

VARIABLE STARS IN MILTON FIELD 49

By CECILIA PAYNE-GAPOSCHKIN

Field No. 49 extends from 7^h30^m to 10^h30^m and from -45° to -75° . It contains forty-six known variable stars supposed to be brighter at maximum than the tenth photographic magnitude. Five of these (SU, YY, AI, and EX Carinae, and TY Velorum) proved to be too faint, or otherwise unsuitable for study. Eight additional stars were examined for variability; they are enumerated in the final section of the paper. In all, 32,338 observations are discussed.

Magnitudes for the comparison stars, which will be published later, were determined on Harvard plates by Miss Frances W. Wright.

VARIABLE STARS IN FIELD 49

Star	Designation	Type	Period	Range	Spectrum	Obs.
R Car	092962	Long-period	308.5	5.6:-11.14	M5e	787
S Car	100661	Long-period	149.6	6.90-11.02	K7e-M5	1207
V Car	082659	Cepheid	6.696734	8.18-8.86	G2-K0	525
X Car	082958	Eclipsing	1.0826310	8.04-8.60	A0	507
Y Car	102957	Cepheid	3.6397603	8.23-8.69	F5	1233
RR Car	095458	Semiregular	109±20	9.08-10.40	M6	789
ST Car	101259	Eclipsing	0.9016495	9.08-10.40	A0	1199
SU Car	101060	Long-period	(230.9)	.....	(Me)	55
SV Car	094559	Long-period	298	10.09-[13.8	.....	425
SW Car	102357	Eclipsing	8.165878	10.81-12.33	.....	1040
SZ Car	095659	Semiregular	126±20	10.01-12.1	Nb	725
UU Car	092673	Long-period	198.5	9.92-[12.9	M3	203
UW Car	102359	Cepheid	5.34576	10.14-10.85	G	1153
UX Car	102557	Cepheid	3.6823	8.32-9.40	F2-K0	1224
UY Car	102861	Cepheid	5.543698	9.43-10.42	G	1150
YY Car	101660	Eclipsing	(2.64264)	.....	.....	.....
YZ Car	102458	Cepheid	18.159*	9.10-10.37	G5	1178
AI Car	074552	.....	.....	.....	.....	.....
AQ Car	101860	Cepheid	9.7701362	9.88-10.39	G0	1183
CK Car	102059	Semiregular	525:	9.20-10.51	Mb	1166
DO Car	100958	Eclipsing	3.85194	9.31-9.49	B8	483
EV Car	101659	Semiregular	347:	9.24-10.58	Mb	1139
EX Car	102163	Eclipsing	(1.396366)	.....	.....	.....
I Car	094262	Cepheid	35.5323	4.97-5.99	G0-K0	848
V Pup	075548	Eclipsing	1.4544867	4.76-5.13	B1	534
T Vel	083447	Cepheid	4.639769	8.75-9.23	G0-G5	475
U Vel	092945	Variable?	4315:	9.40±0.08	Mb	672
V Vel	091955	Cepheid	4.3710408	8.17-8.76	F8-G5	781
W Vel	101153	Long-period	394.9	9.53-[13.1	M7e	249
Y Vel	092551	Long-period	446.6	9.69-[13.0	Me?	336
Z Vel	094953	Long-period	425.2	9.56-[13.2	Me	286
RS Vel	092048	Long-period	409.5	9.10-[12.55	M7e	463
RV Vel	091550	Eclipsing	4.82109852	11.42-11.88	G0	571
RW Vel	091649	Long-period	451.7	8.94-[13.1	M7e	453
RX Vel	092450	Eclipsing	3.11182966	10.99-11.84	A2	735
RY Vel	101654	Cepheid	28.1311*	9.35-10.56	G2-K2	709
ST Vel	084150	Cepheid	5.8584249	10.48-11.43	K	402
SW Vel	084047	Cepheid	23.51284*	8.49-10.17	K2	476
SX Vel	084145	Cepheid	9.54993	8.79-9.69	G5	480
TT Vel	101645	Eclipsing	2.1083907	10.85-12.26	.....	526
TY Vel	091554	Variable?	.....	.....	.....	434
UU Vel	093253	Long-period	420.7	11.69-[13	M2e	231
WY Vel	091852	Irregular	.....	8.84-10.22	Map	712
WZ Vel	101347	Semiregular	3100:	9.91±0.14	Mb	681
AH Vel	080846	Cepheid	4.227172	6.44-6.74	F8p	626
AL Vel	082847	Eclipsing	96.106	9.77-10.17	A3p	470
AO Vel	080848	Eclipsing	1.5845853*	9.57-9.95	B9	609
N Vel	092856	Variable?	.....	5.0±0.12	K5	613

* Variable period.

