THE ASTRONOMICAL JOURNAL VOLUME 65, NUMBER 2 MARCH, 1960

Observations of ϵ Aurigae

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(Received November 12, 1959)

Photoelectric observations made at the Flower and Cook Observatory, using the Pierce photometer and interference filters, are presented.

THE observations presented here were made with the Pierce photometer (Blitzstein 1953, 1958), mounted on the Flower and Cook Observatory 15-in. siderostat, and cover the observing seasons 1954 through 1958. The photometer was used as a single channel photometer for these observations. The observations during the first two seasons were made by F. B. Wood, the third season's observations were made by Wood and Fredrick, and the last two seasons' observations were by Fredrick. The filters used during the first four seasons are the same as those described by Wood and Blitzstein (1956). During the last season the old interference filters were replaced by new ones, the ultraviolet filter remaining the same. So far as can be determined, there is no systematic shift due to the change in the filters.

Observations from previous eclipses have been compiled by Güssow (1936). A photoelectric light curve of the 1928 to 1930 eclipse has been given by Huffer (1932). Light curves of the present eclipse have been published by Larsson-Leander (1958) and Huruhata and Kitamura (1958), and in addition Gyldenkerne has has circulated a plot of his observations made at Brørfelde.

The observations are tabulated in Table I. λ Aurigae was used as the comparison star and 2 Aurigae was used as the check star to check the constancy of λ Aurigae. The observations in the table are in the sense λ Aurigae minus ϵ Aurigae and are corrected for differential extinction; the epoch is heliocentric reckoned from Greenwich mean noon, and n refers to the number of observations making up a normal point. The observations have been plotted in Fig. 1 for each color. The scale for the variable is to the right of each plot. At the bottom of each plot the check star observations are plotted using slightly larger circles and the scale for these observations is on the left of each plot. The dashed line indicates a break in the time scale.

The light outside eclipse is remarkably constant as can be seen in the work by Güssow cited above. The variation about the mean light outside eclipse seldom exceeds 0.1 mag. From five to three years before or after eclipse the variation may get as large as, but seldom exceeds, 0.2 mag. During totality the variation is often as large as 0.3 mag, and perhaps a little larger. The intrinsic variation can be seen in the egress branch in Fig. 1. A slight change in color accompanies the intrinsic variation. Our observations in the blue show excellent agreement with the light curve by Larsson-Leander, but show a discrepancy with the ultraviolet and blue observations of Huruhata and Kitamura from JD 2435900 to 920. During the same interval, our observations in the yellow disagree with Larsson-Leander's yellow light curve but agree quite well with the observations of Huruhata and Kitamura. This is as yet unexplained. The extremely high value of the ultraviolet observation on JD 2435542 is real, and is the mean of three very good observations.

It was originally hoped to combine the photometric information from a number of sources with the astrometric material collected at the Sproul Observatory during the past 20 years. A preliminary check of the Sproul material proved to be rather inconclusive as far as a possible astrometric orbit was concerned so the idea has been dropped until more material has been obtained.

The fact that the system loses the same amount of light in all colors has caused the system to receive a remarkable amount of attention during the past few decades. Perhaps more attention should be paid to another interesting aspect of the light curve of this system. During the total phase the light is not constant, as is often stated in the literature, but rather, totality deepens from second contact to third contact by about 0.1 mag. This is easily seen in the light curve given by Huffer and also in the one published by Larsson-Leander. The slope in each case is very nearly the same. If the eclipsing body is a cloud as is often suggested, it is quite difficult to visualize how this cloud can retain such a shape as to repeat the slope so consistently. The slope cannot be explained by a long term intrinsic variation as in the case of VV Cephei, because such a variation would be easily detected by visual observers and no such variation shows during the past 140 years.

ACKNOWLEDGMENT

My thanks to Dr. F. B. Wood who suggested that these observations be made as well as allowing me to publish his observations, some of which were published previously in graphical form (Wood 1957).

