PUBLICATIONS OF
THE DAVID DUNLAP OBSERVATORY
UNIVERSITY OF TORONTO

VOLUME I NUMBER 17

LIGHT CURVES OF THE VARIABLE STARS IN THE GLOBULAR CLUSTER NGC 5466

BY

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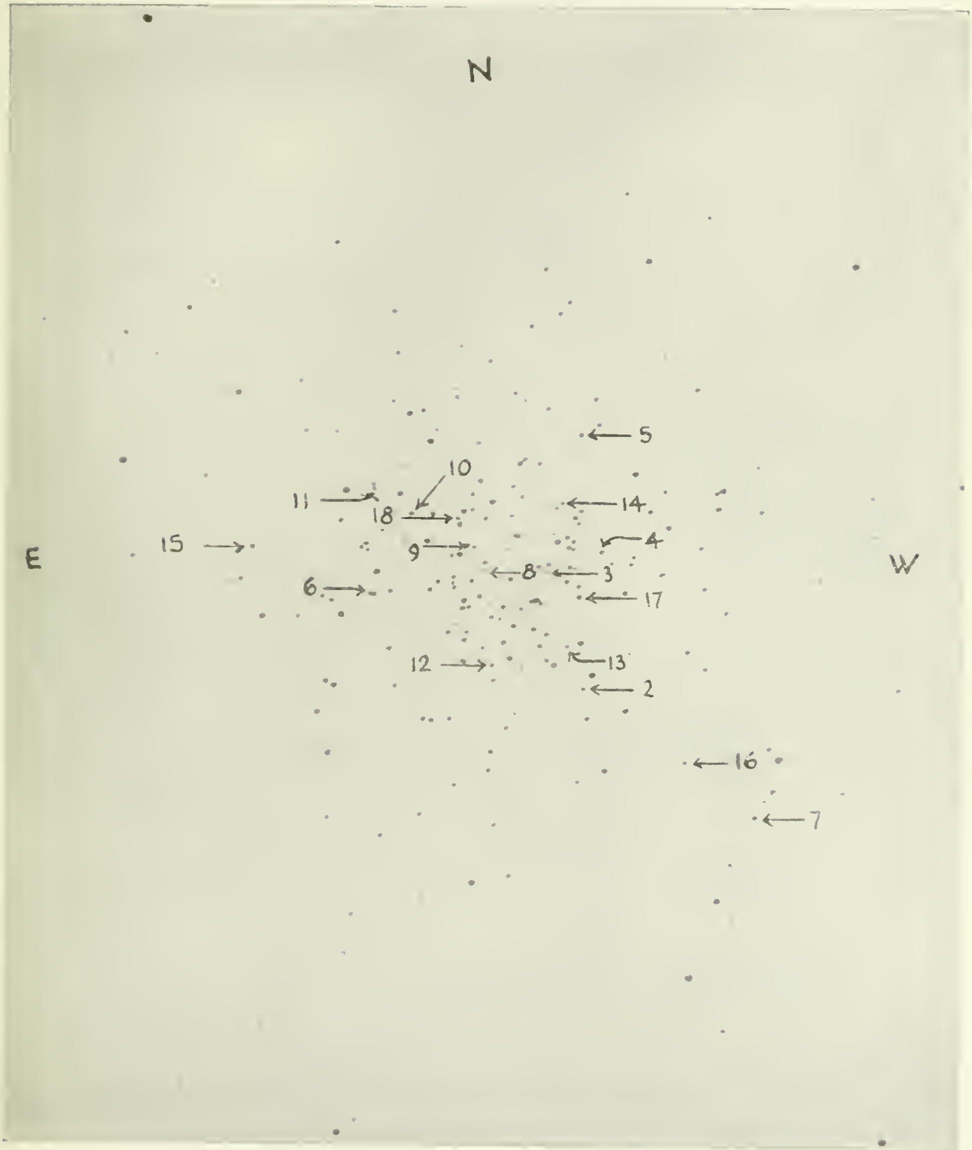
1945
THE UNIVERSITY OF TORONTO PRESS
TORONTO, CANADA

PLATE XXXI



The cluster NGC 5466, with variables marked. Enlarged from D.D.O. plate 7857, 1942, June 8, exp. 20^{m}. Scale, 1 mm = 6″.6.

LIGHT CURVES OF THE VARIABLE STARS IN THE GLOBULAR CLUSTER NGC 5466

By Helen B. Sawyer

(with Plate xxxi)

THE globular cluster NGC 5466 is a loose cluster of low absolute magnitude lying in very high galactic latitude. It closely resembles the cluster NGC 5053 which is relatively close to it in the sky. It is well situated for observation from the northern hemisphere, since its R.A. is $14^h\ 03^m.2$ and Dec. + 28° 56′ (1950). It has a galactic longitude of 8°, and latitude of + 72°.