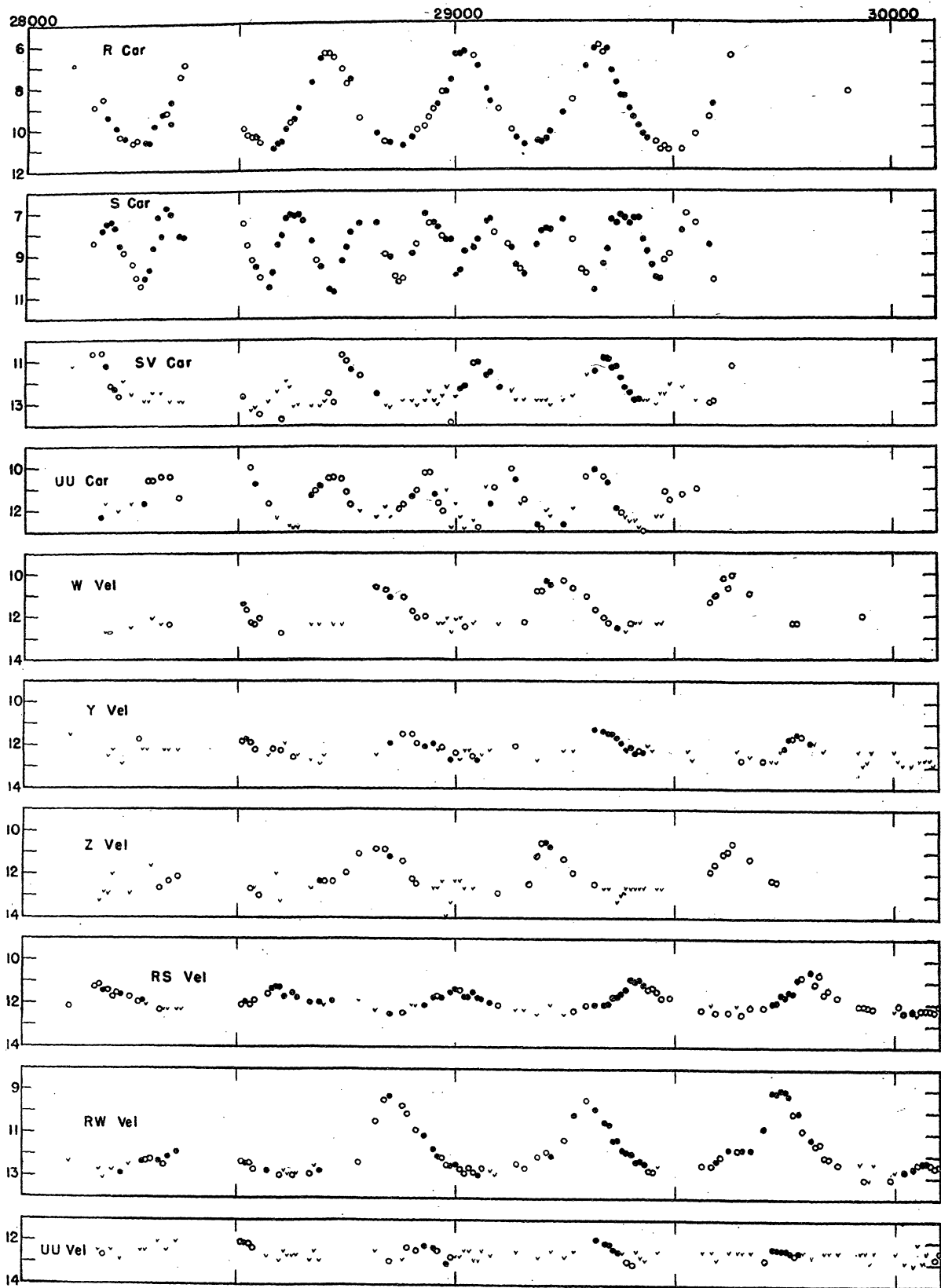


FIGURE 1

THE LONG-PERIOD VARIABLES

Eleven long-period variables are listed below; SU Carinae, however, proved to be too faint for study. The group is remarkable for the large number of stars (6) with periods of about four hundred days.

LONG PERIOD VARIABLES IN FIELD 49

Star	Designation	Period	Spectrum	Range	Median Maximum	Median Minimum
R Car	092962	308.5	M5e	5.6:-11.14	6.50±0.18	10.84±0.11
S Car	100661	149.6	K7e-M5	6.90-11.02	7.38±0.11	10.52±0.34
SU Car	101060	(230.9)	(Me)	.....	.....	.....
SV Car	094559	298	.....	10.09-[13.8	10.68±0.39	.....
UU Car	092673	198.5	M3	9.92-[12.9	10.24±0.18	.....
W Vel	101153	394.9	M7e	9.53-[13.1	10.30±0.19	.....
Y Vel	092551	446.6	Me?	9.69-[13.0	11.04±0.40	.....
Z Vel	094953	425.2	Me	9.56-[13.2	10.69±0.72	.....
RS Vel	092048	409.5	M7e	9.10-[12.55	11.64±0.68	.....
RW Vel	091649	451.7	M7e	8.94-[13.1	9.74±0.81	.....
UU Vel	093253	420.7	M2e	11.69-[13	12.04±0.26	.....

R Carinae.— Long known to be variable, R Carinae has been under constant observation by the AAVSO. Seventeen maxima and nineteen minima are deduced from the photographic material. The period 308^d.5 has been used to compute the phases (Prager, *Gesch. und Lit.* II, 1, 177, 1934). Median minimum magnitude is 10.84±0.11.

MAXIMA AND MINIMA OF R CARINAE

Maxima			Minima		
JD	IPg	Phase	JD	IPg	Phase
15760	6.61	51.086	21310	6.32	69.076
16085	6.26	52.139	23180	6.53	75.138
17010	6.46	55.138	25340	6.61	82.139
17320	6.32	56.143	27180	6.61	88.104
17640	6.83	57.180	27500	5.6	89.141
17945	6.83	58.168	28705	6.46	93.047
19160	6.46	62.107	29020	6.32	94.068
19480	6.61	63.144	29330	6.18	95.073
21000	6.61	68.071			
			16265	11.06	52.723
			16545	10.70	53.630
			16875	10.88	54.700
			18400	10.88	59.643
			18690	10.62	60.583
			19010	10.62	61.621
			20270	11.14	65.705
			21185	10.70	68.671
			22110	10.88	71.637
			24250	[10.88	78.606
			24600	[10.88	79.741
			26430	10.88	85.673
			26740	[10.88	86.677
			27960	10.80	90.632
			28260	10.80	91.604
			28580	11.06	92.642
			28865	10.80	93.566
			29180	10.80	94.587
			29500	11.14	95.624

S Carinae.— This star has long been under systematic visual observation. Forty-seven maxima and forty-three minima are deduced from our material. The period 149^d.6 was used in computing phases.

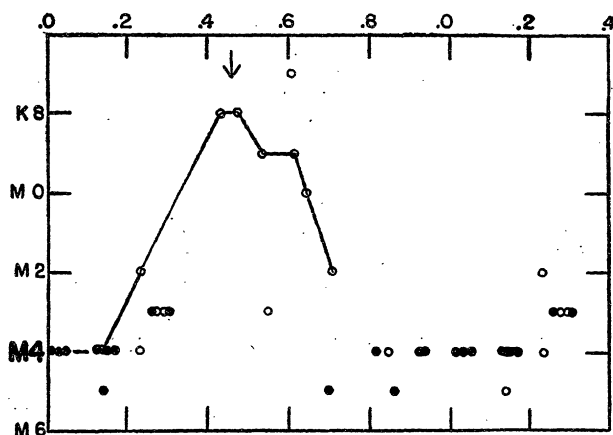


FIGURE 2.— Spectrum and phase for S Carinae. Circles denote spectra with bright lines. The points referring to Cycle 108 are joined with straight lines, and the epoch of the corresponding maximum is marked with an arrow.

The median minimum magnitude is 10.52 ± 0.34 . The large dispersion, contrasting with the value 0.11 for the maxima, is reflected in the light curves, which show that there is a tendency for deep and shallow minima to alternate. A test of the reality of the difference in depth for minima of even and odd epoch (T. E. Sterne and L. Campbell, HA 105, 486, 1937) gives a value of .064 for $p(r)$; we conclude that the alternation is genuine.

Twenty-nine spectra of S Carinae have been published by Miss Cannon (HA 79, 198, 1928); they are repeated here with phases, and reproduced in Figure 2. It should be noted that the first nine entries in the table precede the photographic observations of brightness.