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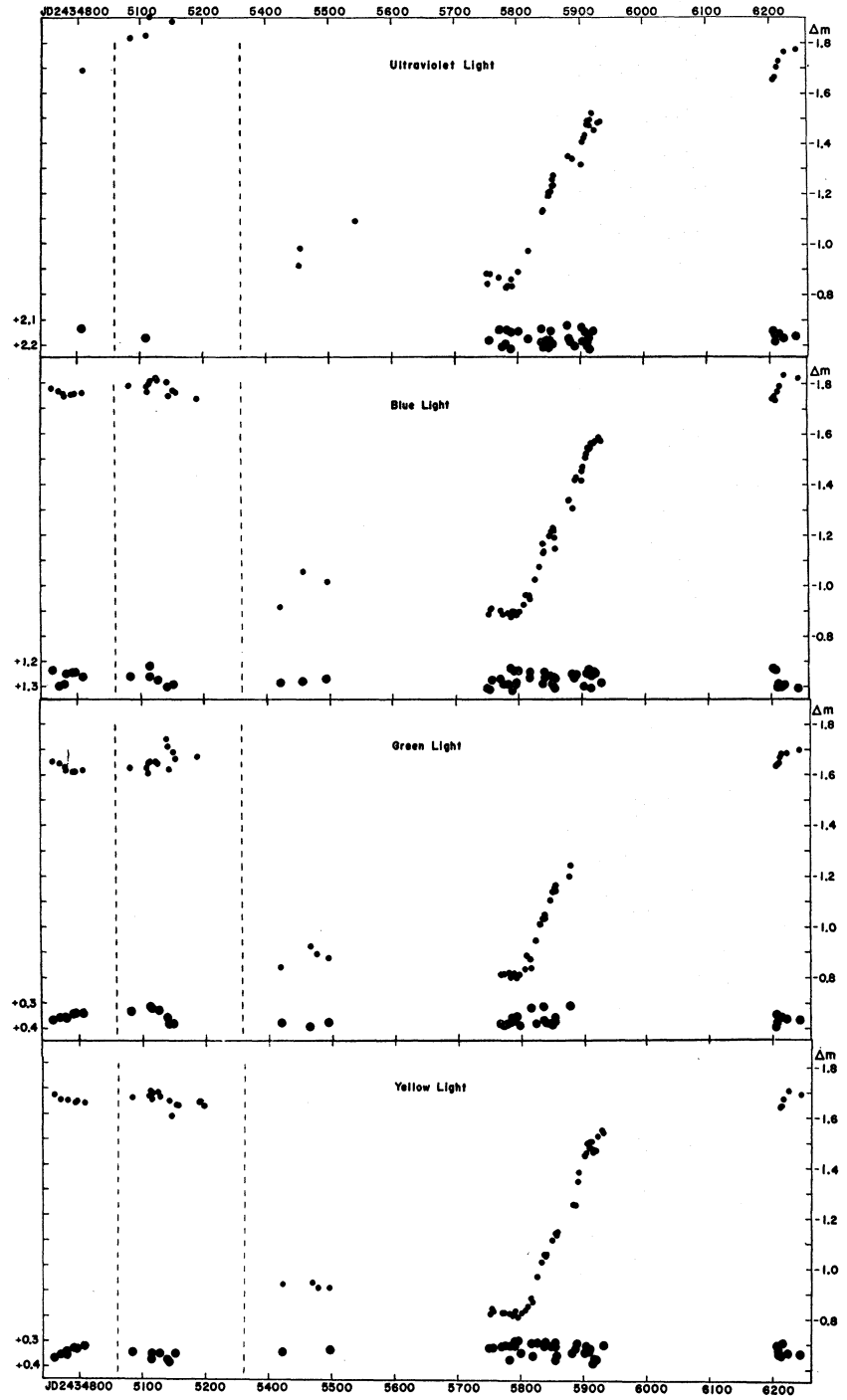

FIG. 1. Four-color observations of ε Aurigae. Small dots refer to the variable, large dots to the check star.

TABLE I.