In 1926 Baade[1] announced the discovery of fourteen variable stars in this cluster. From the similarity of their magnitudes and the general trend of the light changes, he concluded they were all cluster type variables. On the basis of a median magnitude of 16.17 for these variables, he derived the distance of the cluster as 19,000 parsecs. This distance was reduced in 1929[2] to 17,000 parsecs by the zero point correction for absolute magnitude of Cepheid variables.

The distance of 17,000 parsecs is still accepted in the recent revision by Shapley[3] of the distances of clusters in high galactic latitudes. From the survey of nebulae in the field it appears that this cluster lies in a region rich in galaxies, and Shapley has therefore applied no correction for absorption. The colour class determined by Stebbins and Whitford is f8, with a colour excess of + 0.05. Because of its high galactic latitude, therefore, this cluster is actually at the very great distance of 16,000 parsecs above the galactic plane, and is one of the few objects which indicates the enormous extent of our galaxy in this direction. It is a cluster of low apparent and absolute magnitude. Its apparent photographic magnitude as determined by Christie[5] with the schraffier kassette is 10.39, giving it an absolute magnitude of only −5.8.

The cluster was put on the observing list of this observatory in 1940, in order that enough plates might be acquired to permit the determination of the periods of Baade's variables. A total of 58 plates has been taken by the writer, who is indebted for instrumental

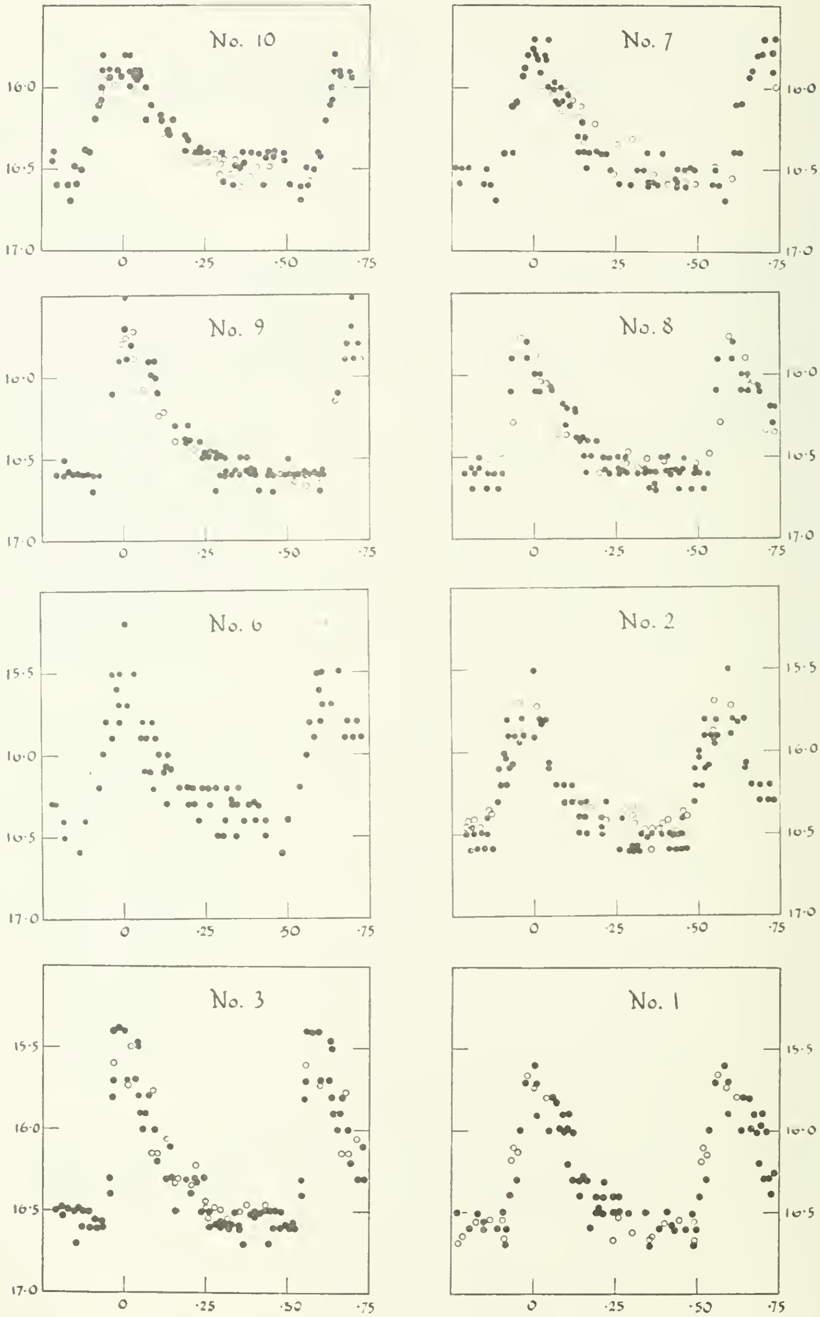


Fig. 1. Light curves of variables with periods between 0.7 day and 0.57 day.