MAXIMA AND MINIMA OF S CARINAE

Maxima						Minima					
JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
15470	7.38	103.409	21330	7.52	142.580	15540	10.43	103.877	22435	10.21	149.966
15765	7.69	105.381	21760	7.22	145.454	15860	9.22	106.016	23190	11.02	155.013
15910	7.04	106.350	22080	7.04	147.594	16150	10.09	107.954	23940	10.84	160.027
16070	7.04	107.420	22515	8.00	150.501	16305	10.90	108.991	24540	10.27	164.037
16225	7.22	108.456	22815	7.69	152.507	16455	9.93	109.993	24680	10.61	164.973
16520	7.22	110.428	23550	7.22	157.420	16500	10.61	110.896	24830	10.84	165.976
16670	7.38	111.430	23830	7.22	159.291	16895	10.32	112.934	25280	10.68	168.984
16820	6.90	112.433	24170	7.04	161.564	17180	9.22	114.839	25425	10.21	169.953
16970	7.22	113.436	24305	7.04	162.467	13740	10.27	115.909	26485	10.68	177.039
17260	7.22	115.374	24600	7.22	164.438	17510	10.96	117.045	26790	10.32	179.077
17580	7.04	117.513	25210	6.90	168.516	17650	10.14	117.981	26970	9.84	180.281
17720	7.04	118.449	25350	6.90	169.452	18095	10.90	120.956	28270	10.50	188.970
18025	7.52	120.488	26425	7.38	176.638	18400	10.84	122.995	28570	10.57	190.976
18330	7.22	122.527	27910	7.22	186.564	18695	10.84	124.967	28720	10.80	191.978
18475	7.22	123.496	28200	7.52	188.503	19155	10.09	128.041	28875	10.27	193.015
18615	6.90	124.432	28335	6.90	189.405	19450	10.68	130.013	29015	9.84	193.950
18770	6.90	125.468	28630	7.04	191.377	19600	10.72	131.016	29160	9.93	194.920
19065	6.90	127.440	28800	7.22	192.513	19905	10.68	133.055	29315	10.68	195.956
19220	7.22	128.476	28930	7.04	193.382	20200	10.20	135.027	29465	10.14	196.959
19525	7.04	130.515	29080	7.22	194.385	20666	10.14	138.101			
20270	7.22	135.495	29240	7.38	195.455	20960	10.96	140.107			
20590	7.52	137.634	29395	7.22	196.491	21390	10.96	142.981			
21040	7.22	140.642	29535	7.22	197.426	21695	10.39	145.020			
21180	7.38	141.578				22140	[10.39	147.995			

SPECTRA OF S CARINAE

JD	Spectrum	Phase	JD	Spectrum	Phase	JD	Spectrum	Phase
12208	K7e	81.604	16164	M4	108.048	16647	M3e	111.277
12589	M4	84.151	16179	M4e	108.148	18056	M5	120.695
12592	M4	84.171	16192	M2e	108.235	18380	M5	122.861
13247	M3e*	88.549	16222	K8e	108.436	18422	M5	123.142
13287	M4	88.817	16228	K8e	108.476	18436	M4e	123.235
13305	M4*	88.937	16237	K9e	108.536	18720	M4	125.134
13359	M3e	89.298	16249	K9e	108.616	23165	M4e	154.846
13360	M3	89.305	16253	M0e	108.643	23178	M4	154.933
13653	M3	91.263	16262	M2e	108.703	23190	M4	155.013
						23193	M4	155.033

* Typographical error in original paper, kindly rectified by Mrs. Mayall.

SU Carinae. — Discovered by Miss Cannon (E. C. Pickering, HC 151, 1909), *SU Carinae* proves to be below our adopted limit.

SV Carinae. — Miss Cannon discovered this variable (E. C. Pickering, HC 151, 1909), and the period of 298 days (C. H. Payne, HB 860, 1928) is confirmed by our present list of twelve maxima.

MAXIMA OF SV CARINAE

JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
16240	11.17	54.497	20960	10.19	70.336	28170	10.54	94.530
16540	10.91:	55.503	22450	10.09	75.336	28740	10.70	96.443
16820	10.19	56.443	24580	10.09:	82.483	29050	11.09	97.483
18010	12.11:	60.436	27550	10.46	92.450	29340	10.80	98.456

UU Carinae. — Discovered by Miss Leavitt (E. C. Pickering, HC 122, 1906), *UU Carinae* has yielded twenty-two maxima. The period of 202^d deduced by Miss Leavitt (HC 170, 1912) has been corrected to 198^d₅, which is used in computing the phases.

MAXIMA OF UU CARINAE

JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
16415	10.54:	82.695	21370	10.27	107.657	28325	10.44	142.695
16610	10.19	83.678	23150:	.....	116.625:	28530:	10.00:	143.728:
16820	10.19	84.736	23510:	.....	118.438:	28725	10.44	144.710
18015:	9.92:	90.756:	24140	10.27	121.612	28935	10.27	145.768
18430:	10.09:	92.846:	24540	10.09	123.627	29130	10.09	146.751
18800	10.00	94.710	25345*	11.06:	127.683:	29320	10.19	147.708
20600	10.54	103.778	27930	10.27	140.705	29525	11.07	148.740
20980	10.00	105.693						

* Very wide.

W Velorum. — Discovered by Kapteyn (AN 142, 75, 1896) this star has been extensively observed visually. Fifteen photographic maxima are derived, and the period 390^d₇ (Schneller's catalogue for 1941) has been corrected to 394^d₉.

MAXIMA OF W VELORUM

JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
15830	10.36	40.086	21310:	10.14	53.963:	26480:	10.21:	67.776
16200	10.29	41.023	21660:	10.14	54.849:	26880:	10.00:	68.800
16580	9.53	41.985	22120	10.50	56.014	28820	10.57	73.765
16990	10.50	43.024	22490	10.57	56.951	29235	10.21	74.827
17375	9.94	43.998	25290	10.57	64.042	29625	10.21	75.825

Y Velorum. — Thirteen photographic maxima have been derived for *Y Velorum*. The period 444^d₄, given in Schneller's catalogue for 1941, has been corrected to 446^d₆.

MAXIMA OF Y VELORUM

JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
15480:	10.86	34.662	21660	9.69	48.500	28520:	11.79:	63.860:
15900	11.00	35.602	23520:	10.93:	52.664	28840	11.44	64.577
16800	11.04	37.618	25300	10.99	56.650	29320	11.29	65.651
17700	10.97	39.633	25755	10.90	57.669	29780	11.46	66.682
19930	10.99	44.626						

Z Velorum. — Fourteen photographic maxima are recorded for *Z Velorum*. Phases have been derived with the period 425^d₂, given in Schneller's catalogue for 1941. A period of 436^d₃ would be derived from Epoch 37 to 56, and a period 415.0 from Epoch 62 to 69. The earlier value is very near to 435^d, derived by Campbell for a similar interval (HB 843, 1927); the mean of the two values is very nearly 425^d₂.

MAXIMA OF Z VELORUM

JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
15880	11.04	37.347	20260	10.78	47.648	27140	10.16	63.829
16255	11.34	38.229	21120:	10.81:	49.671	28820	10.81	67.780
16750:	.....	39.393:	22420	9.86	52.728	29200	10.59	68.674
17620:	41.439:	24150	9.56	56.797	29630	10.59	69.685
18065	10.99	42.486	26720	9.56	62.841			

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RS Velorum.— This variable was discovered by Mrs. Fleming (HC 76, 1904), and the period of 421^d was derived by Miss Cannon. Fourteen maxima and eight minima lead to the revised value 409^d₅.

MAXIMA AND MINIMA OF RS VELORUM

Maxima						Minima		
JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
15855	9.71	38.718	25330	10.63	61.856	26410	[12.55	64.493
16720:	.....	40.830:	25750	11.32	62.882	26750	[12.55	65.324
18760	10.63	45.812	28170	11.16	68.791	27190	[12.5	66.398
22060	10.25	53.870	28590	11.24	69.817	27600	[12.55	67.399
22460	9.10:	54.847	29000	11.38	70.818	28850	[12.45	70.452
24170:	11.86:	59.023:	29415	10.86	71.831	29220	[12.55	71.355
24510:	11.16	59.853	29810	10.46	72.796	29680	[12.45	72.479
						29995	[12.5	73.248

RW Velorum.— Discovered by Miss Cannon (E. C. Pickering, HC 151, 1909) *RW Velorum* has not been studied except at Harvard (C. H. Payne, HB 860, 1928). Its light curve is peculiar and irregular, with well marked secondary maxima. The length of the cycles is unusually variable, and possibly the primary and secondary maxima interchange. The table gives eighteen primary maxima, four secondary maxima, and seven minima. The period has been corrected to 451^d₇.