Yellow light			Green light			Blue light			Ultraviolet light		
JD	Δm	n	JD	Δm	n	JD	Δm	n	JD	Δm	n
2434760.5219	−1.673	4	.5267	−1.650	4	.5235	−1.777	3			
771.5053	1.654	5	.5099	1.644	5	.5106	1.767	5			
780.5570	1.651	5	.5578	1.629	5	.5584	1.752	5			
781.5134	1.648	3	.5145	1.614	3	.5152	1.745	3			
792.5280	1.640	4	.5289	1.611	4	.5296	1.752	4			
796.4940	−1.649	4	.4950	−1.608	4	.4958	−1.755	3			
808.5128	1.642	3	.5136	1.613	3	.5143	1.756	3	.5485	−1.686	2
2435084.6103	1.660	4	.6138	1.625	4	.6147	1.783	4	.6578	1.819	1
110.6237	1.667	2	.6247	1.625	2	.6256	1.785	2	.5734	1.830	5
112.5422	1.689	1	.5432	1.603	1	.5439	1.762	1			
115.5467	−1.656	4	.5427	−1.642	3	.5436	−1.796	3			
116.5946	1.679	4	.5956	1.645	4	.5975	1.805	4	.5470	−1.903	4
125.5948	1.684	2	.5958	1.648	2	.5968	1.819	2			
128.5749	1.667	4	.5763	1.642	4	.5778	1.810	2			
142.5707	1.655	2	.5718	1.736	2	.5732	1.800	2			
143.6069	−1.647	5	.6156	−1.708	5	.6096	−1.802	4			
146.5267	1.592	2	.5281	1.620	2	.5300	1.795	2			
152.5363	1.636	4	.5374	1.688	4	.5384	1.769	4	.5811	−1.881	2
157.5206	1.632	2	.5216	1.662	2	.5229	1.758	2			
190.5296	1.646	2	.5305	1.668	2	.5316	1.735	2			
197.5176	−1.626	2									
2435422.6912	0.925	4	.6873	−0.839	4	.6884	−0.914	4			
453									.6811	−0.912	2
455									.5928	0.983	3
458						.6568	1.037	2			
469.5882	−0.932	2	.5894	−0.921	2						
479.6069	0.911	1	.6078	0.892	1						
497.5765	0.911	7	.5775	0.872	7	.5784	−1.015	7			
542									.5568	−1.090	3
2435752.8072	0.811	4				.8083	0.880	4	.8058	0.842	4
755.8076	−0.836	5				.8087	−0.905	5	.8185	−0.878	5
757.8020	0.824	10				.8148	0.908	10	.8122	0.882	10
771.8214	0.820	12	.8189	−0.810	12	.8166	0.898	12	.8176	0.866	5
775.8060	0.818	9	.8070	0.810	9	.7998	0.881	9	.7995	0.887	5
782.8081	0.822	16	.8037	0.817	16	.8047	0.894	16	.7798	0.830	6
783.7653	−0.818	13	.7709	−0.817	13	.7719	−0.895	13	.7866	−0.832	5
788.7976	0.809	3	.7985	0.800	3	.7994	0.874	3			
790.7589	0.804	9	.8217	0.801	3	.7656	0.890	9	.7792	0.859	4
791.7515	0.812	5	.7525	0.801	5	.7408	0.901	5	.8258	0.835	7
792.7242	0.826	4	.7251	0.813	4	.7260	0.899	4			
793.7238	−0.816	4	.7247	−0.800	4	.7326	−0.884	4			
796.7332	0.802	6	.7442	0.794	6	.7453	0.882	6			
801.7106	0.816	6	.7112	0.810	6	.7118	0.895	6	.7525	−0.889	4
808.6827	0.828	3	.6838	0.831	3	.6847	0.924	3			
811.6482	0.843	4	.6491	0.883	4	.6561	0.964	4			
817.6795	−0.877	7	.6763	−0.870	7	.6813	−0.962	7	.7545	−0.974	4
819.7058	0.858	6	.7029	0.835	6	.6852	0.945	6			
826.6632	0.963	3	.6643	0.944	3	.6652	1.024	3			
833.6202	1.020	1	.6211	1.007	1	.6229	1.074	1			
838.5690	1.049	7	.5757	1.032	7	.5790	1.166	7			
840.6342	−1.046	6	.6351	−1.031	6	.6360	−1.126	6	.6558	−1.121	3
841.5852	1.048	7	.5861	1.042	7	.5762	1.132	7	.6269	1.132	5
849.5941	1.107	9	.5951	1.104	9	.6020	1.194	9	.6342	1.203	6
853.5690	1.124	5	.5699	1.138	5	.5708	1.211	5	.6285	1.206	6
855.6097	1.134	4	.6050	1.149	4	.6059	1.228	4	.6535	1.233	2
856.5599	−1.126	5	.5608	−1.150	5	.5675	−1.220	5	.6210	−1.259	6
857.5921	1.137	2	.5930	1.148	3	.5939	1.190	3	.6458	1.234	2
858.5592	1.136	6	.5538	1.142	6	.5547	1.147	6	.6230	1.271	6
880			.5042	1.198	1						
881.5271	1.252	5	.5111	1.239	5	.5051	1.342	5	.5781	1.351	5
887.5198	−1.243	5				.5192	−1.305	5	.5481	−1.338	2
890.5302	1.340	5				.5357	1.418	5	.5846	1.415	3
891.5221	1.374	3				.5222	1.426	3			
901.5633	1.438	4				.5639	1.413	4			
902.5501	1.495	1				.5510	1.451	1	.5300	1.316	3