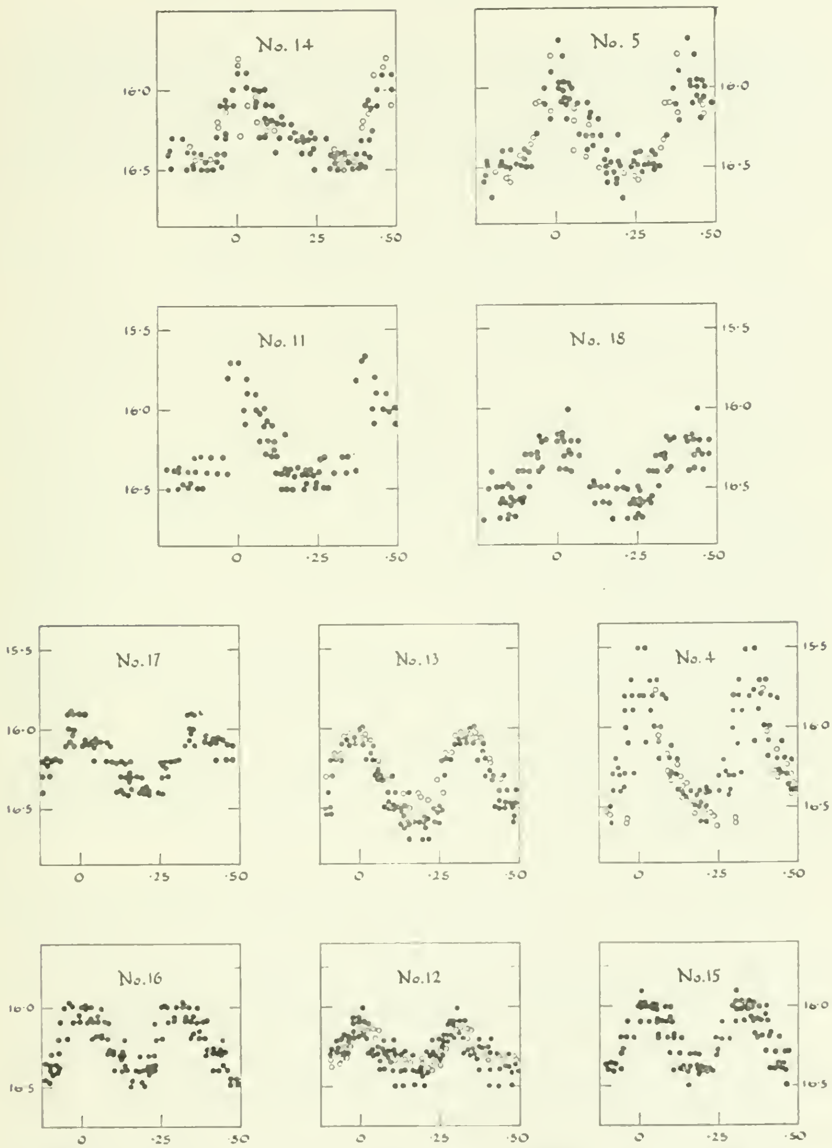


Fig. 2. Light curves of variables with periods between 0.44 and 0.28 day. Baade's observations are represented by open circles, Sawyer's, by dots.

assistance especially to Dr. F. S. Hogg, and to Mr. G. Longworth, Miss Ruth Northcott, Mr. D. K. Norris and Mr. W. S. Armstrong.

About a dozen pairs of these plates have been systematically examined with the blink microscope and four new variables discovered. These all have small ranges of only half a magnitude. The positions of the new variables on the same co-ordinate basis as those found by Baade are given in the remarks to Table I.

Baade published a drawing of the cluster for identification of his variables. Plate XXXI shows a print of this cluster from a David Dunlap plate, on which Sawyer's four new variables are marked, and all of Baade's except No. 1 which is too far from the cluster centre to show. All of the variables except No. 1 are included in the catalogue of 241 stars of this cluster published by Hopmann,[6] which he later[7] compared with the Hamburg positions.

All of the variables were estimated on the David Dunlap plates with the use of the magnitude sequence as determined by Baade. Because of the relative sparseness of stars, magnitude estimates in this cluster possess a greater degree of reliability than in the more compact clusters.

The 58 plates from this observatory, along with the 21 observations published by Baade for most of his variables, have permitted the determination of periods for all of the 18 variables. For six variables there are no observations by Baade available. Four of these are the new variables found by the writer. The other two are close double stars, on which Baade could make no reliable estimates from the Hamburg plates. These periods are therefore not so well determined as for most of the other twelve variables.

Table I gives the elements of the variables, including the number in Hopmann's catalogue, the maximum and minimum magnitudes, the mean, an epoch of a well observed maximum, and the period. Remarks on a few individual stars follow the table.

Table II gives the observations of these eighteen variables from the David Dunlap plates, with the phase expressed in thousandths of a day as computed on the basis of the assigned period.

