THE ECLIPSING BINARIES ZZ CEPHEI AND UY VIRGINIS*

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ABSTRACT

Spectrographic elements have been obtained for the eclipsing binaries ZZ Cephei and UY Virginis. The brighter of the two visual companions of ZZ Cephei has been found to be a spectrum variable with a period of 3.770 days.

I. THE SYSTEM OF ADS 16252

ZZ Cephei = ADS 16252-A.—The variability of ZZ Cephei[1] (=410.1929 Cep = BD+67°1463 = HD 215661 [A2] = OΣ 529-A = ADS 16252-A) was discovered by H. Schneller at Neubabelsberg[2] and was recognized to be of the eclipsing type. The variable is the brightest component of the triple system[3] ADS 16252, and on small-scale plates it is blended with the B component, 3″.6 distant in $p = 202°$. The photographic range of the combined light of A and B is 8.6–8.9 mag., according to Schneller,[2,4] while the variable itself ranges between 9.0 and 10.1 mag. on larger-scale plates, where the images of the two stars are resolved. Schneller derived the light-elements

$$\text{Min} = \text{JD } 2425936.60 + 2^{\text{d}}.1419\,\text{E}$$

from seven minima in 1927–1929. Unpublished observations by K. Kordylewski[5] gave the elements

$$\text{Min} = \text{JD } 2427403.710 + 2^{\text{d}}.1418\,\text{E}\,,$$

which were found to represent satisfactorily fourteen minima observed by A. Kwiek[6] in 1934–1935. Kwiek, however, derived an improved normal minimum on the basis of his observations; i.e., JD 2427928.4507. Two additional minima were observed photographically in 1944 and 1945 at Mount Hamilton. When combined with Kwiek's observations, these minima gave the improved elements

$$\text{Min} = \text{JD } \underset{(\pm 0.001)}{2427928.451} + \underset{(\pm 0.000002)\text{ p. e.}}{2^{\text{d}}.141800\,\text{E}}\,.$$

These elements have been employed throughout the present paper.

Schneller's[4] photographic light-curve revealed that the principal minimum, with a total duration of 5 hours, had no constant phase at minimum; there was no indication of a secondary minimum or of any appreciable ellipticity effect. Kwiek's visual observations, on the other hand, indicated the duration of primary minimum to be 10.1 hours;

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[1] α (1900) = $22^{\text{h}}41^{\text{m}}.7$; δ (1900) = $+67°36'$.

[2] *A.N.*, **237**, 221, 1929.

[3] It is the north-following component of this triple star, not the south-following one, as stated by Schneller.

[4] *Veröff. Berlin-Babelsberg*, **8**, Heft 6, 49, 1931.

[5] *Rocznik astronomiczy obserwatorjum Krakowskiego*, No. 13, p. 55, 1935.

[6] *Acta astr.*, Ser. C, **2**, 137, 1936.

probably much of the difference can be ascribed to the fact that the blending of the light of the B component of the triple system on Schneller's small-scale plates would tend to mask a gently sloping shoulder of the primary minimum.

ZZ Cephei was included in the Lick Observatory spectroscopic program of the late Dr. A. B. Wyse, but only one spectrogram had been obtained prior to his death. The plate was, however, not of the best quality; and, since it could not contribute anything of value to the present study (the period being known with sufficient accuracy), it was not included in the discussion. The thirty-five spectrograms used in this investigation were obtained in 1944–1945 with the two-prism spectrograph of the 36-inch refractor and a 6-inch camera. The dispersion is 75 A/mm at $H\gamma$, and the exposures averaged about 35 minutes when the variable was outside eclipse. All but a few plates were taken on the relatively fine-grain, low-contrast Eastman II*a*–O emulsion.

The velocities given in Table 1 were grouped into eight normal places, each containing from three to five individual velocities. Table 2 contains these normal places, their probable errors as obtained from the individual plate residuals, the number of plates included, and the residuals of the normal places from the orbit of Table 3.

The spectroscopic elements in Table 3 were derived after several adjustments. No formal attempt was made to correct the elements by least squares in view of the large scatter of the observations; however, the final adjustments leading to the elements of Table 3 were guided by the criterion that $[pvv]$ should be a minimum. Figure 1 shows the representation of the observations with the elements in Table 3.

