

## No. 112 UBVRJLK LIGHT CURVES OF CLASSICAL CEPHEIDS

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### ABSTRACT

Observations of classical Cepheids are presented. Analyses will be published separately.

We have made multicolor photoelectric observations on the UBVRJLK system (Johnson, Mitchell, Iriarte and Wisniewski 1966) for 20 classical Cepheid variable stars. For 18 of these stars, the observations extend from the ultraviolet to  $2.2\mu$  or  $3.4\mu$  in the infrared; for two, the data are limited to the UBVR filters.

The individual observations are listed in Table 1. This table is divided into two parts; the first, contains the UBVR data and the second, the JKL data. Since the photometric apparatus was the same as that used on the bright star program, the probable errors listed by Johnson, et al., (1966) also apply to the data of Table 1.

The data of Table 1 are sufficient to define light curves for these stars as wavelengths ranging from the ultraviolet to the infrared. Figures 1–20 show the observed light curves. The UBVR data listed by Mitchell, Iriarte, Steinmetz and Johnson (1964) were also plotted, thereby increasing the weights of the UBVR curves.

The light curves shown in Figures 1–20 exhibit the well-known shift of phase with wavelength. For example, the times of maximum and minimum light for T Mon shift to later and later phases as one progresses from U to L (from  $0.36\mu$  to  $3.4\mu$ ). On the other hand several stars (SU Cas, DT Cyg and SZ Tau) seem not to show much phase shift. These same three stars are also almost constant in light output at  $2.2\mu$  and  $3.4\mu$  (K and L magnitudes).

Another group of stars ( $\eta$  Aql, U Aql, W Gem, S Sge and U Sge) exhibit another effect. These stars have secondary “bumps” on the visual light curves; as we proceed to the longer wavelengths these secondary “bumps” become the primary maxima. We suggest that this effect may be related to the phase shifts exhibited by stars with asymmetrical light curves; for example, T Mon and X Cyg.

We are preparing, for separate publication, analyses of the data given here in terms of the bolometric light curves and effective temperature curves. The combination of our data with the known radial velocity curves enables us to compute the absolute magnitude for each of these Cepheid variable stars. Our absolute magnitude determinations are entirely empirical and do not depend upon stellar model computations. The results of these analyses will be published in the near future.

This research was supported by the Office of Naval Research.

### REFERENCES

- Johnson, H. L., Mitchell, R. I., Iriarte, B. and Wisniewski, W. Z. 1966, *Comm. Lunar and Planet. Lab.*, 4, 99.
- Mitchell, R. I., Iriarte, B., Steinmetz, D. and Johnson, H. L. 1964, *Bol. Obs. Tonantzintla y Tacubaya*, 3, 153.

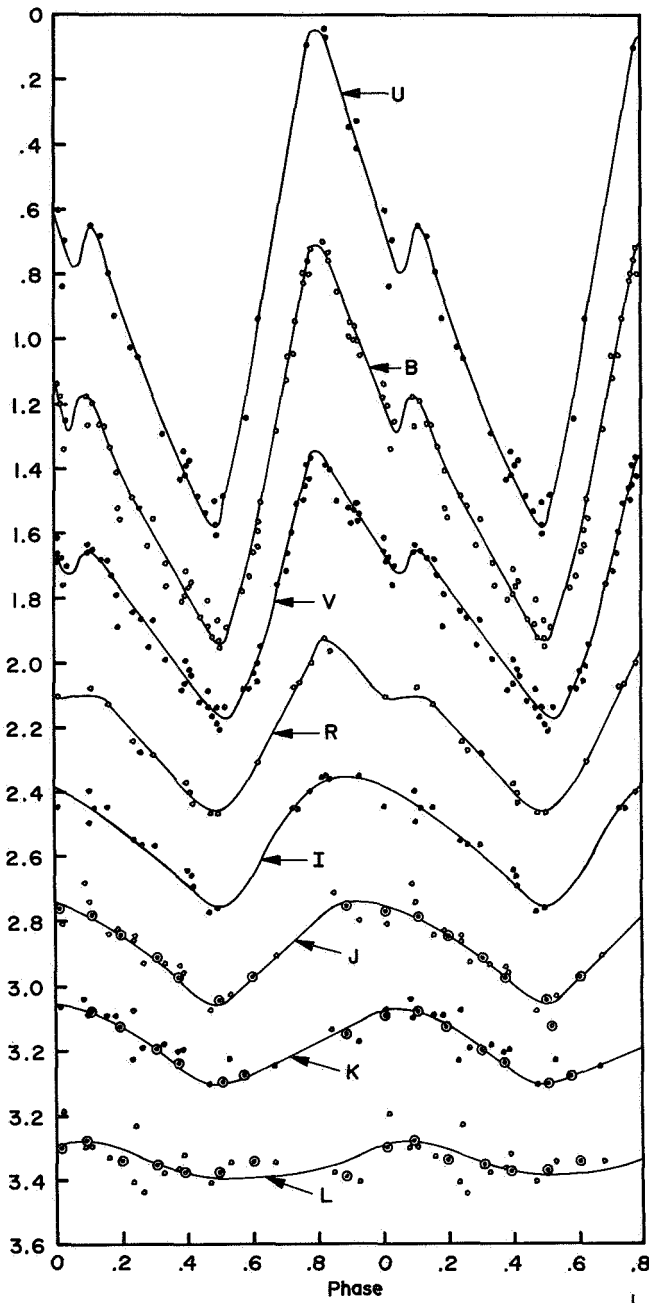


Fig. 1 The light curves for U Aql. Vertical scale gives magnitude differences with arbitrary zero point.

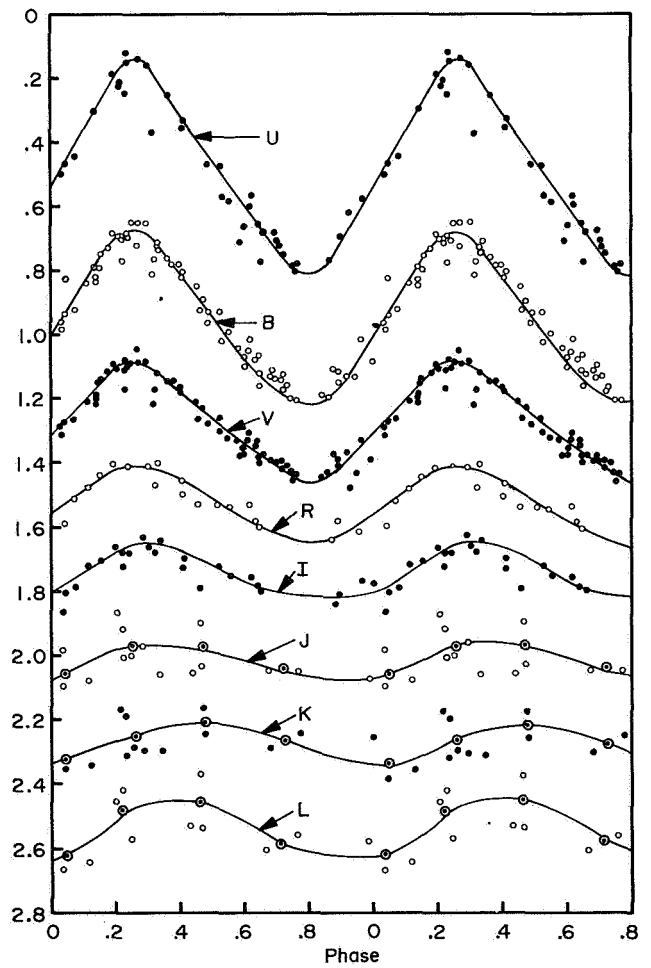


Fig. 2 The light curves for FF Aql.

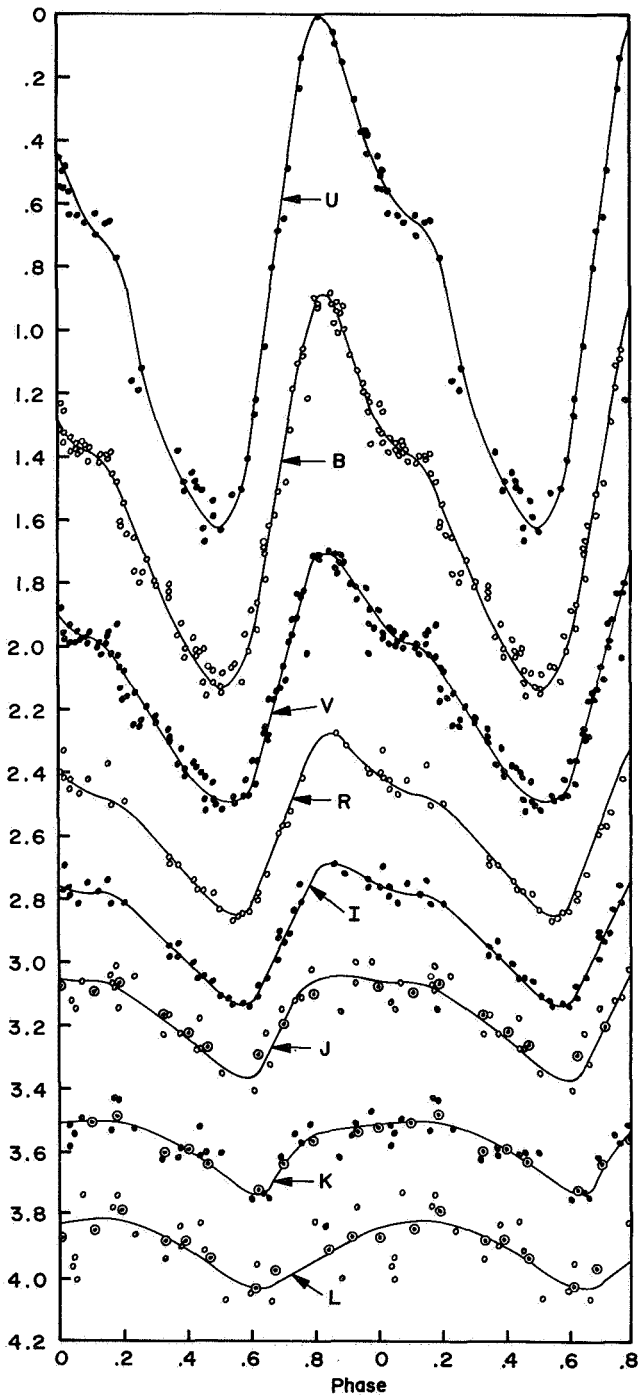


Fig. 3 The light curves for  $\eta$  Aql.

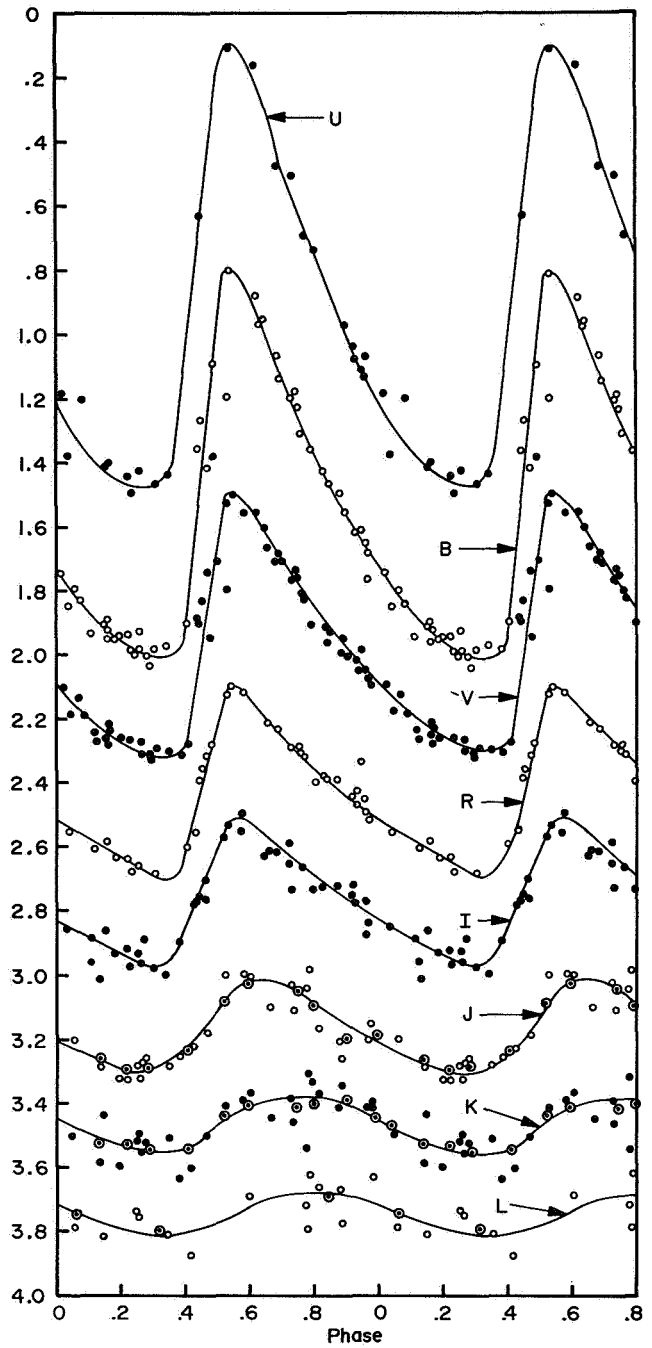


Fig. 4 The light curves for RT Aur.