MAXIMA AND MINIMA OF RW VELORUM

Maxima						Minima		
JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
13553	.....	30.006	25740	9.37	56.988	25980	12.93	57.520
16150:	10.74	35.756:	27060	9.44	59.911	26410	12.87	58.472
16530:	10.74	36.598:	27520	9.78	60.929	62840	12.87	59.424
16855*	11.31*	37.317*	27950:	9.00:	61.881	28620	12.93	63.365
16960	10.51	37.550	28300*	12.26*	62.656*	29060	12.93	64.339
18760	10.19	41.535	28850	9.29	63.874	29500:	.....	65.313:
20610	9.69	45.631	29300	9.44	64.870	29970	[13.07	66.354
21060:	.....	46.627	29635*	11.66*	65.612*			
22480:	9.37	49.771	29740	8.94	65.844			
23870:	10.19:	52.848	30065*	12.33*	66.564*			
25240	10.19	55.881	30170	]10.4	66.797:			

* Secondary Maxima.

UU Velorum.— Discovered by Wood (AN 211, 446, 1920), *UU Velorum* has hitherto been of unknown type. From thirteen photographic maxima it proves to be a long-period variable. The deduced period is 408^d₉; it is much fainter at maximum than our adopted limit.

MAXIMA OF UU VELORUM

JD	IPg	Phase	JD	IPg	Phase	JD	IPg	Phase
14980:	12.14	36.635	25670	11.69	62.778	28930	12.22	70.751
16250:	12.00	39.741	26100	12.14	63.830	29320	11.90	71.704
16645	11.92	40.707	26475	12.00	64.747	29735	12.30	72.719
23200	12.00:	56.737	28510	12.08	69.723	30125	12.00	73.673
25285	11.92	61.836						

THE SEMIREGULAR AND IRREGULAR VARIABLES

Seven variables, one of them of spectral class N, are placed in this category.

SEMIREGULAR RED VARIABLES IN FIELD 49

Star	Designation	Period	Spectrum	Range	Median Maximum	Median Minimum
RR Car	095458	109±20	M6	9.08-10.40	9.35±0.11 (41)	9.81±0.13 (27)
SZ Car	095659	126±20	Nb	10.01-12.1	10.30±0.09 (29)	10.71±0.13 (23)
CK Car	102059	525:	Mb	9.20-10.51	9.40±0.17 (16)	10.04±0.12 (17)
EV Car	101659	347:	Mb	9.24-10.58	9.48±0.12 (7)	10.18±0.20 (10)
U Vel	092945	4315:	Mb	9.40±0.08	.....	.....
WY Vel	091852	.....	Map	8.84-10.22	.....	.....
WZ Vel	101347	130:	Mb	9.91±0.14	.....	.....

RR Carinae.—The variability of this star was announced by Mrs. Fleming (*Astr. and Ap.*, 13, 502, 1894). It has not since been studied photographically; but has been observed from time to time by the AAVSO (HC 235, 1922; 244, 1923; 259, 1924; 426, 1937; 435, 1940). Forty-one maxima and twenty-eight minima are tabulated. The median cycle, deduced from consecutive maxima and minima, is 109±20 days. From nine consecutive cycles (28500 to 29580) the mean cycle is 120 days; from four (16445 to 16940) it is 124 days.

MAXIMA AND MINIMA OF RR CARINAE

Maxima				Minima			
JD	IPg	JD	IPg	JD	IPg	JD	IPg
15880	9.49	22435	9.34	15825	9.84	28940	9.72
16150	9.34	23200	9.40	16525	9.94	29105	9.61
16445	9.34	23540	9.40	16610	10.08	29250	9.84
16550	9.52	24150	9.52	16795	9.90	29330	9.57
16665	9.34	24645	9.34	16890	9.79	29430	9.90
16845	9.68	25290	9.34	18150	9.61	25525	9.79
16940	9.40	25410	9.12	18370	9.30	29640	9.84
17290	9.44	27960	9.08	18480	9.84		
18030	9.12	28205	9.44	18810	9.90		
18300	9.08	28305	9.19	20645	9.94		
18405	9.19	28500	9.12	21000	9.84		
18750	9.62	28630	9.27	21730	9.94		
19505	9.44	28735	9.30	22100	9.90		
19920	9.40	28870	9.19	24260	10.40		
20240	9.40	29040	9.12	24570	10.21		
20955	9.68	29190	9.34	25245	9.72		
21030	9.40	29295	9.34	25340	9.72		
21170	9.27	29360	9.44	28255	9.61		
21350	9.19	29480	9.34	28560	9.49		
21665	9.27	29580	9.27	28690	9.44		
22075	9.79			28790	9.72		

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SZ Carinae.— Since its discovery by Mrs. Fleming (E. C. Pickering, HC 158, 1910) this star has been neglected. It is a typical small-range N star. Long-term variations of the curve are indicated: it was unusually faint near JD 18400. These long-term variations are too gradual for the determination of a mean cycle.

The median short cycle is 126 ± 20 days. Four consecutive cycles (16470 to 16950) give a mean value of 120 days; seven others (28540 to 29540), a value of 143 days.

MAXIMA AND MINIMA OF SZ CARINAE

Maxima				Minima			
JD	IPg	JD	IPg	JD	IPg	JD	IPg
15910	10.30	22450	10.37	15850	11.19	28500:	10.71:
16245	10.48	24150	10.24	16170	10.71	28610	10.65
16470	10.41	24275	10.11	16275	10.90	28780	10.71
16610	10.37	24530	10.37	16420	10.60	28905	10.60
16850	10.48	24670	10.24	16530	10.65	29040	10.53
16950	10.37	25270	10.37	16805	10.71	29195	10.71
18340	10.83	28545	10.11	16900	10.60	29345	10.90
18440	10.90	28630	10.01	17350	10.65	29490	10.60
18640	10.60	28850	10.16	18380	11.19		
19480	10.41	28955	10.24	18690	10.94		
19895	10.30	29100	10.24	19170	12.1		
20920	10.11	29235	10.37	21005	10.48		
21070:	10.24	29410	10.16	21140	10.94		
21200	10.24:	29540	10.24	22090	10.83		
21355	10.37:			24210	10.48		