Between eclipses the spectrum of ZZ Cephei is of type[7] B7. The hydrogen lines are strong and broad, but the weaker lines do not suggest a large velocity of rotation. The micrometer settings on the lines were rather uncertain, as is evidenced by the large probable error of the velocity from a single plate, ± 14.4 km/sec. The B7 star dominates the photographic region, but a few very weak metallic lines, notably λλ 4383 (*Fe* I), 4325 (*Fe* I + *Sc* II), 4307 (*Fe* I + *Ti* II), 4271 (*Fe* I), and 4045 (*Fe* I), were usually present on good plates at all phases and served to define the velocity-curve of the fainter component. Only near the nodes did the difference in velocity between the two stars become sufficiently large to reveal the duplicity of the hydrogen lines. A good spectrogram taken at mid-primary eclipse (phase 0.999 period) revealed the fainter star to be of spectral type F0 V.

Measurements of the sharp and moderately strong K line in the B7 star give a mean velocity of -21.5 km/sec. The component of the velocity of the sun in the direction of ZZ Cephei is -11.1 km/sec. The K line is not entirely stationary, however, for the individual plates show a tendency toward a slight sinusoidal wave in the velocities, of semi-amplitude about 15 km/sec, and in phase with the velocity-curve of the B7 star. This is probably due to the blending of the predominant interstellar K line with that of the B7 star.

The slit width used for the spectrograms of ZZ Cephei was 0.10 mm, which corresponds to 1\".3 in angular measure in the focal plane of the 36-inch objective. The perpendicular distance from the slit (which was placed east-west) to component B was 3\".4 when the variable was on the slit. It is quite conceivable that there was an unconscious tendency in the guiding to overemphasize the necessity of keeping component B off the slit. In good seeing, when the star image (in photographic light) falls almost entirely within the slit jaws, this would tend to introduce a guiding error which would operate to produce positive (O−C) residuals with telescope east of pier, and negative residuals with telescope west. The residuals of the B7 star seem to show such an effect, as exhibited in Table 4.

When the residuals are weighted according to the quality of the seeing, the effect be-

[7] All spectral types in this paper are on the Yerkes system of Morgan, Keenan, and Kellman, *An Atlas of Stellar Spectra* (Chicago: University of Chicago Press, 1943).

comes very much more conspicuous. The very large scatter, as well as the fewer plates, mask such a tendency in the velocities of the F0 star. Such an effect is a combination of the guiding error and of the systematic differences, peculiar to the spectrograph and arising from flexure and collimation effects, between velocities determined with telescope east and west of the pier.[8] The uncertainty in the value of these mean residuals is so