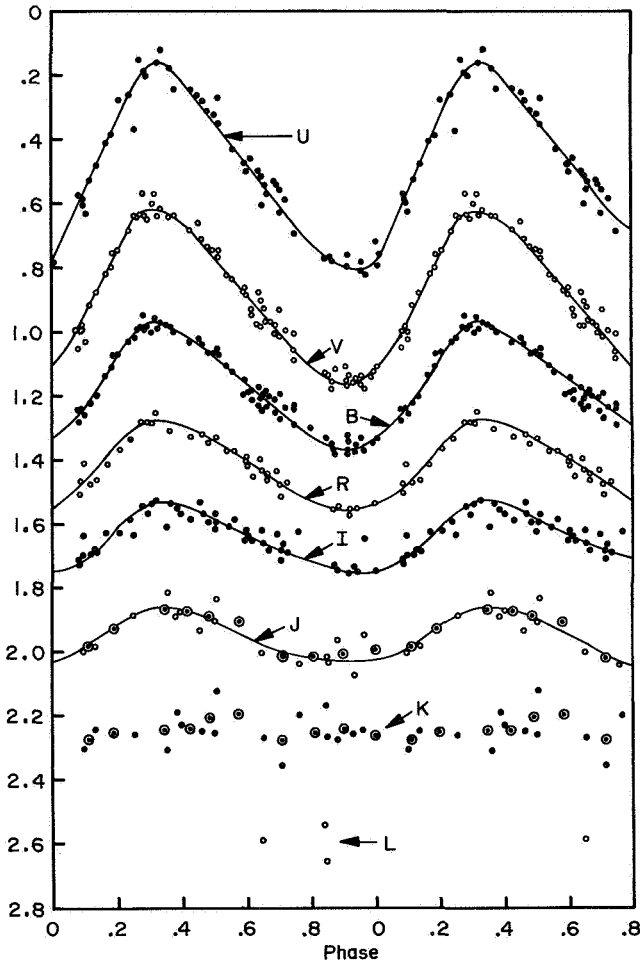


Fig. 5 The light curves for SU Cas.

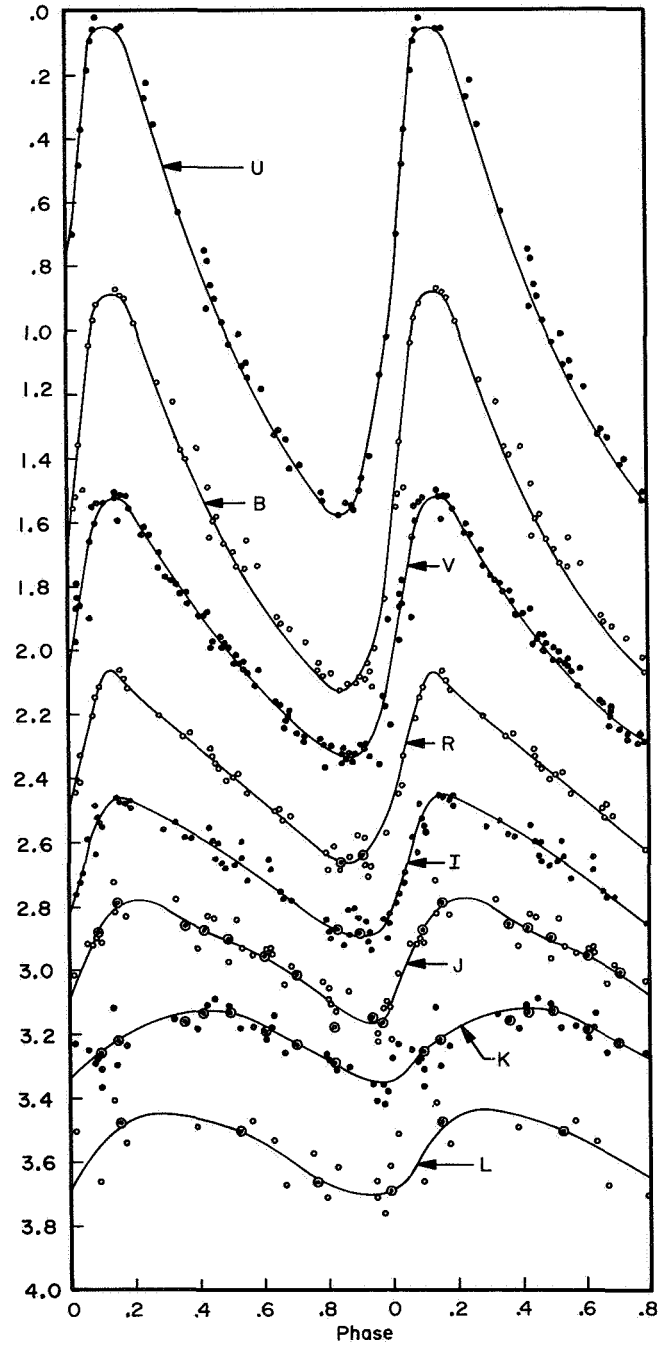


Fig. 6 The light curves for  $\delta$  Cep.

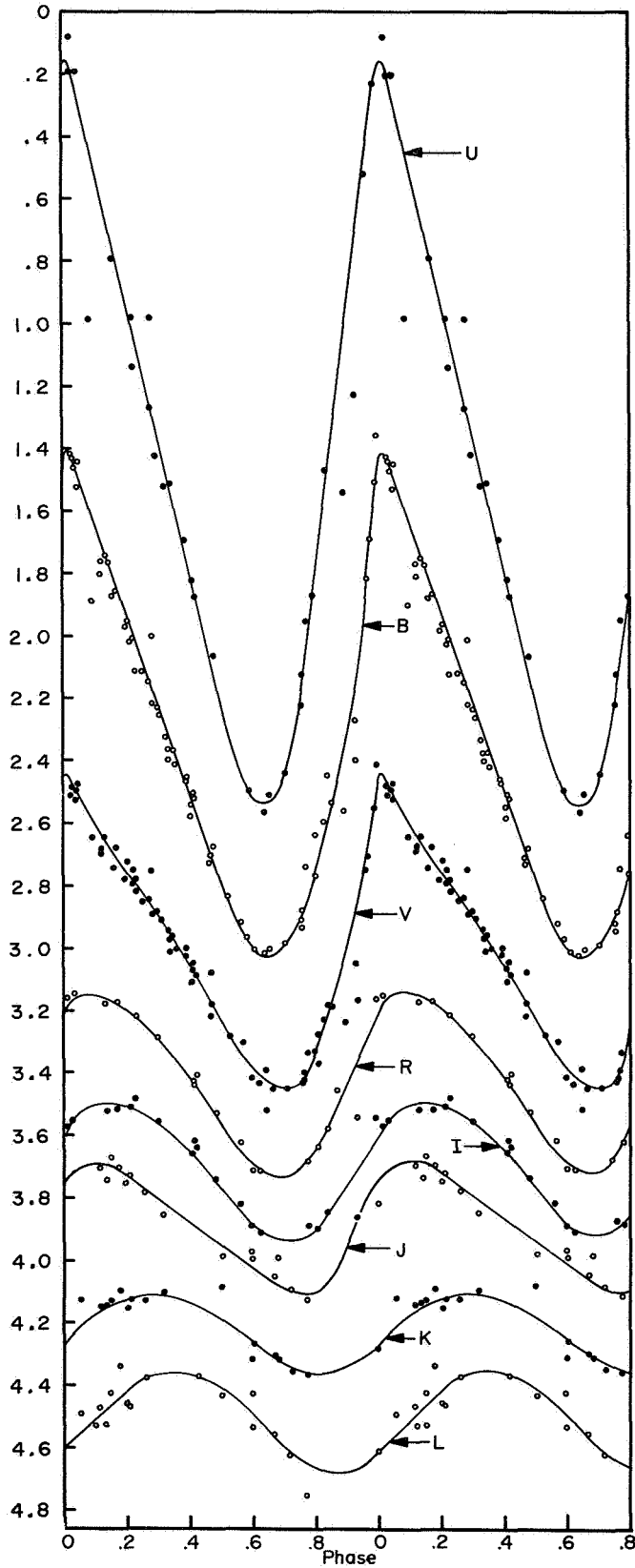


Fig. 7 The light curves for X Cyg.

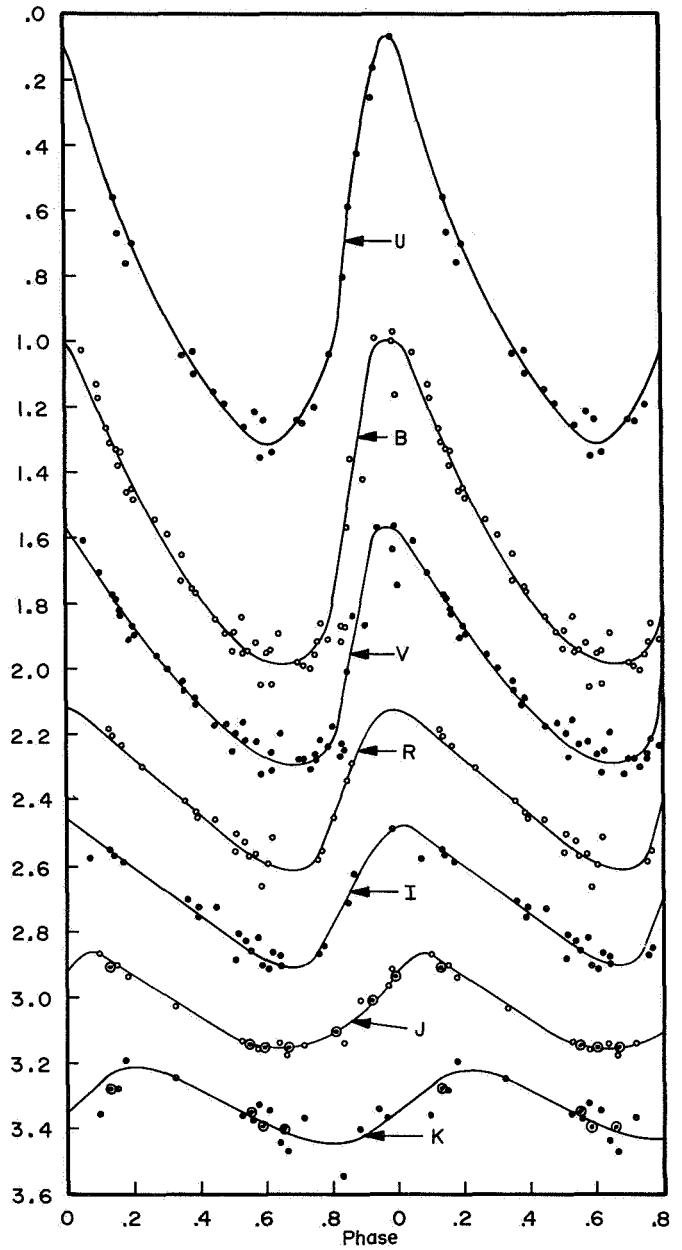


Fig. 8 The light curves for SU Cyg.