The light curves for all of these stars are shown in Figures 1 and 2, where the stars are arranged in order of decreasing period length. The light curves are of an ordinary type. The interval between Baade's plates and the writer's is only twenty years, but there is not much suggestion of period change. For one or two variables the two series of observations might be best represented by slightly different periods, but in general the periods appear very constant. No long-period Cepheids have been found in this cluster. The mean magni-

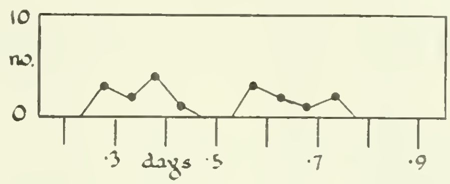


Fig. 3. Frequency of periods in NGC 5466.

tude of the eighteen variables is 16·17, the same as determined by Baade for eleven variables nineteen years ago.

On the basis of period frequency, NGC 5466 belongs to the double maximum type of cluster to which the writer[3] has recently called attention. Figure 3 gives a diagram of the period frequency in this cluster. The periods are collected in groups of 0.05 day; the ordinate represents the number of variables having periods in the interval indicated by the abscissa. There appear to be no periods close to half a day in this cluster; the periods fall around two-thirds of a day and one-third of a day. In NGC 5466, the gap in which no periods have been found amounts to 0.13 day. It will be important to discover the reason behind such a frequency distribution of period lengths.

REFERENCES

(1) Baade, *Ham. Mitt.*, v. 6, no. 27, 1926.
(2) Shapley and Sawyer, *H.B.*, no. 869, 1929.
(3) Shapley, *P.N.A.S.*, v. 30, pp. 61-68, 1944.
(4) Stebbins and Whitford, *Mt. W. Cont.*, no. 547, 1936.
(5) Christie, *Mt. W. Cont.*, no. 620, 1939.
(6) Hopmann, *A.N.*, v. 217, p. 333, 1922.
(7) Hopmann, *A.N.*, v. 229, p. 209, 1927.
(8) Sawyer, *J.R.A.S.C.*, v. 37, pp. 295-302 (*Comm. D.D.O.* no. 11), 1944.

Richmond Hill, Ontario,
April 25, 1945.

TABLE I

ELEMENTS OF THE VARIABLE STARS IN NGC 5466

Var. No.	Hop-mann	Magnitudes Max.	Min.	Mean	Epoch Julian Day	Period
1	—	15.6	16.7	16.15	30553.674	0.577415
2	64	15.5	16.6	16.05	30554.720	0.588523
3	95	15.4	16.7	16.05	30550.623	0.578065
4	56	15.5	16.6	16.05	30556.602	0.337968
5	61	15.7	16.7	16.20	20519.697	0.380519
6	202	15.2	16.6	15.90	39786.653	0.62096
7	20	15.7	16.7	16.20	30519.697	0.703423
8	141	15.8	16.7	16.25	30520.617	0.629120
9	148	15.5	16.7	16.10	30170.656	0.685027
10	186	15.8	16.7	16.25	30519.697	0.709273
11	198	15.7	16.7	16.20	30884.625	0.37799
12	134	16.0	16.5	16.25	30880.665	0.2942387
13	83	16.0	16.7	16.35	30556.702	0.341557
14	84	15.8	16.5	16.15	30880.599	0.440041
15	227	15.9	16.5	16.20	30519.618	0.28672
16	37	16.0	16.5	16.25	30553.612	0.29667
17	68	15.9	16.4	16.15	30519.713	0.370117
18	166	16.0	16.7	16.35	30519.697	0.37406

REMARKS TO TABLE I

1. This star is very near the edge of the plates, and measures have considerable uncertainty.

4. The large range and steepness of the curve strongly suggest that the period of this star might lie close to half a day. But the writer has not been able to satisfy the existing observations with a related period around 0.51 day.

5. Baade's observations from plates 3475 and 3476 are not plotted as they seem inconsistent with the others.

6. The variable is one component of a close double and no measures are published by Baade.

11. This star is also one component of a double, and Baade could not derive reliable measures from his plates. The related period of 0.60668 day satisfies the observations nearly as well as the period published, but with slightly larger scatter.

12. Baade's observation from plate 3476 is inconsistent and not plotted.

13. Baade's observation from plate 3476 is omitted from plot.

15. x″, + 223; y″, + 20.

16. x″, − 149; y″, − 175.

17. x″, − 60; y″, − 30.

18. x″, + 44; y″, + 41.