TABLE 1

SPECTROGRAPHIC OBSERVATIONS OF ZZ CEPHEI

Plate No.	Date (Geocentric U.T.)	JD 2431+ (Heliocentric G.M.T.)	Velocity (Km/Sec)		Phase (Period)	Mean Phase
			B7 Star	F0 Star		
29910	1944 Sept. 28, 8^h35^m	361.858	+ 1.8	+ 98.	0.048	
30251	1945 Jan. 24, 2 54	479.621	− 45.2	....	.031	0.021
30252	1945 Jan. 24, 3 40	479.653	− 88.6	+ 36.	.046	
30567	1945 June 16, 11 13	622.967	− 10.1	....	.958	
29741	1944 Aug. 10, 7 43	312.822	−102.8	+132.	.152	
29913	1944 Sept. 28, 12 54	362.039	− 48.6	....	.132	
30034	1944 Nov. 8, 6 12	402.761	−106.0	+157.	.145	.142
30035	1944 Nov. 8, 6 50	402.787	−119.4	....	.157	
30186	1945 Jan. 7, 4 29	462.688	− 75.3	+179.	.124	
30104	1944 Dec. 4, 2 30	428.606	−101.3	....	.212	
30105	1944 Dec. 4, 3 06	428.631	− 86.3	....	.224	.232
30307	1945 Feb. 17, 3 08	503.629	−106.6	....	.241	
30308	1945 Feb. 17, 3 40	503.651	−144.5	+170.	.251	
29921	1944 Oct. 3, 6 42	366.781	− 67.4	....	.346	
29922	1944 Oct. 3, 8 27	366.854	− 75.4	....	.380	
30100	1944 Nov. 28, 2 58	422.626	− 59.5	....	.420	.402
30152	1944 Dec. 13, 3 06	437.631	− 47.8	+ 55.	.426	
30153	1944 Dec. 13, 3 42	437.656	− 68.7	+ 36.	.438	
30003	1944 Oct. 23, 2 53	386.622	+ 63.4	....	.610	
30004	1944 Oct. 23, 3 34	386.651	+ 22.5	....	.624	.594
30191	1945 Jan. 8, 2 18	463.597	+ 26.8	− 78.	.549	
30239	1945 Jan. 23, 4 19	478.680	+ 27.0	−145.	.591	
29766	1944 Aug. 22, 5 09	324.716	+102.4	....	.706	
29951	1944 Oct. 6, 7 09	369.800	+ 90.1	....	.756	.739
30579	1945 June 22, 11 02	628.958	+ 73.2	−189.	.755	
29954	1944 Oct. 6, 9 58	369.918	+ 58.6	....	.811	
29995	1944 Oct. 19, 8 34	382.859	+ 48.5	....	.853	
29996	1944 Oct. 19, 9 06	382.881	+ 77.2	....	.864	.854
30045	1944 Nov. 16, 5 33	410.733	+ 56.9	....	.867	
30046	1944 Nov. 16, 6 10	410.755	+ 60.7	−162.	.877	
29584	1944 June 3, 10 37	245.940	+ 24.4	....	.926	
29983	1944 Oct. 17, 6 28	380.771	+ 34.8	....	.878	
29984	1944 Oct. 17, 7 00	380.794	+ 36.6	....	.888	0.907
29998	1944 Oct. 19, 11 51	382.996	+ 11.8	−142.	.917	
29999	1944 Oct. 19, 12 20	383.016	+ 11.4	....	.927	
30588	1945 June 29, 9 46	635.906	....	− 10.4	0.999	

[8] For a provisional determination of the amount of this systematic effect see R. J. Trumpler, *Lick Obs. Bull.*, **18**, No. 494, 172, 1938.

large that they were not applied as corrections to the individual velocities. The principal effect of such a correction would be to displace the γ-axis; the effect on the other elements would be small.

ADS 16252-B.—The B component of ADS 16252 is located at $d = 3\rlap{.}''6$, $p = 202°$ (from ZZ Cephei), and is of photovisual magnitude 10.2. The measurements of relative position given in Aitken's *Catalogue*, supplemented by a photographic position deter-

TABLE 2

NORMAL VELOCITIES OF B7 COMPONENT OF ZZ CEPHEI

Phase (Period)	Velocity (Km/Sec)	P.E. (Km/Sec)	No. of Plates	Residual (O−C) (Km/Sec)	Phase (Period)	Velocity (Km/Sec)	P.E. (Km/Sec)	No. of Plates	Residual (O−C) (Km/Sec)
0.021....	− 39.4	±13.1	4	− 9.9	0.594....	+ 35.9	± 7.7	4	+ 3.1
.142....	90.7	7.4	5	− 2.5	.739....	89.7	8.0	3	+ 9.7
.232....	110.1	8.0	4	− 1.5	.854....	61.3	4.6	5	+ 1.9
0.402....	− 65.2	± 5.7	5	−10.8	0.907....	+ 23.2	± 4.2	5	−12.1

TABLE 3

SPECTROSCOPIC ELEMENTS OF ZZ CEPHEI

P (assumed) = 2.141800 days	K_2 = 205.0 km/sec
T = phase 0.699 period, counted from primary minimum	$a_1 \sin i = 2.80 \times 10^6$ km
	$a_2 \sin i = 6.03 \times 10^6$ km
$\gamma = -17.4$ km/sec	$m_1 \sin^3 i = 4.10\ \odot$
$e = 0.03$	$m_2 \sin^3 i = 1.90\ \odot$
$\omega_1 = 340°$	$m_1/m_2 = 2.16$
$K_1 = 95.0$ km/sec	