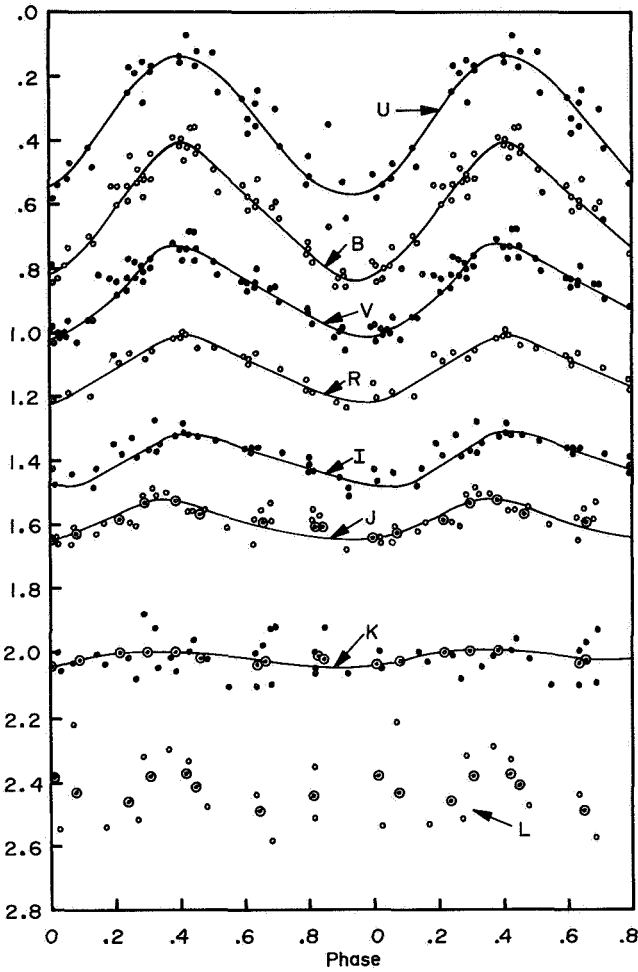


Fig. 9 The light curves for DT Cyg.

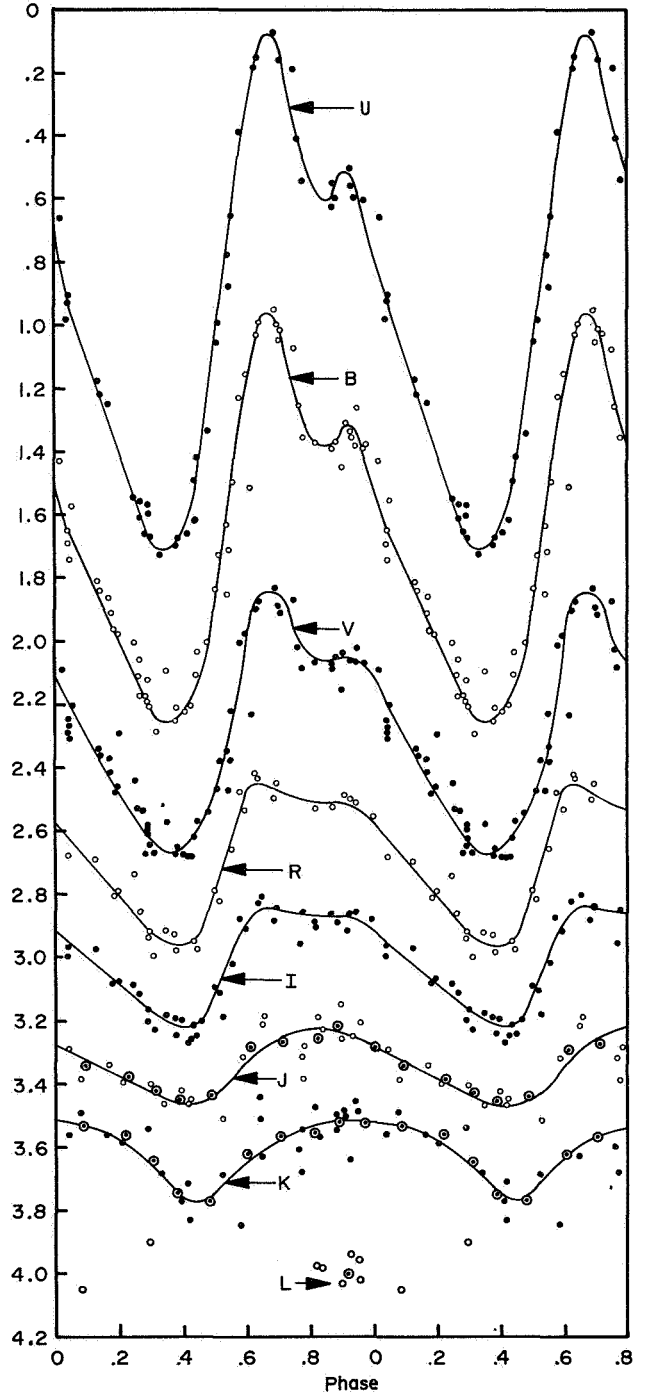


Fig. 10 The light curves for W Gem.

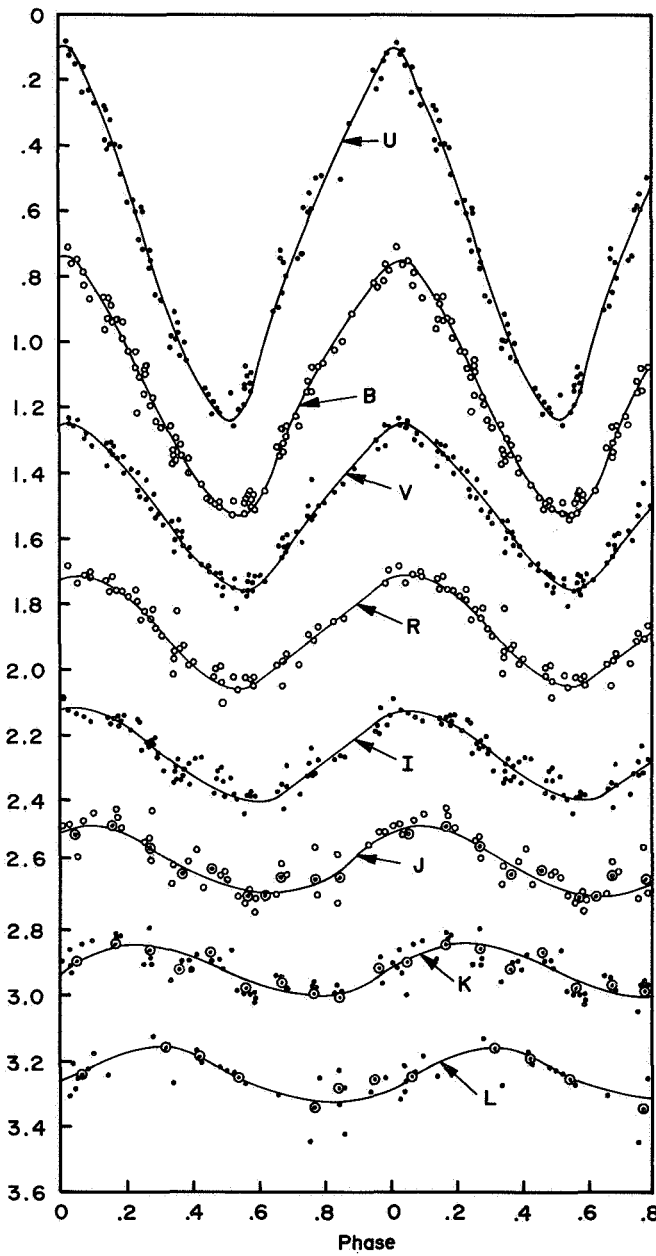


Fig. 11 The light curves for  $\zeta$  Gem.

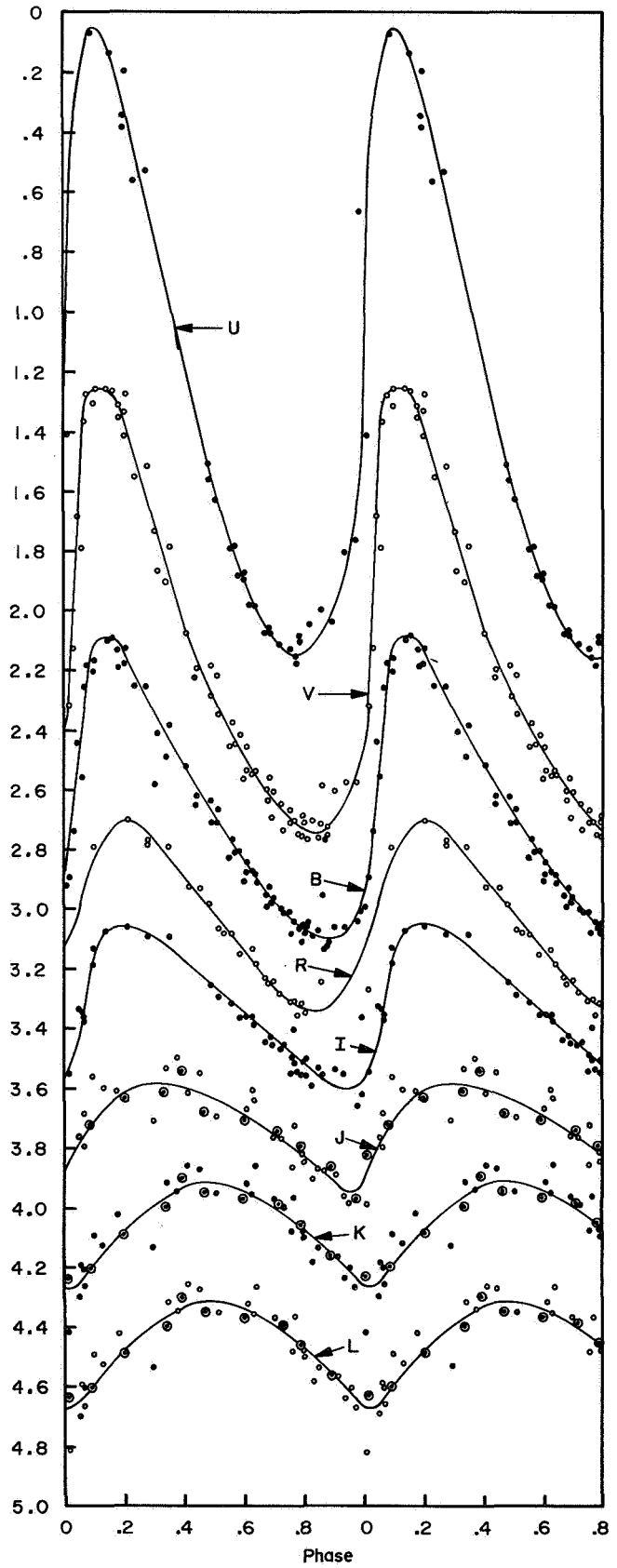


Fig. 12 The light curves for T Mon.

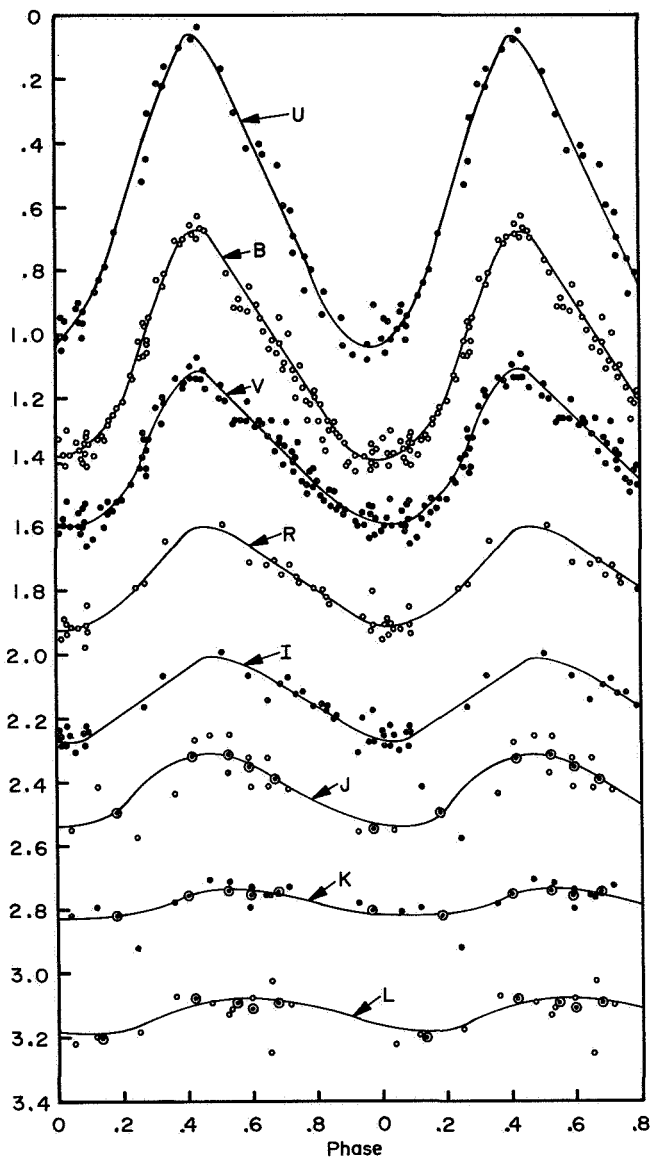


Fig. 13 The light curves for Y Oph.