TABLE I.—*Continued.*

Yellow light			Green light			Blue light			Ultraviolet light		
JD	Δm	n	JD	Δm	n	JD	Δm	n	JD	Δm	n
903.5179	−1.451	4				.5237	−1.470	4	.5548	−1.406	2
907.5875	1.500	4				.5884	1.506	4	.5606	1.424	3
908.5607	1.476	4				.5616	1.521	4	.5267	1.432	3
910.5616	1.476	4				.5620	1.543	4	.5182	1.474	3
911									.5346	1.490	2
912.5618	−1.500	3				.5627	−1.540	3	.5304	−1.473	4
914.5592	1.453	3				.5582	1.543	3	.5262	1.470	3
915.5552	1.471	3				.5548	1.565	3	.5255	1.493	3
919.5425	1.463	3				.5434	1.566	3	.5193	1.521	2
921.5533	1.522	4				.5543	1.572	4	.5289	1.454	3
929.5435	−1.542	3				.5444	−1.588	3	.5284	−1.482	2
931.5572	1.528	2				.5583	1.572	2	.5391	1.486	3
2436207.5659	1.642	3	.5668	−1.636	3	.5677	1.744	3	.6154	1.655	3
208.5660	1.642	2	.5669	1.640	2	.5678	1.748	2	.6090	1.658	2
209.5813	1.642	2	.5822	1.633	2	.5831	1.736	2	.6341	1.664	2
212.5768	−1.647	2	.5777	−1.669	2	.5786	−1.770	2	.6146	−1.704	2
215.5762	1.672	2	.5771	1.682	2	.5780	1.792	2	.6119	1.728	2
223.5826	1.706	1	.5835	1.683	1	.5844	1.832	1	.6093	1.763	1
243.5788	1.692	2	.5797	1.697	2	.5806	1.822	2	.5620	1.770	2

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THE ASTRONOMICAL JOURNAL VOLUME 65, NUMBER 2 MARCH, 1960

Twenty Variable Stars in Sagittarius

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(Received December 7, 1959)

Periods have been determined for 20 variable stars in VSF 193 in Sagittarius: one semi-regular, one Algol, 17 typical Mira-type, and one (K0 Sgr) with a period of 312 days whose light curve suggests a U Geminorum star, but which is probably a long-period variable with a faint companion.

IN continuation of the program of work on Variable Star Field 193 in Sagittarius (Hoffleit 1957, 1958, 1959), periods have been determined for 20 more variable stars (Table I). Four of them had not previously been announced as variable and are given the temporary designations a through d in Table I. Variable a is semi-regular and variable d an Algol-type binary. The others are long-period variables, all but K0 Sgr appearing to have typical Mira-type light curves with periods from 175 to 300 days. Identification charts for variables a, d and K0 Sgr are given in Fig. 1, the variable in each case is the brightest star within the small circle.

The entries in Table I include the Julian date minus 2400000 of a well-defined maximum in the case of the long-period variables and of a minimum for the eclipsing variable, the number of epochs included in the determination of the period, and the type of variation. The two columns headed obs. and c give initials representing the women who made the estimates of magnitude, and those who derived the periods. They are: A, Jean Hales Andersen; B, Jennifer Bagster-Collins; C, Marguerite Camusso; F, Margo Friedel; H, D. Hoffleit; L, Ida Lowell; M, Janet Marshall; P, Zora Prochazka; and W, Barbara Welther.

The observations of the semi-regular variable, a, obtained on Harvard plates of the A, B and MF series, taken with the 24-in. Bruce, 8-in. Bache, and 10-in. Metcalf photographic refractors, respectively, are shown in Fig. 2. No single period has been found to fit