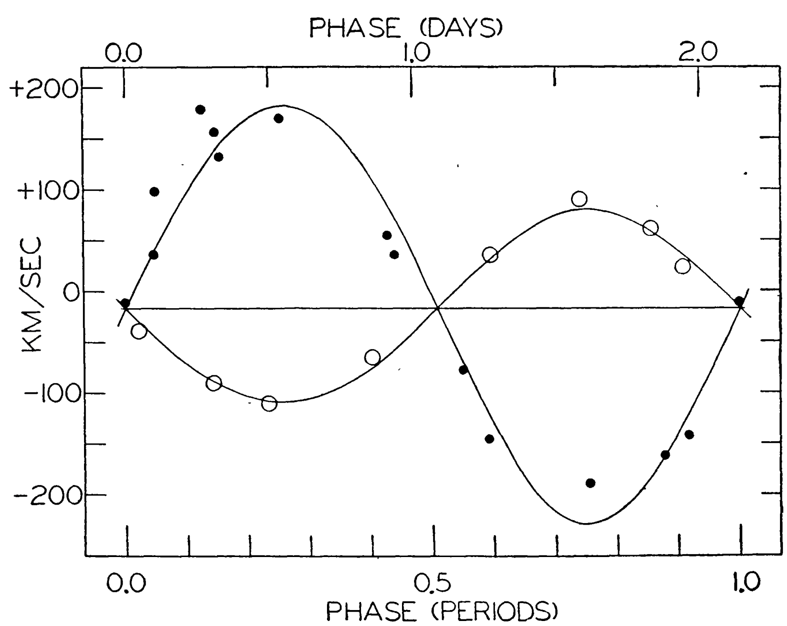

FIG. 1.—The velocity-curves of ZZ Cephei. The open circles represent the normal velocities of the B7 component; their radii are equal to the mean probable error of the velocity of a normal place. The points represent velocities of the F0 component from individual plates.

mined with the 36-inch refractor in 1944, indicate no sensible change in separation or in position angle since 1849. The spectrum of ADS 16252-B is of type A2p. The *Si* II pair, λλ 4128–4130, is very strong, and the K line is very weak for the spectral type; *Sr* II λ 4077 is also rather strong. Several lines of *Cr* II and *Eu* II, which are often fairly prominent, are at other times very faint or absent. The most prominent variable lines are *Eu* II λ 3930.50, λ 4205.05, and *Cr* II λ 3979.51, λ 4012.50. Another member of the $a^9S^o - z^9P$ multiplet of *Eu* II, to which λ 4205.05 belongs, is located at λ 4129.73, between the two *Si* II lines, and undoubtedly contributes to their strength. A persistent displacement of *Sr* II λ 4077 toward the violet by about 0.5 A might be explained by the presence of the *Cr* II line at λ 4076.87.

A majority of the spectrograms of ADS 16252-B were taken on the rather grainy Eastman 103*a*–O emulsion, with the result that estimates of the strengths of the variable lines are somewhat uncertain. Although the observations do not rule out the possibility that all the lines do not vary precisely in phase with one another, the following elements

TABLE 4

VELOCITY RESIDUALS OF B7 STAR

	Mean Residual	P.E.	No. of Plates
Telescope east..................	+0.7 km/sec	±2.7 km/sec	28
Telescope west..................	−1.7	±5.0	7

were found to represent satisfactorily the general variation of line intensities on the twenty-four plates available:

$$\text{Maximum intensity} = \text{JD } 2431308.0 + 3^{d}.770\,E\,.$$

The star probably is a member of W. W. Morgan's chromium-europium group of spectrum variables.[9] The radial velocity of ADS 16252-B, based on measures of nineteen spectrograms, is -0.6 ± 1.9 km/sec. There is no indication of any variation in the velocity.

ADS 16252-C.—The faintest component of ADS 16252 is located at $d = 20''.6$, $p = 219^\circ$; the photovisual magnitude is 11.0. Double-star measurements indicate no sensible relative motion since 1849. The spectrum is quite normal and is of class A5 V. The radial velocity from three plates is -5.4 ± 2.6 km/sec.

The distances of the three components of the visual system from the sun, as judged from the absolute magnitudes corresponding to the apparent magnitudes and spectral types, may be of the same order, about 600 parsecs; but the evidence of the relative radial velocities leaves little choice except the conclusion that the A−B system is not a physical one, unless the B component possesses variable radial velocity. The absence of relative motion is of little significance in view of the very small proper motions to be expected of such distant stars.

II. UY VIRGINIS

The variability of UY Virginis[10] (=BD−18°3528 = HD 113158 [A3] = HV 3603) was discovered by Miss A. J. Cannon[11] on the Harvard plates; she listed six dates on

[9] *Ap. J.*, **74**, 24, 1931.

[10] α (1900) = $12^h56^m.6$; δ (1900) = $-19°15'$.