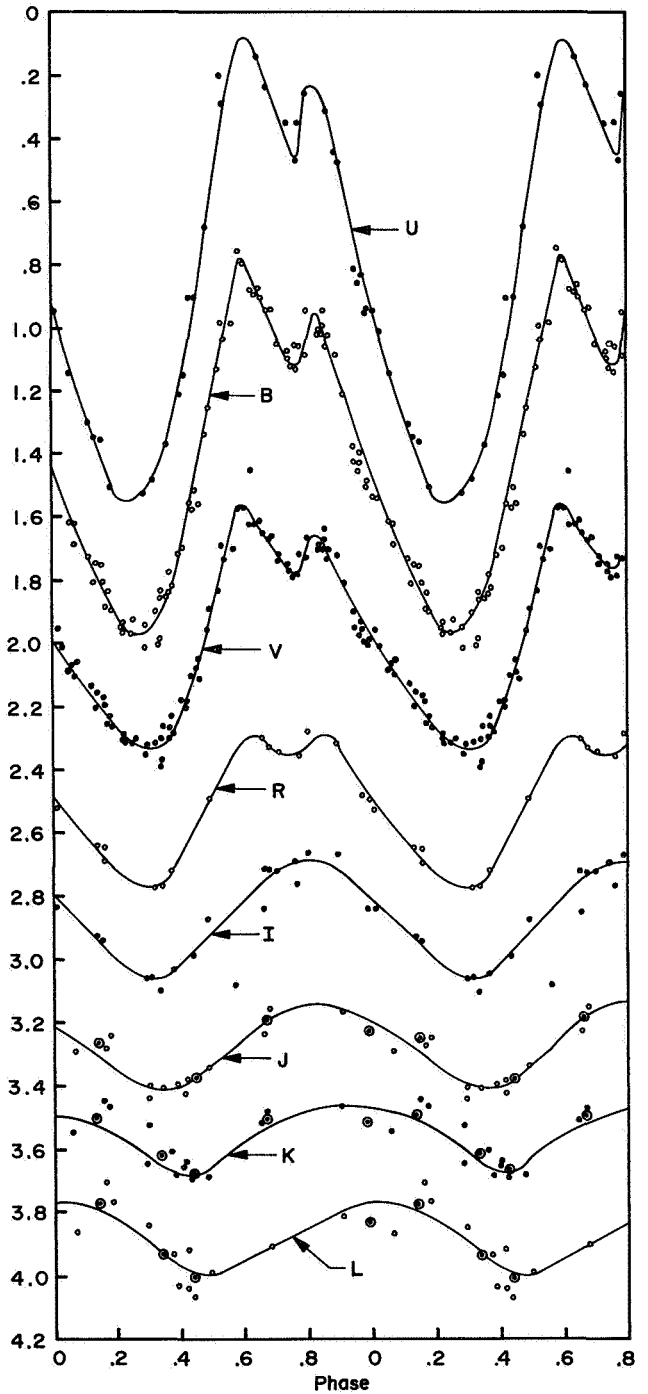


Fig. 14 The light curves for S Sge.



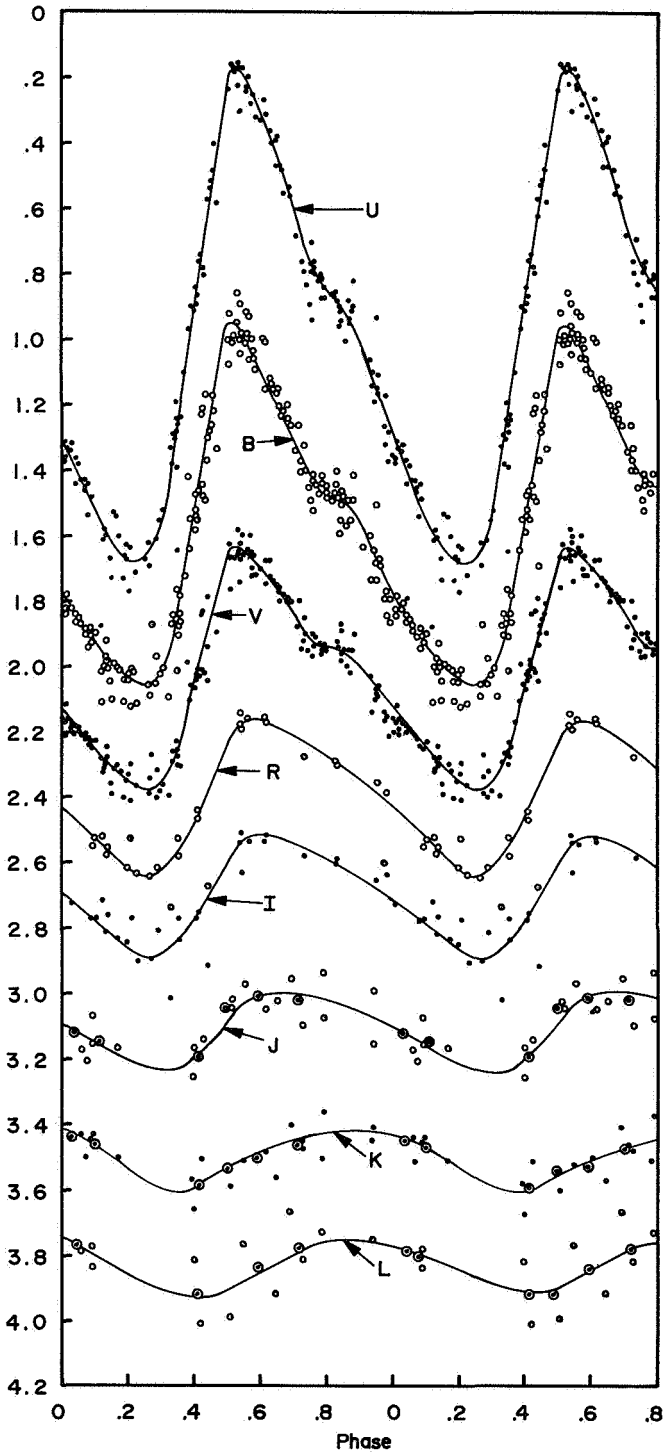


Fig. 15 The light curves for U Sgr.

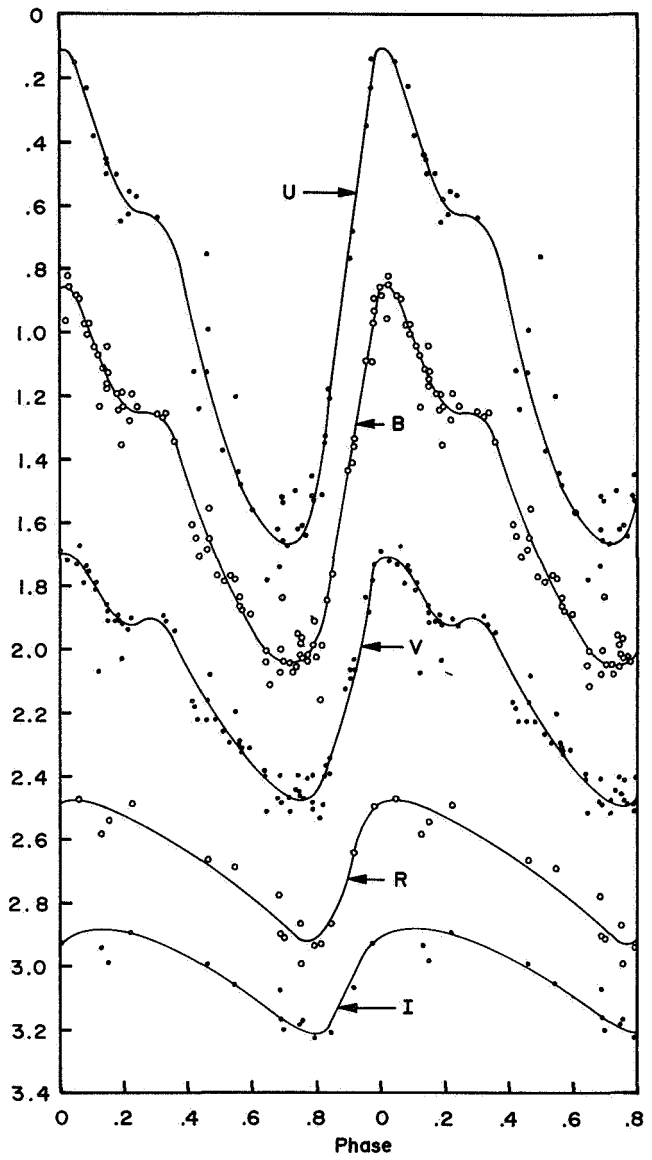


Fig. 16 The light curves for W Sgr.

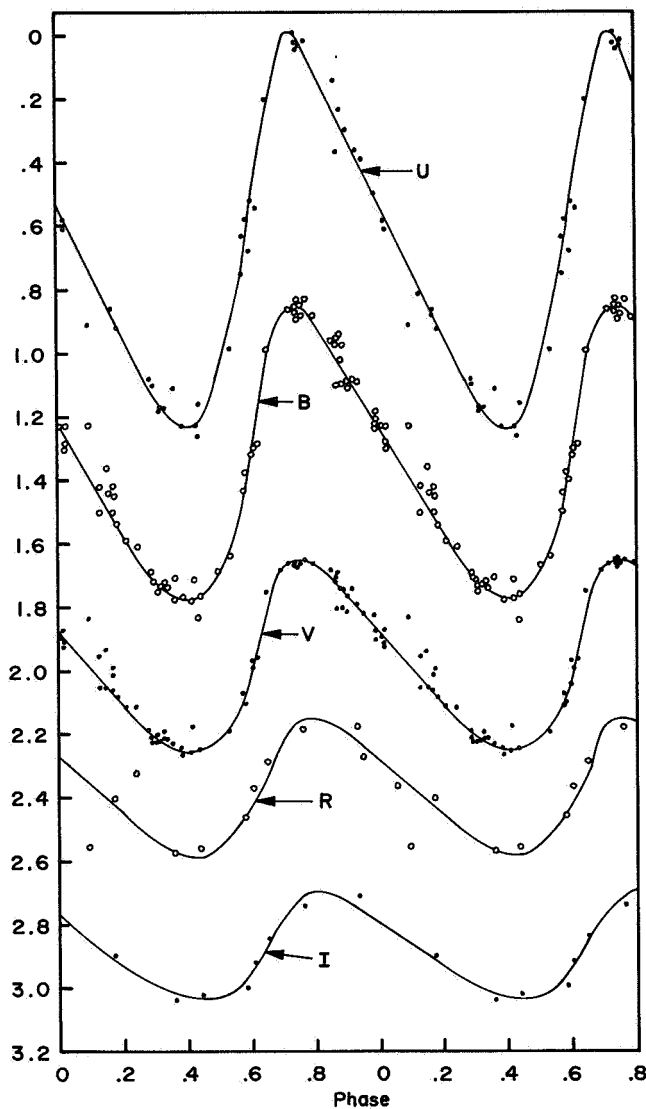


Fig. 17 The light curves for X Sgr.