TABLE II—OBSERVATIONS OF VARIABLE STARS

Plate	Julian Day	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
		Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase
5697	29785.670	16.0	535	16.2	150	16.5	405	16.4	311	16.0	373	16.2	259
5709	86.653	16.7	364	15.9	544	16.3	232	16.3	280	16.7	214	15.2	000
5806	813.632	16.5	204	16.5	451	15.5	042	16.4	222	16.5	176	16.2	278
5818	14.631	16.0	048	16.4	273	16.6	463	16.6	207	16.2	034	15.5	035
5833	15.628	16.6	468	16.3	093	16.6	304	16.6	190	16.5	270	16.3	411
6845	30170.656	—	386	16.3	212	16.5	400	16.4	013	—	275	—	250
6856	71.630	16.5	205	16.1	038	16.3	218	15.8	312	16.4	107	15.6	603
6873	72.700	16.3	120	16.1	520	16.3	132	16.1	030	16.1	036	16.5	431
7853	519.618	15.7	011	16.5	209	16.4	211	16.4	192	16.5	302	16.4	232
7857	.697	15.9	090	16.6	288	16.6	290	16.2	271	15.7	000	16.4	311
7858	.713	15.9	106	16.6	304	16.6	306	16.0	287	15.8	016	16.3	327
7859	.728	16.0	121	16.6	319	16.6	321	15.8	302	16.0	031	16.5	342
7868	20.617	16.6	433	15.8	031	16.0	053	16.5	178	16.5	159	15.7	610
7872	.710	16.3	526	16.3	124	16.3	146	16.3	271	16.5	252	15.8	082
7936	50.623	16.5	413	16.1	023	15.4	000	16.3	104	16.3	104	16.2	189
7953	53.612	16.4	515	16.2	069	16.2	099	16.0	052	16.1	049	16.1	073
7958	.674	15.6	000	16.5	131	16.5	161	16.3	104	16.2	111	16.3	135
7973	54.640	—	389	15.9	509	16.4	549	16.2	066	16.5	316	16.6	480
7978	.720	—	469	15.5	000	15.9	051	16.4	146	16.2	396	16.0	560
7987	55.608	—	202	16.6	299	16.6	360	15.8	020	16.3	142	—	207
7991	.652	—	246	16.5	343	16.5	404	16.0	064	16.3	186	16.2	251
7995	.720	—	314	16.5	411	16.5	472	16.4	132	16.4	254	16.2	319
8006	56.602	—	041	16.3	116	16.3	198	15.5	000	15.9	375	15.9	580
8009	.626	—	065	16.3	140	16.3	222	15.5	024	16.0	019	15.8	604
8011	.645	—	084	16.3	159	16.5	241	15.8	043	16.0	038	15.7	002
8016	.702	—	141	16.5	216	16.6	298	16.2	100	16.1	095	15.8	059
8017	.710	—	149	16.4	224	16.6	306	16.3	108	16.2	103	15.9	067
8802	880.599	16.2	108	16.6	426	16.6	479	16.5	224	16.6	171	16.4	435
8805	.627	16.3	136	16.4	451	16.6	507	16.3	252	16.6	199	—	463
8808	.665	16.6	174	16.1	492	16.3	545	15.9	290	16.5	237	16.4	501

TABLE II—*Continued*—OBSERVATIONS OF VARIABLE STARS

Plate	Julian Day	No. 1		No. 2		No. 3		No. 4		No. 5		No. 6	
		Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase
8811	30880.694	16.5	203	15.8	521	15.4	574	15.7	319	16.5	266	16.2	530
8814	.732	16.4	241	15.8	559	15.5	044	16.1	019	16.4	304	—	568
8828	83.599	16.3	221	16.2	483	15.7	011	16.5	182	16.2	127	16.3	331
8831	.635	16.4	257	15.9	519	15.8	047	16.4	218	16.4	163	16.4	367
8834	.672	16.5	294	15.9	556	15.8	084	16.4	255	16.5	200	16.4	404
8837	84.625	16.0	092	16.5	332	16.5	458	16.5	194	16.0	011	16.0	115
8840	.653	16.0	120	16.5	360	16.5	486	16.5	222	16.2	039	16.0	143
8843	.685	16.3	152	16.5	392	16.6	518	16.5	254	16.3	071	16.2	175
8847	.726	16.4	193	16.5	433	15.9	558	16.4	295	16.3	112	16.3	216
8852	.775	16.5	242	16.3	482	15.7	030	15.8	006	16.5	161	16.3	265
8854	.800	16.5	267	16.0	507	15.9	055	15.9	031	16.6	186	16.5	290
8888	99.610	15.8	064	15.8	016	16.5	414	16.1	308	16.5	156	16.2	197
8890	.630	16.0	084	15.8	036	16.5	434	15.9	328	16.5	176	16.2	217
8899	.715	16.3	169	16.2	121	16.6	519	15.8	075	16.4	261	16.5	302
8903	.762	16.4	216	16.5	168	15.7	566	16.2	122	16.5	308	16.3	349
8913	900.608	16.5	485	16.6	425	16.5	256	16.4	293	16.1	012	15.8	574
8915	.624	16.6	501	16.6	441	16.6	272	16.3	309	16.0	028	15.5	590
8923	.710	15.9	010	16.1	527	16.6	358	15.7	057	16.4	114	15.9	055
8937	01.656	—	378	16.6	296	16.1	148	16.3	327	16.4	299	16.3	380
9026	33.642	—	029	16.0	502	16.5	340	16.5	206	16.5	322	16.1	076
9031	.694	—	081	15.9	554	16.5	392	16.6	258	16.1	374	16.1	128
10101	1257.690	16.4	147	16.6	274	16.0	094	16.4	142	16.5	169	15.5	604
10110	58.678	15.7	558	16.2	081	16.6	503	16.1	116	16.0	015	16.2	350
10115	.732	15.8	034	16.4	138	15.8	557	16.4	170	16.1	069	16.3	404
10123	59.619	16.5	344	16.5	437	16.6	288	15.7	044	16.4	195	15.9	049
10128	.656	16.6	381	16.6	474	16.6	325	15.8	081	16.5	232	16.1	086
10132	.702	16.6	427	16.2	520	16.7	371	16.2	127	16.5	278	16.1	132
10137	.772	16.7	497	15.9	001	16.7	441	16.4	197	16.3	348	16.3	202