[11] *Harvard Circ.*, No. 231, 1922.

which the star was faint. E. Hartwig[12] derived the light-elements

$$\text{Min} = \text{JD } 2421697.0 + 1^{\text{d}}.998\,\text{E},$$

apparently from the dates given by Miss Cannon. F. Henz[13] obtained the elements

$$\text{Min} = \text{JD } 2424302.399 + 1^{\text{d}}.99955\,\text{E}$$

from observations of the beginning of four minima and the end of two minima, those phases being well defined. F. Lause[14] found that the variable was not faint in 1937 at the times predicted by Henz's 1925 elements; minima observed in 1937 by O. Morgenroth[14] also did not fit Henz's elements. J. Gadomski[15] was unable to represent either the published times of minima or his own observations by linear elements; he suggested the elements

$$\text{Min} = \text{JD } 2424302.399 + 1^{\text{d}}.9982\,\text{E}$$

for the year 1938. Lause[16] obtained the elements

$$\text{Min} = \text{JD } 2428285.499 + 1^{\text{d}}.99441\,\text{E}$$

from his own observations in 1936 and 1937; he agreed that the minima could not be fitted to linear elements. Gadomski[17] announced that the true period was one-third of that previously accepted, and he derived the elements

$$\text{Min} = \text{JD } 2424302.40 + 0^{\text{d}}.666063\,\text{E}.$$
$$\text{p.e.}\,(\pm 0.02) \qquad (\pm 0^{\text{d}}.000003)$$

In 1946, Mrs. Cecilia H. Payne-Gaposchkin very kindly communicated to the writer a set of accurate, unpublished elements which she had obtained from Harvard photographs:

$$\text{Min} = \text{JD } 2430999.969 + 1^{\text{d}}.99447584\,\text{E}.$$

These elements were found to fit the spectrographic observations satisfactorily, which was not the case with Gadomski's period of 0.666 day. The Harvard elements have been used throughout this paper.

The Lick spectrographic observations of UY Virginis listed in Table 5 were begun by Wyse, who obtained nine spectrograms in 1936 with the two-prism spectrograph and 6-inch camera attached to the 36-inch refractor. An additional series of spectrograms was exposed by the writer in 1944, 1945, and 1946 with the same equipment. The majority of the 1944–1946 plates were taken on either Eastman 103*a*-O or II*a*-O emulsion; the exposures averaged about 20 minutes. The plates were measured with a micrometer microscope and were reduced with the aid of the wave lengths recommended for A-type stars by Commission 30 (Radial Velocities) of the I.A.U.[18] The probable error of the velocity given by a single plate, as determined by the residuals from the adopted velocity-curve, is ±4.7 km/sec.

[12] *V.J.S.*, **57**, 207, 1922.

[13] *Beob. Zirk.*, **8**, No. 19, 39, 1926.

[14] *A.N.*, **263**, 165, 1937.

[15] *A.N.*, **263**, 166, 1937.

[16] *Op. cit.*, **263**, 381, 1937; **264**, 107, 1937.

[17] *A.N.*, **264**, 327, 1937.

[18] *Trans. I.A.U.*, **4**, 188, 1932.