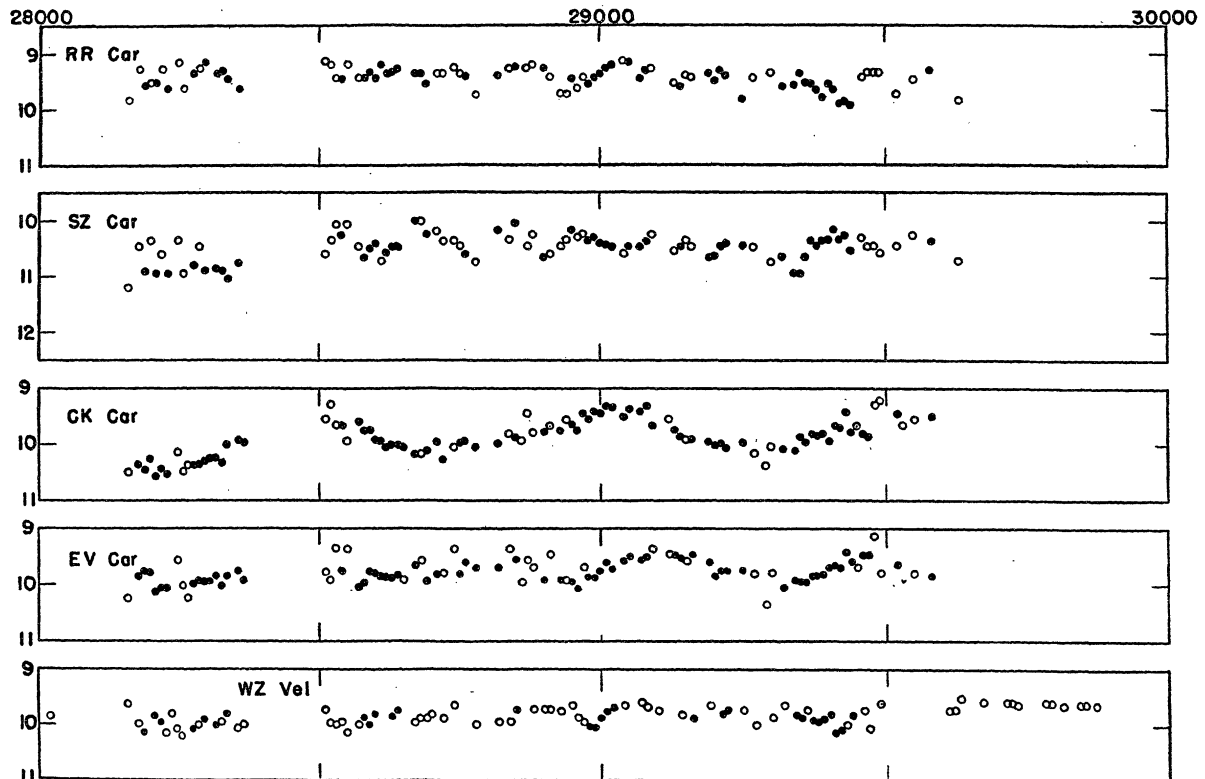


FIGURE 3

CK Carinae.— This star has not been studied since its discovery by Miss Woods (HC 225, 1921). The variation is gradual and small. Between JD 28000 and 30000, where the observations are most numerous, there are but three maxima and three minima, and a cycle of about 550 days is indicated. Between JD 14000 and 19000, and from JD 24000 to 25000, however, half of this cycle is operative. For intervals of several hundred days, as between JD 21200 and 21900, there is no appreciable variation.

MAXIMA AND MINIMA OF CK CARINAE

Maxima				Minima			
JD	IPg	JD	IPg	JD	IPg	JD	IPg
15910	9.42	21260	9.60	15520	10.28	21040	10.28
16180	9.56	22460	9.30	16310	10.28	22130	10.51
16420	9.91	24200	9.56	16570	10.14	22670	10.04
16740:	9.68:	24740:	9.30:	16880	10.14	24340	10.04
16960	10.04	28490	9.42	17100:	10.28:	24630	9.91
17270	9.91	29020	9.30	18340	10.10	28220	10.51
18010	9.56	29500	9.56	18680	9.91	28710	10.14
18500	9.56			19170	9.91	29290	10.28
19570	9.20			19910	10.04		

EV Carinae.— This star, twice discovered at Harvard, by Miss Leavitt (HC 122, 1906), and by Miss Cannon (HC 151, 1909) varies slowly with small amplitude, and bears a likeness to *CK Carinae*. There is a cycle of about a year's duration (see Figure 3). For long intervals, as between JD 24400 and 24900, there is no appreciable variation, and Worsell's failure to establish variability from five plates is not, therefore, surprising (UOC 46, p. 16, 1919).

MAXIMA AND MINIMA OF EV CARINAE

Maxima		Minima	
JD	IPg	JD	IPg
15940	9.48	16150	10.58
16700:	9.80	16935	10.34
17400	9.24	17970	10.24
18110	9.58	18600	10.46
25350	9.69	20250	10.34
28810	9.52	21050	10.46
29100	9.43	28250	10.13
29475	9.37	28650	9.91
		28960	9.97
		29320	9.97
		29630	9.91

U Velorum.— The variations of *U Velorum*, which do not seem to have been studied since the early work of Roberts (AJ 21, 84, 1901), are evidently too small to be examined successfully from our material. A study of the frequency of step estimates leads to a median magnitude 9.40 ± 0.08 . Variation with a range of about a quarter of a magnitude is therefore possible. A long, slow cycle is suggested.

WY Velorum.— Discovered by Miss Cannon (HB 783, 1923), this star belongs to the interesting group of stars with composite spectra, an absorption spectrum of late type and a high-temperature emission spectrum. "The spectrum, which is of Class Ma, contains also five well-marked bright lines or bands, which appear, on the dispersion available, to coincide with some of the strongest bright lines of unknown origin in the spectrum of η Carinae. The approximate positions are 4244 (perhaps including the enhanced iron line 4233), 4287, 4352 to 4358, 4414 to 4416, and 4452 to 4457. The last is much fainter than the other four. $H\beta$ does not appear as a bright line."

"The magnitude of the star has been measured by two observers on 101 photographs that are distributed rather evenly throughout the years from 1890 to 1922. From 1890 to 1901 there was a slow and apparently steady increase in light from magnitude 9.8 to 9.2; and since 1902 the light has slowly decreased. The magnitude was 10.1 in May, 1922."

The observations made during the present program are assembled in 100-day means, which are plotted

in Figure 4. During the decline of brightness (JD 15000 to 21000) a rough cycle of 550 days may be suspected; during the more recent rise there was (JD 27000 to 30000), a vaguer cycle of 370 days, which is, however, so near a year as to be open to suspicion. The light curve is shown on p. 101.

WZ Velorum. — Discovered on Harvard plates by Miss Harwood (HB 791, 1923), *WZ Velorum* is a variable of small range and slow variation. From the frequency of the step estimates, the median magnitude is 9.91 ± 0.14 . The range is too small for successful study on patrol plates; the mean light curve appears to undergo slow variations with a very long cycle. There is a suggestion of short cycles of 130 days.

THE CEPHEID VARIABLES

Fifteen classical Cepheids have been successfully studied in Field 49; they are part of the concentration of Cepheids so conspicuous in the neighboring Field 50. No cluster type stars within our range are present.