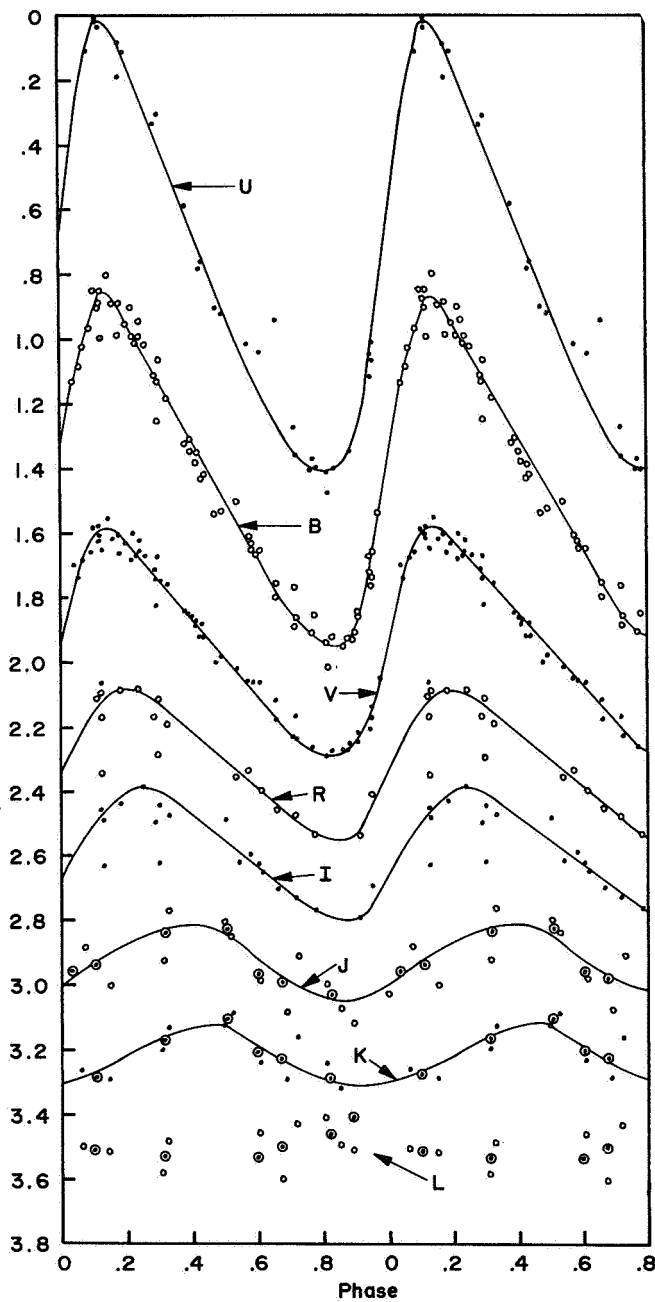


Fig. 18 The light curves for Y Sgr.

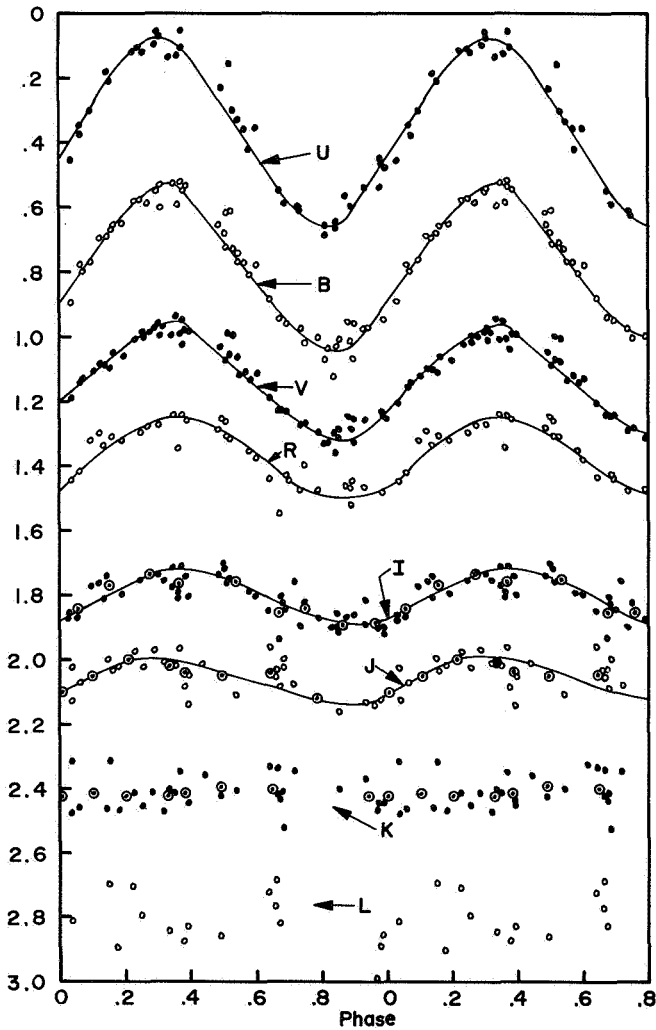


Fig. 19 The light curves for SZ Tau.

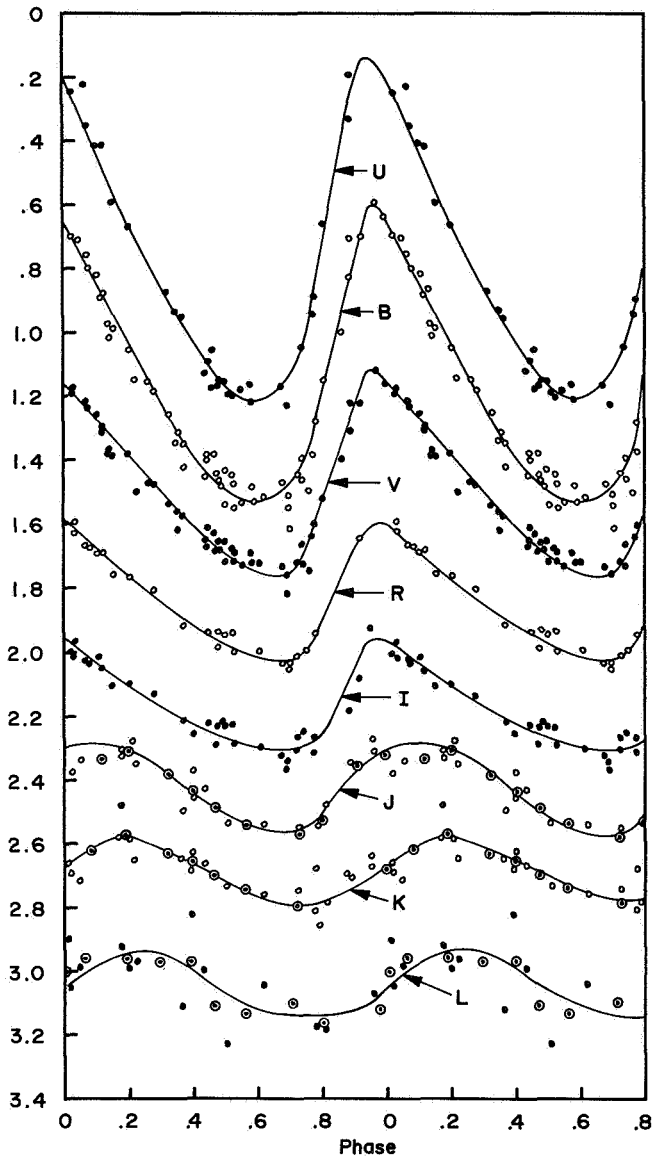


Fig. 20 The light curves for T Vul.

TABLE IA  
UBVRI CEPHEID MAGNITUDES

JD2430000+	V	B	U	R	JD2430000+	V	B	U	R	I
8658.6819	6.209	7.140		5.462	9028.6638	5.284	6.017	6.554	4.707	4.228
8674.6014	6.314	7.337		5.500	9029.6093	5.414	6.215	6.769	4.737	4.258
8675.6604	6.385	7.465		5.530	9035.6264	5.432	6.212	6.780	4.813	4.268
8676.6531	6.570	7.755		5.678	9037.6249	5.284	6.003	6.532	4.664	4.199
8679.6402	6.299	7.245		5.469	9038.6398	5.447	6.276	6.855	4.785	4.287
8930.9055	6.839	8.070	9.002	5.869	9040.5978	5.366	6.120	6.641	4.718	4.289
8932.8651	6.131	6.998	7.593	5.399	9041.5968	5.188	5.847	6.350	4.614	4.161
9028.6748	6.742	7.949	8.878	5.832	9042.6010	5.361	6.129	6.676	4.736	4.221
9035.6406	6.719	7.960	8.887	5.801	9045.6055	5.194	5.882	6.389	4.613	4.165
9038.6497	6.102	6.956	7.563	5.362	9066.5908	5.501	6.311		4.784	4.310
9040.6079	6.353	7.392	8.146	5.500	9068.5770	5.218	5.919		4.595	4.139
9041.6180	6.563	7.714	8.554	5.672	9069.5591	5.423	6.189	6.782	4.740	4.250
9042.6246	6.696	7.911	8.844	5.770	9281.8972	5.374	6.134	6.666	4.798	4.305
9045.6161	6.092	6.933	7.538	5.337	9376.6646	5.204	5.896		4.617	4.183
9066.5975	6.055	6.901		5.324	9377.6422	5.367	6.121		4.733	4.292
9068.5827	6.332	7.363		5.466						
9069.5654	6.544	7.682	8.520	5.638			ETA AQL			
9281.9046	6.784	8.006		5.858						
9377.6500	6.355	7.466		5.500	8209.8687	3.616	4.412	4.871	3.092	2.634
					8496.9658	3.727	4.459	4.940	3.103	2.664
					8506.9990	4.177	5.171	5.885	3.395	2.883
					8515.9797	4.233	5.143	5.769	3.504	3.012
					8517.9670	3.542	4.194	4.652	3.014	2.620
7592.6268	5.228	5.898	6.413		8518.9789	3.789	4.585	5.129	3.123	2.691
8658.6745	5.484	6.319		4.804	8522.9687	4.274	5.222	5.903	3.540	3.039
8659.6973	5.476	6.309		4.821	8526.9639	3.766	4.603	5.160	3.077	2.641
8670.6167	5.275	5.969		4.675	8536.9699	4.278	5.267	6.017	3.571	3.036
8678.6268	5.309	6.037		4.680	8655.6994	3.756	4.575		3.123	2.652
9000.7069	5.251	5.992		4.646						



TABLE 1A UBVR I CEPHEID MAGNITUDES

JD2430000+	V	B	U	R	I	JD2430000+	V	B	U	R	I
9173.6665	5.059	5.456		4.622	4.358	9035.8059	5.784	6.440	6.880	5.207	4.738
9174.6128	5.414	6.059		4.879	4.528	9036.7865	6.160	6.976	7.478	5.456	4.924
9175.6856	5.772	6.581		5.104	4.691	9037.8815	5.831	6.485	6.943	5.231	4.787
9177.6800	5.164	5.622		4.711	4.430	9038.8309	6.181	6.966	7.491	5.465	4.955
9178.6649	6.343	7.148		5.579	4.869	9041.8546	5.835	6.511	6.979	5.226	4.768
9468.9180	5.327	5.908	6.286	4.814	4.471	9042.7274	6.173	6.958	7.463	5.471	4.954
						9045.7875	5.864	6.534	7.011	5.248	4.790
						9045.9346	5.924	6.639	7.130	5.276	4.786
						9066.6829	5.869	6.547	6.978	5.267	4.822
7592.7799	6.040	6.786	7.293	5.316	4.834	9068.6999	5.830	6.483	6.962	5.226	4.780
7597.7843	5.986	6.723	7.236			9069.6397	6.034	6.796	7.289	5.375	4.882
8367.6409	5.995	6.681	7.171	5.309	4.847	9098.7681	6.031	6.768	7.268	5.365	4.877
8367.7442	6.007	6.706	7.215	5.335	4.859	9099.5872	6.040	6.802	7.279	5.407	4.922
8368.6558	6.037	6.732	7.236	5.368	4.885	9100.5889	5.944	6.662		5.299	4.821
8369.6007	6.005	6.698	7.212	5.308	4.826	9100.8023	6.071	6.815	7.326	5.379	4.878
8370.6416	6.008	6.682	7.183	5.365	4.886						
8371.5817	5.983	6.729	7.160	5.355	4.847	9154.6046	5.803	6.402		5.186	4.735
8408.6634	5.977	6.681	7.199	5.299	4.819	9159.6148	6.182	6.920		5.450	4.940
8410.7360	5.991	6.729	7.246	5.415	4.906	9159.7329	6.174	6.957		5.452	4.945
						9173.6595	6.077	6.853		5.376	4.912
8658.8733	6.145	6.929	7.420	5.438	4.946						
8674.7998	5.938	6.623	7.111	5.315	4.827						
8680.8546	5.784	6.436		5.184	4.744						
8682.8851	5.756	6.373		5.153	4.724						
8700.7914	5.865	6.544	7.021	5.237	4.769						
8720.6548	6.050	6.806	7.238	5.337	4.830	7592.7544	4.327	5.204	5.851	3.580	3.145
9004.9639	5.902	6.626		5.274	4.808	8368.5873	3.958	4.670	5.196	3.362	2.971
9028.9927	6.167	6.981		5.460	4.929	8369.5924	4.161	4.986	5.625	3.482	3.053
9031.7725	5.786	6.451	6.899	5.185	4.770	8370.6230	4.356	5.236	5.877	3.686	3.239
						8371.5731	4.004	4.652	5.088	3.451	3.068
						8408.5811	4.338	5.190	5.817	3.595	3.155