TABLE 5

SPECTROGRAPHIC OBSERVATIONS OF UY VIRGINIS

Plate No.	Date (Geocentric U.T.)	JD 24+ (Geocentric)	Velocity (Km/Sec)	Heliocentric Phase (Period)
23398	1936 Feb. 7, 9^h46^m	28205.907	−43.1	0.101
23399	1936 Feb. 7, 10 47	28205.949	−32.1	.122
23443	1936 Mar. 4, 9 49	28231.909	−40.7	.139
23444	1936 Mar. 4, 10 49	28231.951	−20.1	.160
23402	1936 Feb. 7, 13 10	28206.049	−25.5	.172
23415	1936 Feb. 26, 9 59	28224.916	+66.1	.633
23503	1936 Mar. 19, 8 48	28246.867	+66.1	.639
23580	1936 May 22, 4 40	28310.694	+66.0	.640
23474	1936 Mar. 13, 9 30	28240.896	+70.5	.645
29518	1944 May 5, 4 17	31215.679	−22.3	.156
29519	1944 May 5, 4 58	31215.707	−12.9	.170
30536	1945 May 3, 4 54	31578.704	−27.5	.171
30895	1946 Jan. 9, 12 30	31830.021	−28.6	.176
30537	1945 May 3, 5 17	31578.720	−32.4	.180
29520	1944 May 5, 5 41	31215.737	−23.7	.185
30896	1946 Jan. 9, 13 03	31830.044	−23.4	.187
30897	1946 Jan. 9, 13 35	31830.066	−15.5	.198
29521	1944 May 5, 6 25	31215.767	−29.7	.200
29484	1944 Apr. 1, 8 58	31181.873	−42.0	.207
29485	1944 Apr. 1, 9 15	31181.885	−34.9	.213
30512	1945 Apr. 27, 7 25	31572.809	−50.3	.216
29522	1944 May 5, 7 13	31215.801	−36.6	.217
30513	1945 Apr. 27, 7 47	31572.824	−48.2	.223
29523	1944 May 5, 7 36	31215.817	−32.3	.225
29538	1944 May 9, 8 27	31219.852	−45.5	.249
30522	1945 Apr. 29, 8 54	31574.871	−50.3	.250
29539	1944 May 9, 8 50	31219.868	−45.8	.257
30523	1945 Apr. 29, 9 17	31574.887	−36.8	.258
29477	1944 Mar. 31, 6 34	31180.773	+59.2	.655
29478	1944 Mar. 31, 6 50	31180.784	+64.8	.661
30361	1945 Mar. 1, 8 50	31515.868	+83.4	.666
29479	1944 Mar. 31, 7 06	31180.796	+64.2	.667
29402	1944 Mar. 17, 8 15	31166.844	+85.8	.671
29480	1944 Mar. 31, 7 23	31180.808	+71.0	.673
30362	1945 Mar. 1, 9 13	31515.884	+75.2	.674
30363	1945 Mar. 1, 9 36	31515.900	+76.4	.682
30364	1945 Mar. 1, 9 58	31515.915	+89.1	.690
29404	1944 Mar. 17, 9 15	31166.886	+92.8	.692
29365	1944 Feb. 16, 11 44	31136.989	+75.2	.701
30365	1945 Mar. 1, 10 33	31515.940	+82.7	.702
29405	1944 Mar. 17, 9 51	31166.911	+81.7	.705
30366	1945 Mar. 1, 10 54	31515.954	+84.7	.709
29366	1944 Feb. 16, 12 26	31137.017	+86.3	.715
30367	1945 Mar. 1, 11 17	31515.970	+76.3	.717
30368	1945 Mar. 1, 11 39	31515.985	+84.0	.725
30562	1945 June 15, 4 38	31621.693	+84.6	.725
29367	1944 Feb. 16, 13 07	31137.047	+84.2	.730
30563	1945 June 15, 5 03	31621.711	+92.2	.734
31087	1946 Apr. 24, 9 26	31934.893	+80.9	.760
31149	1946 May 20, 8 08	31960.839	+74.3	.768
31088	1946 Apr. 24, 9 57	31934.914	+72.0	.770
31150	1946 May 20, 8 38	31960.860	+69.5	.778
31089	1946 Apr. 24, 10 28	31934.936	+77.4	0.781

The low declination of UY Virginis (−19°) makes it very difficult to observe at Mount Hamilton at hour-angles greater than about 3.5 hours. This circumstance, together with the fact that the period differs from 2 sidereal days by only 0.000063 day, makes it impossible to cover the entire velocity-curve in a practical length of time from a northern observatory; over 60 years would be required at Mount Hamilton. For this reason the 1944–1946 observations are confined to two regions, half a period apart, extending from phase 0.15 to 0.26 period, and from 0.65 to 0.78 period. All that can be said for the spectroscopic elements (Table 6), obtained on the basis of this restricted material, is that

TABLE 6

SPECTROSCOPIC ELEMENTS OF UY VIRGINIS

P	= 1.99447584 days (assumed)	K	= 80.0 km/sec
Epoch of primary minimum	= JD 2430999.969 (assumed)	γ	= +4.0 km/sec
		e	= 0.30
		ω	= 269°.65
T	= Phase 0.571 period = 1.139 days	$a \sin i$	= 2.09×10^6 km
		f	= 0.092 ☉