TABLE II—*Continued*—OBSERVATIONS OF VARIABLE STARS

Plate	Julian Day	No. 7		No. 8		No. 9		No. 10		No. 11		No. 12	
		Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase	Mag.	Phase
5697	29785.670	16.4	347	16.6	494	15.8	684	16.2	071	16.7	240	16.3	161
5709	86.653	16.4	626	16.5	219	16.5	297	16.6	344	16.1	089	16.3	262
5806	813.632	16.4	172	16.4	146	16.6	560	16.4	371	16.4	231	16.5	171
5818	14.631	16.6	467	16.7	516	16.4	189	15.9	661	16.3	096	16.1	287
5833	15.628	16.0	057	16.6	255	16.5	501	16.4	239	16.3	337	16.3	107
6845	30170.656	16.4	560	16.5	459	15.7	000	16.1	631	16.0	054	16.1	283
6856	71.630	16.4	127	16.5	175	16.6	289	16.3	186	16.7	272	16.3	080
6873	72.700	16.5	494	15.8	615	15.9	674	16.6	547	16.5	208	16.2	268
7853	0519.618	16.1	624	16.6	259	16.5	284	16.0	630	16.5	131	16.1	278
7857	.697	15.7	000	16.6	338	16.5	363	15.8	000	16.5	210	16.3	063
7858	.713	15.9	016	16.7	354	16.6	379	15.9	016	16.4	226	16.4	079
7859	.728	15.8	031	16.6	369	16.6	393	15.9	031	16.5	241	16.3	094
7868	20.617	16.5	217	16.0	000	16.7	597	16.4	211	15.8	374	16.5	100
7872	.710	16.5	310	16.2	093	15.5	005	16.4	304	16.2	089	16.4	193
7936	50.623	15.8	679	16.7	437	16.7	462	16.6	427	16.5	141	16.3	094
7953	53.612	16.3	151	16.6	281	15.8	026	16.5	579	16.2	106	16.4	140
7958	.674	16.4	213	16.6	343	16.0	088	15.9	641	16.4	168	16.5	202
7973	54.640	16.5	475	16.1	051	16.5	369	16.3	189	15.7	000	16.2	286
7978	.720	16.6	555	16.4	131	16.6	449	16.4	269	16.0	080	16.2	071
7987	55.608	15.7	036	16.5	389	16.1	652	16.5	447	—	212	16.3	077
7991	.652	16.0	080	16.6	433	15.9	011	16.4	491	16.3	256	16.3	121
7995	.720	16.4	148	16.6	501	15.9	079	16.6	559	16.3	324	16.4	189
8006	56.602	16.5	325	16.2	125	16.5	276	15.8	023	16.2	072	16.4	188
8009	.626	16.6	351	16.4	149	16.5	300	15.9	047	16.3	096	16.3	212
8011	.645	16.6	370	16.4	168	16.6	319	16.0	066	16.3	115	16.3	231
8016	.702	16.6	427	16.6	225	16.6	376	16.2	123	16.5	172	16.1	288
8017	.710	16.6	435	16.5	233	16.6	384	16.3	131	16.4	180	16.1	002
8802	880.599	16.0	046	16.2	125	16.5	255	16.4	591	16.4	132	16.2	228
8805	.627	16.1	074	16.5	153	16.7	283	16.2	619	16.4	160	16.2	256
8808	.665	16.1	112	16.4	191	16.6	321	15.9	657	16.5	198	16.0	000