SU CAS

SU CAS

RT AUR

DEL CEP

TABLE 1A UBVR I CEPHEID MAGNITUDES

JD2430000+	V	B	U	R	I	JD2430000+	V	B	U	R	I
8410.5580	3.691	4.257	4.655	3.204	2.865	9151.5804	3.824	4.493		3.267	2.893
8655.7872	4.183	4.936	5.420	3.571	3.167	9154.5697	4.324	5.172		3.711	3.246
8677.7534	3.655	4.136	4.498	3.209	2.895	9159.5829	4.342	5.203		3.661	3.204
8679.7104	3.877	4.581		3.309	2.905	9377.8025	4.016	4.831		3.388	2.959
8699.6627	3.521	3.967		3.075	2.780				X CYG		
8722.7145	3.973	4.688	5.156	3.360	2.911	8224.8599	6.449	7.560	8.424	5.644	5.063
8724.5809	4.372	5.277		3.691	3.211	8555.8999	6.047	7.039		5.278	4.717
8931.9296	3.987	4.744	5.234	3.335	2.956	8655.7359	6.181	7.307		5.320	4.676
8939.9428	4.340	5.220	5.758	3.668	3.245	8658.7384	6.469	7.835		5.524	4.854
9004.8617	3.973	4.612	5.002	3.426	3.039	8678.6542	6.837	8.302		5.815	5.111
9028.7674	3.991	4.762	5.272	3.412	2.986	8681.6250	6.676	7.925		5.740	5.094
9031.7304	3.865	4.453	4.833	3.331	3.006	9028.7435	5.950	6.806	7.428	5.265	4.743
9035.7694	4.296	5.175	5.812	3.640	3.161	9031.6999	6.078	7.154	7.989	5.276	4.716
9036.7625	4.197	4.953	5.444	3.567	3.153	9035.7137	6.448	7.798	9.022	5.539	4.815
9037.8003	3.516	3.982	4.356	3.092	2.786	9038.6985	6.816	8.261	9.694	5.813	5.088
9038.8064	3.824	4.467	4.932	3.269	2.888	9041.6568	6.738	8.028	9.151	5.785	5.088
9041.8197	4.313	5.179	5.768	3.674	3.223	9042.6946	6.581	7.740	8.668	5.684	5.047
9042.7142	3.600	4.060	4.397	3.152	2.844	9066.6360	6.286	7.525	8.618	5.386	4.753
9045.7989	4.170	5.013	5.615	3.530	3.085	9068.6099	6.484	7.810	9.075	5.503	4.833
9066.6752	4.058	4.839	5.408	3.451	3.028	9069.5940	6.573	7.972	9.268	5.630	4.937
9068.6651	4.322	5.140	5.772	3.628	3.190			SU CYG			
9069.6164	3.540	4.010	4.362	3.116	2.818	8655.6922	7.119	7.761		6.554	6.146
9098.6612	4.038	4.786	5.339	3.389	2.981	8658.6951	7.137	7.844		6.570	6.158
9099.5943	4.196	5.030	5.642	3.520	3.092	8681.6058	7.098	7.785		6.504	6.104
9100.5823	4.347	5.233	5.882	3.649	3.198	8931.8811	7.226	7.951	8.255	6.633	6.203
9148.5866	4.299	5.167		3.621	3.172	8932.8768	6.914	7.467	7.703	6.340	6.012
9150.5828	3.518	3.989		3.124	2.799						





TABLE IA UBVR I CEPHEID MAGNITUDES

JD2430000+	V	B	U	R	I	JD2430000+	V	B	U	R	I
8658.9893	7.004	8.041		6.176	5.593	8143.6327	3.802	4.586	5.189	3.159	2.738
8674.0277	6.761	7.671	8.294	6.009	5.460	8147.6229	4.136	5.075	5.827	3.448	3.007
8676.9463	7.365	8.586		6.496	5.833	8367.9144	3.866	4.765	5.450	3.215	2.807
8680.9553	6.763	7.670		6.024	5.490	8368.7934	4.014	4.939	5.735	3.320	2.890
8723.9315	7.147	8.303	9.248	6.236	5.683	8369.7884	4.137	5.102	5.931	3.380	2.924
9038.0023	6.759	7.650		5.995	5.459	8369.8951	4.107	5.082	5.898	3.372	2.894
9041.9947	7.318	8.400	9.187	6.447	5.820	8370.7835	4.138	5.074	5.830	3.426	2.986
9042.9506	6.921	7.790	8.353	6.152	5.620	8371.8949	4.030	4.932	5.417	3.449	3.023
9045.9054	6.747	7.653	8.260	6.016	5.468	8376.9809	3.758	4.526	5.095	3.155	2.772
9067.0170	6.680	7.453		6.029	5.509	8378.9056	3.992	4.941	5.672	3.338	2.896
9098.9643	6.573	7.295	7.853	5.927	5.429	8379.9302	4.113	5.107	5.917	3.424	2.977
9100.8361	6.775	7.685	8.324	6.020	5.463	8380.9785	4.118	5.064	5.772	3.445	3.007
9148.6076	6.733	7.605		5.980	5.439	8381.8637	4.026	4.915	5.602	3.387	2.974
9151.6586	7.310	8.484		6.432	5.799	8397.8254	3.798	4.624	5.267	3.154	2.753
9154.8581	6.587	7.349		5.949	5.443	8431.7905	4.123	5.053	5.799	3.429	2.987
9159.5985	7.343	8.499		6.416	5.769	8441.8147	4.179	5.088	5.842		
9174.5937	7.175	8.263		6.298	5.677	8443.8127	3.884	4.672	5.244	3.313	2.926
9174.6323	7.165	8.274		6.293	5.676	8449.7746	4.005	4.940	5.692	3.367	2.938
9175.8476	7.272	8.390		6.414	5.781	8461.7298	4.123	5.085	5.854	3.419	2.982
9177.6875	6.709	7.523	8.090	5.973	5.474	8469.6901	3.958	4.856	5.571	3.297	2.910
9468.9452	7.356	8.512	9.374	6.479	5.843	8480.6503	4.054	4.997	5.757	3.383	2.950
		ZET GEM				8481.6745	4.172		6.128	3.488	3.060
						8482.6394	4.118	5.060	5.796	3.424	2.983
						8483.6307	3.992	4.852	5.456	3.350	2.957
						8498.6163	3.745	4.528	5.095	3.114	2.749
8080.7593	3.672	4.379	4.815	3.094	2.745						
8108.7136	3.935	4.750	5.283	3.289	2.885						
8113.6326	3.855	4.677	5.301	3.189	2.761						
8142.6444	3.715	4.462	4.930	3.102	2.755						

TABLE 1A UBVR I CEPHEID MAGNITUDES

JD2430000+	V	B	U	R	I	JD2430000+	V	B	U	R	I
8510.6310	4.043	4.968	5.715	3.413	2.944	8369.7682	6.581	8.004	9.260	5.491	4.783
8658.9956	3.707	4.418	4.872	3.147	2.793	8370.7597	6.550	7.983	9.236	5.516	4.815
8671.0208	3.780	4.554	5.082	3.126	2.746	8408.8598	5.626	6.568	7.332	4.907	4.364
8675.0154	4.216	5.213	5.958	3.458	2.998	8410.8007	5.757	6.816	7.665	4.977	4.389
8676.9584	4.014	4.856	5.445	3.389	2.984	8468.6659			5.122	4.505	
8678.0174	3.860	4.619		3.254	2.877	8469.6885			5.134	4.499	
8679.9853	3.632	4.307	4.783	3.080	2.729	8674.0204	6.394	7.614	8.549	5.470	4.851
8699.8893	3.660	4.360	4.840	3.136	2.781	8682.9807	5.883	7.081	4.992	4.392	4.392
8723.9389	3.946	4.903	5.696	3.217	2.876	8723.8714	6.454	7.878	9.130	5.442	4.854
9038.0094	3.937	4.837	5.556	3.272	2.846	9037.9503	6.133	7.482	8.645	5.186	4.556
9041.9104	3.995	4.857	5.441	3.378	2.960	9041.9846	6.383	7.828	9.125	5.384	4.688
9042.9733	3.901	4.670	5.199	3.267	2.878	9042.9297	6.449	7.896	9.206	5.430	4.747
9045.9242	3.696	4.423	4.935	3.110	2.743	9045.8878	6.567	8.045	9.315	5.552	4.847
9067.0235	3.736	4.524	5.110	3.156	2.769	9067.0046	6.263	7.671	8.925	5.286	4.622
9098.9710	3.929	4.839	5.554	3.279	2.857	9151.6998	6.459	7.900	9.210	5.445	4.756
9129.9113	4.008	4.928	5.682	3.345	2.914	9154.6203	6.579	8.003	5.547	4.866	
9148.8413	3.790	4.622	5.274	3.177	2.785	9159.6618	6.504	7.780	8.805	5.561	4.928
9151.7265	4.150	5.108	5.916	3.438	2.990	9173.7886	6.212	7.641	8.763	5.267	4.593
9159.6697	3.912	4.788	5.473	3.245	2.837	9207.6478	6.539	7.999	9.288	5.507	4.819
9174.6198	3.906	4.712	5.289	3.313	2.928	9391.9840	6.307	7.712	9.020	5.350	4.665
9175.7333	3.835	4.591	5.204	3.241	2.865	9392.9952	6.376	7.843	9.115	5.337	4.666
9177.6957	3.642	4.347	4.851	3.136	2.735	9470.9422	6.164	7.514			
8108.6928	5.705	6.603	7.204	4.993	4.492	8510.9334	6.401	7.873	9.110	5.116	4.151
8367.8854	6.423	7.854	9.189	5.449	4.734	8518.9611	5.962	7.264	8.263	4.796	3.892
8368.7660	6.500	7.942	9.247	5.466	4.750						

