than the value found here. When the period is computed from these four epochs together with the one derived in this note, the resulting value is:

$$1^{d}\cdot3074685$$
$$\pm\ 41 \text{ m.e.}$$

1) *V.S.* **5**, 276, 1939.

The phases were computed according to the formula:

$$\text{Phase} = {}^{d-1}\cdot764840\ (\text{J.D.} - 2420000).$$

TABLE 3

Phase	m_{pg}	n	Phase	m_{pg}	n
P	m		P	m	
·0117	+ ·94	38	·4040	+ ·40	40
·0388	+ ·75	30	·4426	+ ·51	51
·0677	+ ·54	38	·4707	+ ·56	41
·0812	+ ·40	33	·5071	+ ·68	33
·0882	+ ·34	49	·5617	+ ·87	44
·1013	+ ·22	42	·6055	+ ·92	45
·1147	+ ·09	54	·6569	+ ·97	46
·1338	+ ·01	64	·7220	+ 1·05	58
·1488	·00	48	·7552	+ 1·07	54
·1933	+ ·09	49	·8146	+ 1·17	48
·2196	+ ·21	46	·8612	+ 1·24	66
·2408	+ ·26	54	·8983	+ 1·23	58
·2970	+ ·38	30	·9246	+ 1·22	63
·3236	+ ·40	39	·9567	+ 1·14	60
·3578	+ ·40	47	·9909	+ 1·05	53