TABLE II—*Continued*—OBSERVATIONS OF VARIABLE STARS

Plate	Julian Day	No. 7 Mag.	No. 7 Phase	No. 8 Mag.	No. 8 Phase	No. 9 Mag.	No. 9 Phase	No. 10 Mag.	No. 10 Phase	No. 11 Mag.	No. 11 Phase	No. 12 Mag.	No. 12 Phase
8811	30880.694	16.2	141	16.6	220	16.6	350	15.9	686	—	227	16.3	029
8814	.732	16.4	179	16.5	258	16.6	388	16.0	015	16.3	265	16.3	067
8828	83.599	16.5	232	15.9	609	16.6	515	15.9	045	16.3	108	16.2	286
8831	.635	16.6	268	16.0	016	16.6	551	16.1	081	16.4	144	16.3	028
8834	.672	16.6	305	16.1	053	16.6	588	16.2	118	16.4	181	16.4	065
8837	84.625	16.6	555	16.6	377	16.3	171	16.5	362	15.7	000	16.5	135
8840	.653	16.7	583	16.5	405	16.3	199	16.4	390	15.8	028	16.4	163
8843	.685	16.4	615	16.6	437	16.4	231	16.4	422	15.9	060	16.4	195
8847	.726	15.9	656	16.7	478	16.5	272	16.4	463	16.1	101	16.3	236
8852	.775	15.8	705	16.6	527	16.6	321	16.6	512	16.2	150	16.2	285
8854	.800	15.8	026	16.1	552	16.6	346	16.7	537	16.4	175	16.2	016
8888	99.610	16.0	065	16.6	263	16.0	085	16.4	452	16.5	243	16.2	114
8890	.630	16.1	085	16.5	283	16.1	105	16.4	472	16.5	263	16.3	134
8899	.715	16.3	170	16.7	368	16.4	190	16.5	557	16.4	348	16.3	219
8903	.762	16.4	217	16.6	415	16.5	237	16.4	604	16.1	017	16.2	266
8913	900.608	16.6	359	16.1	003	16.6	398	15.9	031	16.3	107	16.3	229
8915	.624	16.6	375	16.1	019	16.7	414	15.9	047	16.4	123	16.2	245
8923	.710	16.5	461	16.3	105	16.6	500	16.3	133	16.4	209	16.3	037
8937	01.656	15.8	000	16.6	421	15.9	076	16.5	370	16.0	021	16.3	100
9026	33.642	16.5	332	16.6	322	16.6	551	16.4	439	16.4	256	16.2	014
9031	.694	16.6	384	16.7	374	16.6	603	16.4	491	16.4	308	16.3	066
10101	1257.690	16.1	102	16.6	373	16.6	581	16.5	349	16.4	367	16.4	105
10110	58.678	16.4	387	16.2	103	16.4	199	16.1	628	16.4	221	16.4	211
10115	.732	16.5	441	16.6	157	16.5	253	15.8	682	16.5	275	16.2	265
10123	59.619	16.1	624	16.6	415	16.6	455	16.2	150	15.9	028	16.2	269
10128	.656	15.9	661	16.6	452	16.6	492	16.4	187	16.0	065	16.1	012
10132	.702	15.8	004	16.6	498	16.6	528	16.4	233	16.1	111	16.3	058
10137	.772	16.1	074	15.9	568	16.6	608	16.6	303	16.4	181	16.4	128

Table II—*Continued*—Observations of Variable Stars

Plate	Julian Day	No. 13 Mag.	No. 13 Phase	No. 14 Mag.	No. 14 Phase	No. 15 Mag.	No. 15 Phase	No. 16 Mag.	No. 16 Phase	No. 17 Mag.	No. 17 Phase	No. 18 Mag.	No. 18 Phase
5697	29785.670	16.7	204	16.4	333	16.2	055	16.4	137	16.2	269	—	253
5709	86.653	16.6	162	16.1	436	16.4	178	16.4	230	16.3	142	16.5	114
5806	813.632	16.4	158	16.3	132	16.4	205	16.4	212	16.2	102	16.6	160
5818	14.631	16.6	132	16.4	251.	16.1	057	16.1	024	16.0	361	16.4	037
5833	15.628	16.3	105	16.4	368	16.4	194	16.3	131	16.2	247	16.6	286
6845	30170.656	16.5	255	16.3	283	—	263	16.1	045	16.1	333	—	331
6856	71.630	16.6	204	16.3	377	16.3	090	16.3	129	16.4	197	16.4	183
6873	72.700	16.6	250	16.2	127	16.1	300	16.0	013	16.3	157	16.5	131
7853	519.618	16.6	146	16.5	293	16.0	000	16.4	123	16.3	275	16.4	295
7857	.697	16.6	225	16.5	372	16.0	079	16.5	202	16.0	354	16.2	000
7858	.713	16.5	241	16.5	388	16.2	095	16.4	218	15.9	000	16.2	016
7859	.728	16.5	256	16.4	403	16.2	110	16.4	233	16.1	015	16.3	031
7868	20.617	16.5	120	16.1	412	16.4	139	16.2	232	16.3	164	16.7	172
7872	.710	16.6	213	16.0	065	16.4	232	16.1	028	16.4	257	16.6	265
7936	50.623	16.3	069	16.1	055	16.0	039	16.1	274	16.3	190	16.7	253
7953	53.612	16.1	326	16.1	404	16.5	161	16.0	000	16.4	218	16.5	250
7958	.674	16.2	046	15.9	025	16.4	223	16.2	062	16.2	280	16.4	312
7973	54.640	16.3	329	16.2	111	16.0	042	16.4	138	16.2	136	16.5	155
7978	.720	16.3	067	16.3	191	16.3	122	16.4	218	16.4	216	16.6	235
7987	55.608	16.2	272	16.4	199	16.4	150	16.3	216	16.1	364	16.4	001
7991	.652	16.1	316	16.5	243	16.4	194	16.0	260	16.1	038	16.4	045
7995	.720	16.1	043	16.5	311	16.2	262	16.2	031	16.2	106	16.5	113
8006	56.602	16.4	242	16.5	313	16.2	284	16.0	023	16.4	247	16.7	247
8009	.626	16.3	266	16.5	337	16.0	021	16.1	047	16.2	271	16.7	271
8011	.645	16.2	285	16.5	356	16.0	040	16.0	066	16.2	290	16.6	290
8016	.702	16.0	000	16.4	413	16.1	097	16.3	123	16.0	347	16.4	347
8017	.710	16.1	008	16.3	421	16.0	105	16.2	131	15.9	355	16.4	355
8802	880.599	16.4	101	15.9	000	16.0	001	16.2	057	16.1	022	16.3	308
8805	.627	16.5	129	16.0	028	16.1	029	16.3	085	16.1	050	16.3	336
8808	.665	16.6	167	16.0	066	16.0	067	16.3	123	16.1	098	16.2	000