CEPHEID VARIABLES IN FIELD 49

Star	Des.	Period	Phase of			Magnitude		Range	Spectrum
			Min.	Med.	Max.	Max.	Min.		
V Car	082659	6.696734	.600	.760	.950	8.18	8.86	0.68	G2-K0
Y Car	102957	3.6397603	.690	.835	.980	8.23	8.69	0.46	F5
UW Car	102359	5.34576	.640	.860	.945	10.14	10.85	0.71	G
UX Car	102557	3.6823	.335	.525	.645	8.32	9.40	1.08	F4.2-G4.8
UY Car	102861	5.543698	.470	.620	.740	9.43	10.42	0.99	G
YZ Car	102458	18.159*	.820	.115	.230	9.10	10.37	1.27	G5
AQ Car	101860	9.7701362	.590	.850	.130	9.88	10.39	0.51	G0
I Car	094262	35.5323	.970	.295	.400	4.97	5.99	1.02	G0-K0
T Vel	083447	4.639769	.550	.710	.875	8.75	9.23	0.48	G0-G5
V Vel	091955	4.3710408	.290	.475	.620	8.17	8.76	0.59	F8-G5
RY Vel	101654	28.1311†	.550	.680	.770	9.35	10.56	1.21	G2-K2
ST Vel	084150	5.8584249	.600	.790	.930	10.48	11.43	0.95	K
SW Vel	084047	23.51284*	(.410)	(.550)	(.630)	8.49	10.17	1.68	K2
SX Vel	084145	9.54993	.110	see text		8.79	9.69	0.90	G5
AH Vel	080846	4.227172	.680	.960	.200	6.44	6.74	0.30	F8p

* Variable period.

† Possibly variable period.

V Carinae. — This star was discovered visually by Roberts (JBAA 3, 372, 1892). The period given by Robinson (HA 90, 47, 1933) was used in reducing the 525 estimates. The star is difficult; the comparison stars are not close to it, and it is near the edge of many of the plates. The spectrum is taken from Shapley and Walton (HC 313, 1927).

MEAN LIGHT CURVE OF V CARINAE

Phase	IPg	No.	Phase	IPg	No.	Phase	IPg	No.
.040	8.25	50	.419	8.76	50	.807	8.30	50
.133	8.39	50	.516	8.80	50	.900	8.19	50
.244	8.54	50	.617	8.86	50	.971	8.18	25
.342	8.66	50	.711	8.66	50			
								525

Y Carinae. — Discovered visually by Roberts (AJ 21, 84, 1901), *Y Carinae* has been studied by Plaut (BAN 7, 296, 1935), who derived the period $3^d639061$ and gave a mean light curve with range 0.70. The star is in a crowded region and is difficult to estimate. The observations show considerable scatter. The period has been slightly corrected to $3^d6397603$. Our mean light curve, derived from 1233 estimates, has a smaller range than Plaut's, and is not the same shape.

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MEAN LIGHT CURVE OF Y CARINAE

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.026	8.30	50	.377	8.60	50	.729	8.67	50
.068	8.39	50	.415	8.65	50	.777	8.56	50
.104	8.45	50	.455	8.65	50	.814	8.51	50
.146	8.46	50	.495	8.64	50	.851	8.41	50
.184	8.47	50	.524	8.66	50	.894	8.33	50
.217	8.50	50	.556	8.67	50	.939	8.30	50
.257	8.52	50	.598	8.67	50	.981	8.23	33
.305	8.56	50	.642	8.68	50			
.342	8.59	50	.688	8.69	50			1233

UW Carinae. — Twice discovered at Harvard, by Miss Leavitt (E. C. Pickering, HC 122, 1906) and by Miss Cannon (E. C. Pickering, HC 151, 1909), *UW Carinae* is here studied from 1154 estimates. It is in a crowded region and was difficult to estimate. The period 5^d34576 proved to be satisfactory.

MEAN LIGHT CURVE OF UW CARINAE

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.018	10.15	50	.359	10.72	50	.710	10.84	50
.061	10.25	50	.396	10.71	50	.752	10.82	50
.103	10.31	50	.448	10.74	50	.790	10.75	50
.137	10.44	50	.490	10.78	50	.837	10.59	50
.176	10.48	50	.536	10.82	50	.885	10.32	50
.226	10.57	50	.577	10.85	50	.934	10.14	50
.280	10.65	50	.612	10.81	50	.978	10.16	53
.320	10.70	50	.661	10.83	50			1154

UX Carinae. — This star was discovered, and its period first determined, by Miss Leavitt (E. C. Pickering, HC 122, 1906; HC 170, 1912). The period 3^d6823, used here, was first determined by Kruytbosch (BAN 6, 17, 1930) together with a light curve ranging from 7^m93 to 9^m27. Spectra have been given by Miss Cannon, F2-G5 (AAS 3, 196, 1916); Shapley and Walton, F2-Ko (HC 313, 1927); and Mayall and Baker, F4.2-G4.8 (HC 436, 1940).

The last determination is given in the tabulation.

The mean light curve is formed from 1224 estimates. It resembles the one published by Kruytbosch, but our range is smaller.

MEAN LIGHT CURVE OF UX CARINAE

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.017	9.14	50	.398	9.34	50	.781	8.55	50
.052	9.16	50	.434	9.28	50	.813	8.62	50
.093	9.22	50	.476	9.19	50	.852	8.76	50
.140	9.28	50	.195	8.91	50	.887	8.84	50
.181	9.30	50	.560	8.63	50	.927	8.83	50
.225	9.35	50	.596	8.42	50	.966	9.00	50
.281	9.38	50	.644	8.32	50	.992	9.11	24
.337	9.40	50	.687	8.37	50			
.371	9.38	50	.739	8.46	50			1224

UY Carinae. — The Cepheid variable UY Carinae was discovered by Miss Leavitt (E. C. Pickering, HC 122, 1906). It has been discussed by Kruytbosch (BAN 8, 7, 1936) and by Plaut (BAN 7, 296, 1935), who gave the period $5^d543698$ and a range 1^m13 . Plaut's period has been successfully used in the discussion of our 1150 observations.

MEAN LIGHT CURVE OF UY CARINAE

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.021	10.01	50	.398	10.41	50	.740	9.43	50
.065	10.08	50	.450	10.42	50	.774	9.49	50
.111	10.13	50	.498	10.42	50	.816	9.62	50
.156	10.19	50	.544	10.29	50	.860	9.64	50
.199	10.23	50	.592	10.06	50	.898	9.72	50
.247	10.35	50	.638	9.82	50	.942	9.86	50
.298	10.36	50	.674	9.59	50	.981	9.92	50
.340	10.37	50	.708	9.46	50			
								1150

YZ Carinae. — Discovered at Harvard by Miss Leavitt (HC 115, 1906) and rediscovered by Miss Cannon (HC 151, 1909), YZ Carinae was shown to be a Cepheid when Miss Leavitt determined its period (HC 170, 1912). The present study is based on 1178 estimates. The period 18^d159 is satisfactory from JD. 15000 to 23000; but the well-determined individual light curves for JD 28000–28999 and 29000–29999 show a small phase shift: on the system used in the tabulation of phases, the phase of rising median magnitude is 0^p140 , rather than 0^p115 as derived for the whole material. There is thus a small but appreciable change of period between JD 23000 and 28000. The light curves tabulated are for the whole material, and for the interval 28000–29999 respectively; they do not differ appreciably in shape, but do not resemble the curve given by Sohön (BAN 3, 204, 1926).