T MON

Y OPH

TABLE 1A. UBVR I CEPHEID MAGNITUDES

JD2430000+	V	B	U	R	I	JD2430000+	V	B	U	R	I
8522.9370	6.186	7.599	8.784	4.959	4.017	8567.9187	5.885	6.910		5.186	
8526.9259	6.342	7.872	9.128	5.009	4.068	8658.7133	5.691	6.591		4.992	4.533
8528.9382	6.385	7.863	9.065	5.045	4.120	8678.6477	5.932	6.880		5.217	4.735
8658.6415	6.068	7.520		4.904	3.992	9028.7082	5.854	6.849	7.647	5.138	4.627
8674.5898	6.011	7.351		4.911	3.961	9031.6912	5.589	6.362		4.986	4.567
8676.6075	6.076	7.500		4.922	3.965	9035.6917	5.635	6.501	7.132	4.982	4.471
8680.5731	6.359	7.882		5.080	4.098	9038.6778	6.013	7.006	7.774	5.272	4.756
8937.7937	6.367	7.904	9.168	5.129	4.167	9041.6475	5.372	6.045	6.528	4.820	4.417
8938.7725	6.393	7.911	9.152	5.136	4.177	9042.6546	5.363	6.055	6.554	4.779	4.362
8939.7929	6.380	7.873	9.109	5.148	4.177	9045.6440	5.868	6.857	7.655	5.146	4.641
9014.6245	5.916	7.178				9066.6160	5.350	6.003		4.795	4.416
9018.6211	6.128	7.532		4.947	3.998	9068.6019	5.422	6.184	6.745	4.800	4.361
9019.6119	6.138	7.598		4.968	4.015	9069.5869	5.653	6.640	7.245	5.017	4.532
9025.6028	6.348	7.841		5.127	4.144	9100.5617	5.423	6.156		4.835	4.417
9028.5984	6.106	7.465		4.984	4.063	9281.92236	6.008	6.940		5.263	4.801
9029.5990	6.009	7.309	8.319	4.845	3.961	9377.6723	5.421	6.158		4.849	4.462
9037.6136	6.221	7.693	8.892	4.988	4.056						
9038.6203	6.296	7.777		5.041	4.095						
9040.5873	6.342	7.846	9.125	5.114	4.167	8224.7839	6.724	7.838	8.591	5.839	5.169
9041.5864	6.321	7.799	9.053	5.105	4.124	8510.9520	6.652	7.758	8.579	5.699	4.987
9042.5909	6.343	7.810	9.036	5.112	4.144	8522.9600	6.375	7.298	7.967	5.562	4.934
9175.0232	6.308	7.824		5.007	4.056	8526.9563	6.996	8.307	9.337	5.925	5.172
9238.8901	6.082	7.414	8.398			8527.9563	7.000	8.311	9.345	5.925	5.176
9246.9052	6.373	7.875	9.043	5.091	4.184						
9280.8805	6.420	7.824	9.109	5.150	4.138	8528.9530	6.363	7.301	7.933		
						8553.8769	7.048	8.342	9.368	6.013	5.247
9281.8801	6.353	7.835	9.075	5.120	4.202	8559.9323	6.929	8.199		5.948	5.170
9377.6031	6.122	7.547		4.917	4.039	8655.6464	7.020	8.270		6.015	5.208

S SGE

U SGR

Y OPH

TABLE 1A UBVR I CEPHEID MAGNITUDES

JD2430000+	V	B	U	R	I	JD2430000+	V	B	U	R	I
8658.6479	6.551	7.626		5.675	4.980	8526.9405	5.055	6.013	6.720	4.260	3.788
8669.6075	6.975	8.205	9.088	5.980	5.238	8527.4583	5.135	6.156	6.990	4.328	3.838
8677.5895	6.374	7.300		5.580	4.941	8655.6306		5.831		4.300	3.770
8906.9058	6.323	7.266	7.870	5.553	4.911	8671.6038	4.996	5.905	6.558	4.331	3.843
8908.8810	6.627	7.745	8.566	5.705	5.004	8937.8053	4.904	5.764	6.314	4.268	3.809
8910.9126	6.975	8.272	9.281	5.979	5.216	8938.7835	4.386	4.974	5.331	3.891	3.531
8931.8025	7.067	8.401	9.413	6.033	5.302	9000.6709	4.677	5.238		3.979	3.542
9000.6893	6.745	7.799		6.077	5.314	9246.9245	4.798	5.770	6.305	4.086	3.659
8937.8286	6.982	8.404	9.573	5.927	5.114	9264.9196	4.660	5.336	5.781	4.041	3.671
8938.8073	7.088	8.383	9.388	6.043	5.296	9281.8668	4.451	5.049	5.570	3.946	3.491
8939.8034	6.732	7.849	8.567	5.842	5.148						
8940.7938	6.345	7.283	7.895	5.561	4.940						
9014.6370	6.458	7.374				8186.8551	4.843	5.764	6.364	4.059	3.517
9018.6558	6.931	8.195		5.926	5.168	8225.7898	4.500	5.235	5.695	3.876	
9025.6229	6.947	8.219		5.953	5.162	8517.9541	4.356	4.987	5.401	3.785	3.341
9246.9409	6.768	7.805	8.637	5.753	5.051	8522.9254	4.827	5.707	6.310	4.067	3.541
9250.9233	6.438	7.344	7.999	5.592	5.032	8526.9174	4.394	5.089	5.564	3.674	3.214
9264.9378	6.376	7.304	8.008	5.568	4.915	8553.8437	4.247	4.832	5.216	3.684	3.239
9280.8961	6.811	7.930	8.872	5.785	5.036	8940.7794	4.418	5.152	5.589	3.772	3.312
9377.6281	7.095	8.388		6.135	5.417	9246.9145	4.567	5.317	5.724	3.867	3.423
						9264.9076	4.610	5.418	6.078	3.901	3.398
						9281.8550	4.700	5.375	5.881	3.960	3.495
						9376.6049	4.436	5.229	6.108	4.059	3.622
8161.9372	5.008	5.989	6.723	4.173	3.674						
8192.8496	5.070	6.035	6.714	4.390	3.866						
8205.8050	4.761	5.648	6.229	4.063	3.595						
8518.9701	5.084	6.035	6.757	4.303	3.806	8510.9430	5.403	6.086	6.582	4.787	4.340
8522.9499	4.505	5.191	5.657	3.885	3.495	8518.9893	5.859	6.816	7.514	5.031	4.495

W SGR

X SGR

Y SGR

W SGR





JD2430000+	I	J	K	L	JD2430000+	I	J	K	L
U AQL					ETA AQL				
8558.9134			4.060		9274.9144		2.467	2.009	1.829
8640.7446		4.425	3.785		9391.6713		2.527	2.128	2.040
8674.6673		4.405	3.758	3.592	9393.6762		2.367	1.945	1.838
8675.6679		4.439	3.783	3.726	9425.6410	2.836	2.526	1.987	1.893
8694.5708		4.308	3.826	3.774					
					RT AUR				
9041.6612		4.523	3.886	3.833	8339.9878	4.679	4.398	3.909	
9061.5864		4.338	3.784	3.694	8368.9258	4.392	4.229	3.882	
9062.5744		4.444	3.771	3.638	8370.9382	4.765	4.470	4.047	
9063.5659		4.553	3.891	3.718	8378.8221	4.699	4.450	4.130	
9064.5849		4.625	3.921	3.747	8379.8659	4.417	4.299	3.942	
9072.5876		4.507	3.940	3.744					
9273.8910		4.531	3.875	3.777	8392.8312	4.818	4.481	4.081	
9274.8930		4.669	3.998	3.803	8396.7753		4.522	4.093	
9391.6343		4.281	3.733	3.777	8397.7844	4.569	4.380	3.997	
9392.6317		4.458	3.925	3.804	8398.7735	4.531	4.308	3.959	
					8400.7883	4.690	4.458	4.025	
9393.6438		4.536	3.893	3.767					
9425.6213	4.751	4.397	3.863	3.808	8431.7587	4.297	4.191	3.885	
					FF AQL				
					8482.6141	4.735	4.525	4.035	
8320.6069	4.365	3.993	3.575		8739.9766		4.481	4.014	3.835
8339.5961	4.132	3.874	3.492		8740.9866		4.192	3.909	
8558.9086		3.959	3.490		8771.7779		4.178	3.802	3.890
8669.7056		3.979	3.543	3.443					
8674.6570		3.906	3.506	3.216	9060.9738		4.479	4.004	3.905
					9061.9030		4.205	3.862	3.787
8676.6587		3.949	3.480	3.403	9062.9350		4.405	3.909	3.865
8693.6376		3.931	3.440	3.331	9063.9466		4.454	3.931	3.910
9061.5744		3.945	3.430	3.359	9140.8533		4.233	4.039	3.817
9062.5649		3.970	3.449	3.371					
9063.5535		3.768	3.363	3.249	9184.6745		4.640	4.103	4.040
					9185.6337		4.175	3.831	3.719
9072.5727		3.817	3.388	3.275	9185.7326		4.364	3.863	3.761
9273.8856		3.900	3.482	3.364	9227.6561		4.396	3.995	3.886
9386.6196		3.795	3.355	3.168	9424.9489	4.700	4.350	3.905	3.731
9393.6363		3.880	3.522	3.460					
					ETA AQL				
					9425.9892	4.728	4.518	3.990	3.850
					9448.9695		4.426	4.009	3.977
					9461.8835		4.458	3.840	3.770
					SU CAS				
8301.6618	2.655	2.411	1.969		8323.7783	4.897	4.594	4.198	
8494.9656	2.803	2.448	2.022		8323.8424	4.881	4.576	4.143	
8497.0069		2.299	1.874		8339.8759	4.808	4.406	4.203	
8521.9722	2.951	2.568	1.999		8343.8297	4.754	4.474	4.084	
8523.9773	2.735	2.422	1.943		8377.6057	4.867	4.610	4.251	
8558.9339		2.707	2.143	1.954	8378.6612	4.839	4.478	4.158	
8564.8931		2.473	1.921	1.822	8379.6509	4.822	4.630	4.093	
8669.6788		2.420	1.981	1.935	8395.5822	4.933	4.665	4.155	
8669.7280		2.447	1.942	2.005	8396.6114	4.732	4.527	4.145	
8670.6390		2.310	1.831	1.734	8397.5879	4.848	4.538	4.140	
8671.7247		2.523	2.022	1.934	8398.6431	4.797	4.421	4.017	
8675.6995		2.457	2.013	2.002	8400.5911	4.811	4.499	4.152	
8694.5840		2.648	2.201	2.065	8430.5729	4.941	4.555	4.167	
9035.6343		2.423	1.915	1.958	8431.5795	4.767	4.468	4.123	
9036.5885		2.367	1.932	1.768	8669.8854		4.590	4.167	3.983
9038.6010		2.569	2.008	1.916					
9061.6463		2.620	2.141	2.071	8693.6708		4.622	4.163	4.049
9062.6081		2.320	1.915	1.818	8771.6360		4.615	4.066	3.935
9063.5981		2.298	1.908	1.768					
9064.6084		2.358	1.896	1.730					
					DEL CEP				
9072.6070		2.446	1.835	1.780	8298.7316	2.823	2.643	2.187	
9273.9115		2.340	1.927	1.848	8315.7095	2.963	2.737	2.316	