TABLE II—*Continued*—OBSERVATIONS OF VARIABLE STARS

Plate	Julian Day	No. 13 Mag.	No. 13 Phase	No. 14 Mag.	No. 14 Phase	No. 15 Mag.	No. 15 Phase	No. 16 Mag.	No. 16 Phase	No. 17 Mag.	No. 17 Phase	No. 18 Mag.	No. 18 Phase
8811	30880.694	16.7	196	16.1	095	16.1	096	16.5	152	16.4	117	16.0	029
8814	.732	16.5	234	16.2	133	16.2	134	16.5	190	16.4	155	16.2	067
8828	83.599	16.2	027	16.5	360	16.4	133	16.3	090	16.1	061	16.5	316
8831	.635	16.3	063	16.1	396	16.3	169	16.3	126	16.1	097	16.2	352
8834	.672	16.5	100	16.0	433	16.4	206	16.5	163	16.4	134	16.2	015
8837	84.625	16.2	028	16.1	066	15.9	012	16.1	226	16.1	347	16.7	219
8840	.653	16.3	056	16.2	094	16.0	040	16.0	254	15.9	005	16.6	247
8843	.685	16.5	088	16.2	126	16.1	072	16.0	286	16.1	037	16.4	279
8847	.726	16.5	129	16.3	167	16.2	113	16.1	030	16.1	078	16.3	320
8852	.775	16.6	178	16.3	216	16.4	162	16.1	079	16.2	127	16.2	369
8854	.800	16.6	203	16.4	241	16.4	187	16.3	104	16.3	152	16.3	020
8888	99.610	16.1	326	16.2	089	16.1	088	16.3	081	16.4	157	16.6	242
8890	.630	16.0	005	16.2	109	16.4	108	16.4	101	16.3	177	16.5	262
8899	.715	16.4	090	16.3	194	16.3	193	16.4	186	16.3	262	16.2	347
8903	.762	16.6	137	16.3	241	16.3	240	16.4	233	16.2	309	16.2	020
8913	0900.608	16.1	300	16.3	207	16.4	226	16.3	189	16.1	045	16.6	118
8915	.624	16.1	316	16.3	223	16 2	242	16.4	205	16.1	061	16.6	134
8923	.710	16.4	060	16.4	309	16.0	041	16.1	291	16.2	157	16.5	220
8937	01.656	16.2	023	16.5	375	16.4	127	16.1	050	15.9	352	16.2	044
9026	33.642	16.6	203	16.4	238	15.9	000	16.1	292	16.3	138	16.6	235
9031	.694	16.2	255	16.4	290	16.2	052	16.2	048	16.4	190	16.6	287
10101	1257.690	16.5	113	16.3	416	16.0	055	16.1	080	15.9	334	16.3	347
10110	58.678	16.5	076	16.0	084	16.3	183	16.4	178	16.4	211	16.5	212
10115	.732	16.6	130	16.2	138	16.4	237	16.4	232	16.2	265	16.6	266
10123	59.619	16.2	335	16.2	175	16.1	263	16.3	229	16.2	042	16.3	031
10128	.656	16.3	030	16.3	182	16.0	014	16.2	266	16.2	079	16.3	068
10132	.702	16.4	076	16.3	228	16.1	060	16.0	015	16.4	125	16.5	114
10137	.772	16.7	146	16.4	298	16.3	130	16.2	085	16.4	195	16.5	184