MEAN LIGHT CURVE OF YZ CARINAE
(all observations)

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.024	10.16	50	.352	9.51	50	.704	10.29	50
.075	9.98	50	.392	9.59	50	.747	10.36	50
.119	9.66	50	.451	9.71	50	.786	10.35	50
.163	9.28	50	.499	9.92	50	.820	10.37	50
.196	9.14	50	.547	9.95	50	.860	10.33	50
.229	9.10	50	.588	10.08	50	.891	10.29	50
.274	9.22	50	.630	10.18	50	.939	10.26	50
.314	9.30	50	.664	10.25	50	.983	10.25	28
								1178

MEAN LIGHT CURVE OF YZ CARINAE (JD 28000–29999)

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.041	10.05	20	.346	9.31	20	.788	10.19	20
.118	9.92	20	.443	9.60	20	.826	10.30	20
.159	9.51	20	.568	9.81	20	.864	10.31	20
.197	9.24	20	.623	10.04	20	.871	10.35	20
.226	9.15	20	.688	10.20	20	.942	10.20	29
.286	9.16	20	.750	10.31	20			
								349

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AQ Carinae.— This variable was discovered by Miss Cannon (E. C. Pickering, HC 151, 1909); the period 9^d7709 was given by Hertzsprung (BAN 3, 111, 1926). From the 1183 observations obtained from Harvard plates, the period 9.7701362 has been derived, and is used in the present discussion.

MEAN LIGHT CURVE OF AQ CARINAE

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.046	9.90	100	.370	10.14	100	.718	10.30	100
.133	9.88	100	.453	10.30	100	.799	10.18	100
.202	9.92	100	.547	10.39	100	.884	10.06	100
.286	10.04	100	.634	10.39	100	.967	9.93	83
								1183

l Carinae.— This well-known bright Cepheid was measured on 848 plates. The principal use to which these observations can be put is a test of the period, which appears to be constant at 35^d5323 . A mean light curve, formed from the 848 photographic estimates is tabulated. For so bright a star photographic magnitudes are only approximate.

MEAN LIGHT CURVE OF l CARINAE

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.027	5.98	50	.398	4.97	50	.713	5.57	50
.090	5.94	50	.442	5.04	50	.759	5.77	50
.151	5.80	50	.506	5.09	50	.810	5.80	50
.217	5.76	50	.556	5.09	40	.882	5.91	50
.270	5.58	50	.592	5.29	50	.959	5.99	58
.335	5.14	50	.645	5.41	50			848

T Velorum.— This star was discovered visually by Roberts (JBAA 3, 372, 1892). Robinson derived the period $4^d639777$ from Harvard plates (HA 90, 47, 1933). In the present study we have used Hertzsprung's period, $4^d639769$ (BAN 8, 158, 1937), which represents all our material. The spectrum was given by Shapley and Walton (HC 313, 1927).

MEAN LIGHT CURVE OF T VELORUM

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.065	8.91	50	.457	9.22	50	.898	8.71	40
.166	9.01	50	.587	9.23	60	.975	8.87	25
.263	9.11	50	.704	8.99	50			475
.358	9.19	50	.814	8.75	50			

V Velorum. This well known Cepheid, discovered visually by Roberts (JBAA 3, 373, 1892) was estimated on 781 plates. This period $4^d371050$ derived by Robinson (HA 90, 47, 1933) was slightly corrected to $4^d3710408$. The difference in range between our light curve and Robinson's results from differences in the comparison stars. The spectrum was given by Shapley and Walton (HC 313, 1927).

MEAN LIGHT CURVE OF V VELORUM

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.032	8.55	50	.423	8.63	50	.828	8.36	50
.097	8.63	50	.480	8.43	50	.879	8.36	50
.150	8.62	50	.543	8.18	50	.934	8.43	50
.223	8.74	50	.615	8.17	50	.981	8.53	31
.286	8.76	50	.681	8.17	50			781
.343	8.72	50	.760	8.27	50			

RY Velorum. — Discovered to be variable by Miss Cannon (E. C. Pickering, HC 151, 1909), *RY Velorum* was first thought to be an irregular variable (HB 831, 1926). The period was determined by Hertzsprung to be 28^d136 (BAN 2, 158, 1924); Robinson used a period $28^d124755$ (HA 90, 47, 1933); and Plaut derived a value of 28^d1311 (BAN 7, 296, 1935). Plaut's period has been used in the present discussion of 709 observations. The possibility of a small variation of period must be admitted. The spectrum is taken from Shapley and Walton (HC 313, 1927). The range derived here, 1^m21 , agrees with the 1^m29 derived by Robinson; Plaut's range is 0^m77 . Our light curve is similar in form to that given by Plaut.

MEAN LIGHT CURVE OF RY VELORUM

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.034	9.95	50	.503	10.56	50	.798	9.35	20
.119	10.13	50	.572	10.56	50	.836	9.43	20
.182	10.32	50	.627	10.30	20	.864	9.47	20
.245	10.40	50	.669	10.10	20	.893	9.57	20
.318	10.50	50	.698	9.78	20	.936	9.66	50
.379	10.54	50	.731	9.35	20	.984	9.82	29
.441	10.55	50	.767	9.39	20			
								709

ST Velorum. — Although discovered many years ago at Harvard by Miss Cannon (E. C. Pickering, HC 151, 1909), *ST Velorum* has only recently been shown to be a Cepheid. The present observations clearly indicated a period about six days. At the time they were under discussion appeared the determination of a period 5^d85906 by Hoffmeister (MVS 13, 1942), which has been slightly corrected to $5^d8584249$. The mean light curve given in the table is obtained from 402 observations. The spectrum is an unpublished determination by Miss Cannon.

MEAN LIGHT CURVE OF ST VELORUM

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.064	10.55	50	.471	11.18	50	.830	10.69	50
.193	10.75	50	.609	11.43	50	.926	10.46	52
.329	10.93	50	.723	11.15	50			
								402

SW Velorum. — Discovered by Miss Cannon (E. C. Pickering, HC 151, 1909), this star is remarkable for its changing period (P. T. Oosterhoff, BAN 8, 80, 1936). Although only 476 estimates were made, the change is large enough to be studied in detail. Observations were plotted separately for 1000-day intervals, and times of rising median magnitude read from the plots. Phases were calculated with the period 23^d51284 , with JD 2400000 as zero point. The results are given in the next tabulation.

PHASE OF MEDIAN RISING MAGNITUDE

Average				Average				Average			
JD	Observed	Phase Adopted	Obs.	JD	Observed	Phase Adopted	Obs.	JD	Observed	Phase Adopted	Obs.
15500	.350	.350	12	21500	.525	.537	38	27500	.460	.463	35
16500	.440	.401	43	22500	.560	.540	8	28500	.420	.429	63
17500	.405	.444	12	23500	.510	.538	25	29500	.395	.396	67
18500	.480	.478	28	24500	.530	.529	17	30200	.375	.371	15
19500	.520	.505	24	25500	.505	.515	21				
20500	.530	.526	32	26500	.500	.492	35				475

A mean light curve was obtained by correcting the phases according to the "adopted" phases of the table. The curves were all arbitrarily referred to JD 22500 as zero point. The resulting mean light curve is similar to that published by Hertzsprung (BAN 8, 30, 1936). One observation, which fell between JD 14000 and 15000, is included in the mean light curve with an extrapolated phase correction.