JD2430000+	I	J	K	L	JD2430000+	I	J	K	L
DEL CEP					SU CYG				
8315.7769	2.990	2.734	2.283		9061.6266		5.735	5.246	5.292
8316.6708	3.155	2.838	2.362		9062.5843		5.862	5.327	
8316.7385	3.192	2.857	2.375		9063.5785		5.848	5.546	
8317.6758	3.201	2.919	2.523		9064.5969		5.570	5.361	
8317.7359	3.141	2.922	2.481		9072.5955		5.645	5.196	
8320.6477		2.732	2.277		9273.9033		5.837	5.359	5.131
8323.6380	2.849	2.702	2.375		9391.6540		5.610	5.281	5.239
8323.6879	2.856	2.717	2.466		9393.6600		5.885	5.473	5.452
8339.6656	2.947	2.718	2.393		9425.6314	5.785	5.620	5.359	5.320
8377.5957	2.765	2.620	2.398						
DT CYG									
8378.5924	2.853	2.583	2.237		8340.6457	5.023	4.825	4.393	
8379.5877	2.902	2.639	2.236		8343.6182	4.950	4.707	4.447	
8395.5718	2.964	2.770	2.209		8377.5883	5.089	4.876	4.458	
8396.6036	3.053	2.793	2.317		8378.5852	4.878	4.683	4.317	
8397.5809	3.123	2.868	2.401		8556.8773		4.752	4.372	
8398.5921	2.899	2.719	2.351		8556.9648		4.729	4.315	
8400.5734	2.866	2.631	2.214		8557.9150		4.807	4.422	4.119
8638.8298		2.928	2.411	2.312	8564.8453		4.769	4.319	
8669.6715		2.756	2.282	2.169	8638.8156		4.757	4.357	
8741.6434		2.899	2.469	2.460	8640.8280		4.788	4.405	
8747.6220		2.694	2.409	2.360	8669.7465		4.894	4.457	
9061.7424		2.749	2.240	2.230	8674.7455		4.782	4.443	4.417
9062.6637		2.898	2.382	2.410	8676.7918		4.856	4.500	4.347
9063.6800		3.023	2.376	2.307	8725.6079		4.789	4.425	4.440
9064.6563		2.630	2.343	2.239	8738.6087		4.700	4.411	4.194
9072.6734		2.846	2.366	2.373	8741.5648		4.803	4.501	
9385.7720		2.813	2.328	2.204	9061.6947		4.780	4.396	4.351
9390.7904		3.000	2.441	2.366	9062.6561		4.842	4.391	
9424.6858	2.927	2.668	2.338	2.267	9063.6691		4.755	4.388	4.235
					9064.6469		4.749	4.397	4.255
X CYG									
8558.9398		4.456	3.697		9072.6617		4.856	4.445	4.445
8646.8088		4.596	3.919		9385.7356		4.703	4.272	4.219
8671.7390		4.352	3.753	3.659	9391.7315		4.784	4.496	4.485
8676.6914		4.588	3.686	3.633	9393.7166		4.748	4.417	4.382
8694.5938		4.575	3.913	3.626	9425.6838	4.987	4.802	4.481	4.419
9038.7372		4.597	3.864	3.731					
9040.7021		4.694	3.953	3.822					
9061.6680		4.421	3.883	3.809	8368.9403	5.798	5.322	4.860	
9062.6298		4.181	3.723	3.690	8370.9534	5.404	5.103	4.606	
9063.6429		4.303	3.741	3.670	8377.8760	5.784	5.403	4.781	
					8378.8291	5.347	5.104	4.536	
					8379.8743	5.459	5.279	4.776	
9064.6260		4.301	3.691	3.537					
9072.6458		4.656	3.902	3.758	8392.8439	5.863	5.359	4.808	
9385.7140		4.729	3.962	3.955	8396.7818	5.519		4.600	
9391.6990		4.340	3.739	3.726	8397.8005	5.563	5.189	4.657	
9393.6944		4.383	3.726	3.573	8398.7797	5.894	5.236	4.653	
9424.6542		4.272	3.730	3.627	8400.7952	5.858	5.347	4.925	
9425.6566	4.706	4.324	3.727	3.664					
SU CYG					W GEM				
8320.6186	6.172	5.848	5.440		8482.6536	5.569	5.212	4.698	
8558.9286			5.346		8483.6691	5.489	5.037	4.645	
8671.7152		5.698	5.340	5.322	8692.9448		5.360	4.782	5.957
8674.7046		5.850	5.367	5.111	8771.7905		5.298	4.637	4.400
8675.6891		5.672	5.368		9060.9841		5.126	4.665	4.479
9035.6009		5.833	5.371	5.334	9061.9282		5.102	4.582	4.522
9040.6874		5.717	5.407	5.353	9062.9452		5.282	4.587	4.552
					9063.9558		5.292	4.680	
					9140.8635		5.146	4.736	4.440
					9185.6431		5.209	4.942	



JD2430000+	I	J	K	L	JD2430000+	I	J	K	L
W GEM					T MON				
9227.6650		5.151	4.594	4.536	8377.8585	4.641	4.263	3.695	
9391.9673		5.079	4.726		8378.8146	4.437	4.058	3.588	
9392.9622		5.170	4.642		8379.8573	4.371	4.100	3.621	
9424.9392	5.498	5.085	4.568	4.476	8392.8184	4.662	4.168	3.423	
9425.9980	5.491		4.547	4.461	8396.7695	4.853	4.360	3.580	
ZET GEM									
8315.9850	2.744	2.427	2.007		8397.7733	4.857	4.315	3.587	
8316.0243	2.742	2.451	2.023		8398.7681	4.892	4.398	3.680	
8316.9714	2.835	2.516	2.038		8400.7809	4.844	4.387	3.668	
8317.0089	2.817	2.576	1.991		8431.7503	4.638	4.293	3.794	
8317.9688	2.935	2.637	2.104		8482.6236	4.852	4.457	3.735	
8318.0047	2.925	2.645	2.092		8483.6451	4.964	4.443	3.769	
8323.9943	2.775	2.550	2.149		8727.7924		4.480	3.914	3.851
8324.0213	2.796	2.518	2.150		8771.7690		4.136	3.362	3.184
8339.9957	2.995	2.693	2.181		9060.9626		4.030	3.417	3.364
8369.9408	2.903	2.628	2.090		9061.8903		3.995	3.443	3.324
8370.9809	2.982	2.701	2.206		9062.9266		4.109	3.361	3.230
8427.7765	2.755	2.482	2.017		9063.9380		4.040	3.371	3.318
8431.7674	2.980	2.683	2.192		9140.8397		4.204	3.633	3.458
8476.7744	2.686	2.480	2.097		9185.6210		4.478	3.702	3.718
8480.6207	2.888	2.587	2.090		9227.6445		4.193	3.449	3.306
8481.6629	2.941	2.624	2.115		9392.9523		4.107	3.458	3.327
8482.6369	2.981	2.745	2.221		9394.9570		4.258	3.473	3.356
8483.6173	2.891	2.633	2.183		9425.9784	4.839		3.634	3.439
8493.6179	2.948	2.592	2.141		9461.8766		4.103	3.518	3.440
8494.6303	2.836	2.545	2.150		Y OPH				
8496.6733	2.718	2.503	2.080		8320.5834	4.203	3.557	2.685	
8499.6014		2.526	2.103		8565.8297		3.582	2.821	2.583
8502.6192	3.040	2.716	2.193		8670.5926		3.439	2.679	2.469
8505.6383	2.865	2.616	2.189		8674.5856		3.422	2.698	2.477
8669.9720		2.575	2.128	2.086	8675.5930		3.422	2.663	2.424
8670.9810		2.560	2.086	2.040	8676.6106		3.430	2.634	2.395
8739.9608		2.539	2.028	2.089	9041.5812		3.556	2.729	2.623
8740.9992		2.510	2.108	2.009	9270.8512		3.282	2.651	
8771.7990		2.465	2.042	2.028	9272.8018		3.261	2.617	2.510
8773.8767		2.570	2.085	1.921	9273.8544		3.330	2.646	2.483
9036.0168		2.443	2.030	1.971	9274.8279		3.329	2.655	2.654
9060.9943		2.694	2.186	2.062	9385.5681		3.419	2.697	2.597
9061.9477		2.687	2.138	2.097	9391.5858		3.263	2.612	2.488
9062.9533		2.702	2.241	2.237	9392.5850		3.376	2.663	2.525
9063.9623		2.642	2.149	2.076	S SGE				
9140.8735		2.662		1.998	8317.6449	4.753	4.419	3.733	
9185.6523		2.567	2.164	2.018	8320.6296	4.542	4.211	3.719	
9197.7443		2.477	2.056	2.107	8670.6514		4.358	3.863	3.836
9227.6715		2.502	2.160	2.049	8674.7281		4.144	3.675	3.607
9424.9578	2.872	2.550	2.068	1.964	8693.6287		4.262	3.653	3.498
9426.0066	2.930	2.642	2.058	2.031	9061.6556		4.272	3.756	3.658
9448.9877		2.688	2.171	2.044	9062.6200		4.223	3.676	3.560
9461.8899		2.573	2.199	2.052	9063.6070		4.387	3.853	3.640
T MON					9064.6139		4.405	3.854	3.709
8323.9793	4.676	4.294	3.762		9072.6198		4.386	3.819	3.732
8324.0146	4.650	4.181	3.700		9273.9241		4.373	3.893	3.829
8368.9097	4.761	4.263	3.492		9391.6795		4.365	3.903	3.863
8369.9562	4.704	4.222	3.469		9393.6842		4.133	3.691	3.699
8370.9112	4.811	4.347	3.597		9425.6477	4.572	4.320	3.897	3.787

JD2430000+	I	J	K	L	JD2430000+	I	J	K	L
U SGR					SZ TAU				
8317.6193	5.232	4.667	3.998		8323.8918	5.211	4.930	4.265	
8320.5954	4.920	4.544	3.981		8343.8809	5.134	4.770	4.312	
8557.8656		4.575	3.991		8377.7290	5.257	4.826	4.216	
8558.8727		4.650	3.939	3.390	8378.7552	5.186	4.763	4.244	
8640.7060		4.706	3.999		8379.7380	5.205	4.825	4.303	
8667.5952		4.671	3.929	3.895	8396.6967	5.270	4.876	4.352	
8670.6240		4.543			8397.7430	5.205	4.939	4.343	
8674.5956		4.657	3.935	3.936	8398.6602	5.218	4.796	4.418	
8676.6231		4.754	4.160		8400.6519	5.149	4.809	4.368	
9256.8799		4.642	3.998	4.112	8430.6737	5.247	4.960	4.297	
9258.9403		4.597	3.965	3.917	8431.5977	5.134	4.796	4.354	
9272.8349		4.428	3.855	3.828	8480.6035	5.154	4.873	4.239	
9273.8656		4.491	3.901	3.851	8482.6039	5.172	4.821	4.310	
9274.8590		4.568	3.947	3.882	8674.9419		4.811		3.991
9298.8741		4.519	4.056	4.017	8727.7808		4.773	4.309	4.106
9385.6065		4.519	4.083	4.091	8769.7089		4.905	4.300	
9391.6044		4.667	4.069	3.921	8771.6463		4.837	4.207	4.092
9392.6029		4.468	4.004	3.871	9041.8690		4.901	4.338	4.252
9393.6028		4.450	3.896	3.763	9045.8543		4.824	4.352	4.192
W SGR					9060.9197		4.929	4.373	4.209
8670.6038		3.515	2.844	2.805	9061.8476		4.807	4.298	4.239
9270.8629		3.505	2.984	2.881	9062.9185		4.887	4.324	4.213
9272.8198		3.343	3.001	2.966	9063.8461		4.938	4.374	4.395
9273.8493		3.130	2.835	2.699	9140.6975		4.887		4.272
9274.8411		3.157	2.609	2.604	9185.5979		4.760	4.229	4.122
9274.8469		3.139	2.759	2.719	9185.6595		4.832	4.317	4.167
9391.5783		3.187	2.700	2.590	9391.9300		4.822	4.365	4.294
9393.5862		3.497	3.098	3.053	9392.9290		4.840	4.316	4.253
X SGR					9424.9229	5.081	4.856	4.235	4.078
9270.8576		2.978	2.528	2.418	9425.9343	5.300	4.926	4.338	4.285
9272.8112		3.159	2.665	2.630	9461.8664		4.848	4.335	4.223
9273.8441		3.147	2.634	2.566	T VUL				
9386.5563		3.123	2.651	2.727	8320.6402	4.882	4.542	4.195	
9391.5707		2.903	2.424	2.355	8340.6327	4.954	4.568	4.176	
9392.5716		3.154	2.616	2.547	8377.5734	4.960	4.745	4.242	
9393.5799		3.363	2.765	2.825	8378.5764	4.622	4.471	4.138	
Y SGR					8379.5718		4.505	3.978	
8339.5872	4.387				8395.5550	5.013	4.878	4.307	
8557.8550		4.123	3.602	3.682	8671.7583		4.538	4.216	4.086
8564.8333		4.049	3.491		8673.7882		4.726	4.230	4.324
8694.6081		4.228			8694.6251		4.472	4.082	4.081
9270.8690		4.200	3.644	3.507	9040.6751		4.545	4.142	4.068
9272.8280		4.206	3.694	3.617	9061.6798		4.513	4.176	4.170
9273.8602		3.969	3.531	3.584	9062.6483		4.520	4.079	4.022
9274.8522		4.006	3.528		9063.6590		4.649	4.128	3.912
9385.5953		4.287	3.696	3.702	9064.6379		4.733	4.254	4.139
9386.5994		4.270	3.723	3.591	9072.6539		4.624	4.162	4.092
9391.5943		4.113	3.566	3.529	9385.7252			4.165	4.002
9392.5937		4.324	3.813	3.610	9391.7216		4.695	4.142	4.216
9393.5949		4.084	3.666	3.601	9393.7082		4.678	4.281	4.277
9425.5802	4.529	4.179	3.641	3.555	9424.6641		4.733	4.357	4.268
					9425.6738	4.707	4.574	4.190	4.150