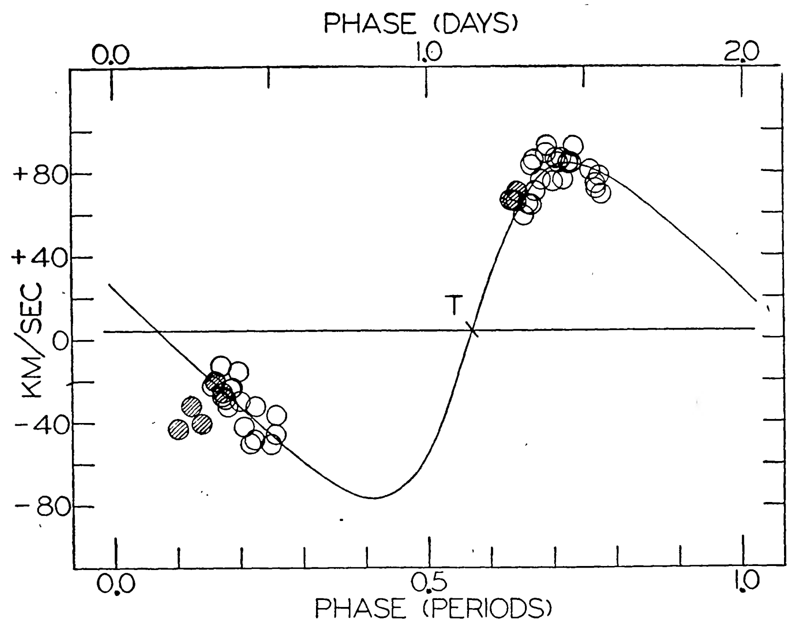

FIG. 2.—The velocity-curve of UY Virginis. The open circles represent velocities of the A7 component from individual plates exposed in 1944–1946; their radii are equal to the mean probable error of a single velocity. The shaded circles represent the 1936 spectrograms.

they represent the available observations satisfactorily. It may be that radial-velocity observations made at phases at present inaccessible from the Lick Observatory would fail to fit these elements. The elements are therefore advanced with the caution that some future revision may be necessary when the entire velocity-curve comes under observation.

The elements given in Table 6 were obtained from the 1944–1946 observations after several adjustments, and Figure 2 shows the computed velocity-curve drawn through the observations.

Only one spectrum is visible, of type A7 on the Yerkes system; the luminosity class is V. The metallic lines are sharp and well defined. The absence of any suggestion of rotational broadening was one reason for regarding a period of 0.666 day with suspicion. The 1936 spectrograms were not included in the solution for elements because of the possibility of a change in the period and because their quality is not high. Three of them, however, fall outside the portions of the velocity-curve now accessible from Mount Hamilton. Their departure from the adopted curve is in the direction to be expected of a rotational effect.

Both Gadomski and Lause were of the opinion that the times of primary minima of UY Virginis could not be predicted by linear elements. The change in the period is well shown by the deviations of the published times of primary minima from Mrs. Gaposchkin's linear elements. These residuals are summarized in Table 7.

TABLE 7

RESIDUALS OF PRIMARY MINIMA OF UY VIRGINIS FROM A CONSTANT-PERIOD EPHEMERIS

Year	Number of Minima	Mean E	Mean Residual (O−C)	Source
1925	6	−3359	$-0^{d}121$	F. Henz, *Beob. Zirk.*, **8**, 39, 1926
1929	1	2696	− .164	O. Morgenroth, *A.N.*, **263**, 165, 1937
1930	3	2461	− .099	O. Morgenroth, *A.N.*, **263**, 165, 1937
1931	1	2267	− .086	O. Morgenroth, *A.N.*, **263**, 165, 1937
1936	3	1354	+ .002	F. Lause, *A.N.*, **264**, 107, 1937
1937	9	−1170	−0.002	F. Lause, *A.N.*, **264**, 107, 1937

The phase of primary minimum, when $v + \omega = 90°$, was found from the spectroscopic elements to be 0.146 day. This residual should not be compared directly with the photometric residuals because of its sensitivity to small changes in the spectroscopic elements which may be demanded when more velocities become available. No light-curve of UY Virginis has been published, but a preliminary mean photographic curve, kindly furnished by Mrs. Gaposchkin, indicates a value of $e \cos \omega$ near $+0.02$ from the position of the secondary minimum; the spectroscopic elements of Table 2 give -0.002.

Further discussion of this difficult system must be postponed until more complete observational data are available.