MEAN LIGHT CURVE OF SW VELORUM

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.057	9.79	50	.462	10.12	10	.588	8.55	10
.155	9.95	50	.489	10.08	10	.609	8.49	10
.253	10.06	50	.509	9.96	10	.671	8.62	50
.350	10.08	50	.525	9.76	10	.775	9.12	50
.403	10.12	10	.544	9.17	10	.889	9.36	50
.425	10.17	10	.569	8.77	10	.964	9.58	16

476

SX Velorum.— Discovered by Miss Cannon at Harvard (E. C. Pickering, HC 151, 1909), *SX Velorum* falls in the interesting 9–10 day interval, and has an unusual light curve, as shown by the studies of Hertzsprung (BAN 8, 28, 1936) and Oosterhoff (BAN 8, 31, 1936). Our light curve, from 480 observations, is similar to theirs in form and range.

MEAN LIGHT CURVE OF SX VELORUM

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.051	9.68	50	.457	8.81	20	.683	8.89	20
.161	9.69	50	.502	8.90	20	.766	9.13	50
.271	9.37	50	.548	8.84	20	.882	9.34	50
.334	9.13	20	.582	8.85	20	.959	9.47	30
.377	8.92	20	.612	8.79	20			
.425	8.84	20	.657	8.83	20			480

Phase and magnitude at primary and secondary maximum, and at secondary minimum, are .455 (8^m81); .620 (8^m79); and .520 (8^m90). Phase half-way up the curve from primary minimum to primary (fainter) maximum is .305.

AH Velorum.— The discoverer of *AH Velorum*, van Gent, derived a period of 4^d2281 (BAN 6, 148, 1931). A later discussion, by Hertzsprung, of 260 Harvard plates, corrected the period to $4^d227172$ and confirmed the atypical light curve (BAN 9, 80, 1940). The mean error of one estimate was found to be almost half the range.

The present discussion, which uses 626 estimates, confirms the period and the light curve given by Hertzsprung, and corroborates the large dispersion in the estimates.

MEAN LIGHT CURVE OF AH VELORUM

Phase	IPg	Obs.	Phase	IPg	Obs.	Phase	IPg	Obs.
.049	6.57	50	.450	6.68	50	.842	6.70	50
.127	6.52	50	.537	6.68	50	.905	6.67	50
.198	6.44	50	.615	6.73	50	.970	6.57	26
.283	6.55	50	.692	6.74	50			
.353	6.66	50	.772	6.67	50			626

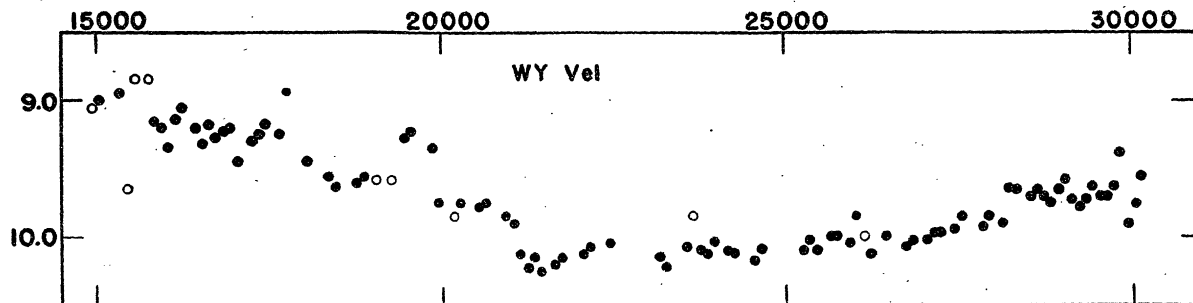


FIGURE 4. Observations of WY Velorum, assembled in 100-day means.

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THE ECLIPSING STARS

Twelve eclipsing stars are listed in the field, but YY and EX Carinae proved to be unmeasurable. The well known variable V Puppis is too bright to be studied successfully. Periods, spectra and magnitudes are tabulated; the light curves will be discussed and published later.

ECLIPSING STARS IN FIELD 49

Star	Des.	Period	Spectrum	M_1	M_2	m_1	m_2	Obs.
X Car	082958	1.0826310	A0	8.04	8.06	8.60	8.57	507
ST Car	101259	0.9016495	A0	9.08	9.08	10.40	9.33	1199
SW Car	102357	8.165878	..	10.81	10.81	12.33	10.83	1040
YY Car	101660	(2.64264)	..	(10.0)	(10.0)	(10.8)	....	....
DO Car	100958	3.85194	B8	9.31	9.31	9.49	....	483
EX Car	102163	(1.396366)	..	(10.0)	(10.0)	(11.5)	....	....
V Pup	075548	1.4544867	B1	4.76	4.76	5.13	4.89	534
RV Vel	091550	4.82109852	G0	11.42	11.42	11.88	....	571
RX Vel	092450	3.11182966	A2	10.99	10.99	11.84	11.09	735
TT Vel	101645	2.1083907	..	10.85	10.85	12.26	....	526
AL Vel	082847	96.106	A3p	9.77	9.77	10.17	....	470
AO Vel	080848	1.5845853*	B9	9.57	9.57	9.95	9.83	609

* Variable period.

MISCELLANEOUS VARIABLES

Eleven additional stars remain to be discussed. The last eight are not known variables.

ADDITIONAL STARS

Star	Des.	Remarks	Obs.
YY Car	101660	too faint for successful study	...
AI Car	074552	too faint for successful study	...
EX Car	102163	too close to another star	...
TY Vel	091554	Variable? 9.5±0.08	434
N Vel	092856	Variable? 5.0±0.12	613
γ Vel	080647	-46°3847 2.2±0.06	55
HD 88500	100760	-60°1719 9 ^m .4±0.08	390
HD 89358	101357	-57°2913 10.5±0.06	112
HD 90657	102258	-58°2205 9.8±0.06	193
HD 92740	103759	-59°2450 6.3±0.08	212
HD 92809	103758	-58°2546 9.1±0.06	212
HD 93131	104059	-59°2548 6.8±0.09	211
HD 93162	104059	-59°2561 8.8±0.11	210

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YY Carinae.— This star, discovered by Miss Leavitt (HC 79, 1904) and discussed by Hertzsprung (BAN 2, 213, 1925) proved to be in a difficult and crowded region, and was not studied.

AI Carinae.— Probably AI Carinae, announced to be variable by Wood (UOC 48, p. 51, 1920) is below our limit, the tenth photographic magnitude. It was not measured.

EX Carinae.— Announced as an eclipsing star by Hertzsprung (BAN 3, 110, 1926), EX Carinae is too near to another star to be successfully studied with our material.

TY Velorum.— Wood announced the variability of TY Velorum (AN 211, 445, 1920). Our estimates show that its range is very small; the probable error from a discussion of the frequency of 434 step estimates is 8^m.08. Hoffmeister (MVS, 14, 1942) questions the variability of the star.

N Velorum.— Like many other bright K stars, N Velorum is difficult to study from our material. The 613 estimates, made only on plates of the smallest scale, furnish no definite evidence concerning the variability, the probable error of one estimate deduced from the frequency of the step estimates being only 0^m.12. Variation with a small range is thus possible, but cannot be studied with our material.

The Wolf-Rayet Stars.— Eight Wolf-Rayet and bright-line O stars were examined for variability. The ranges, if any, are all small. A slight excess of "faint" estimates is found for HD 88500 and HD 90657; the largest dispersion is found for HD 93162.