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Konkoly Observatory
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REDISCUSSION OF THE PHOTOMETRIC ELEMENTS OF SW LYN

The light variation of the eclipsing binary SW Lyn has been the subject of several photoelectric investigations (Gleim 1967, Vetešník 1968, Vetešník 1977).Vetesnik(1977) also obtained a single-lined radial velocity curve, but the eccentricity reported by him is probably spurious according to Wilson's (1979) rediscussion of Vetešník's (1968) lightcurve in yellow light.

In view of the appreciably discordant photometric elements computed by Gleim (1967), Vetešník (1968), and Wilson (1979), we have reanalyzed Vetešník's (1968) two-colour photoelectric observations by using Wood's (1972; 1973-1978) lightcurve synthesis numerical model. In the table we list our new photometric elements (for the explanation of the symbols see Mardirossian et al.(1980)). The chief variable parameters are the orbital inclination angle i, the unperturbed radius r_h of the hotter component, the ratio $k=r_c/r_h$ of the unperturbed radii and the temperatures T_h and T_c of the two components. The mass ratio $q=M_c/M_h$ was also taken as a free parameter.

That no good concordance exists between our two photometric solutions emphasizes that SW Lyn is a very complicated system; for any formalized binary model it is probably difficult to represent this binary well. However, it is likely that SW Lyn is a contact system; its secondary member (probably around K0 according to our values of T_c) seems to be slightly farther from the ZAMS than its F2V companion, whenever a mass typical of dwarfs of the same spectral type is assumed for this hotter star.

Table

λ	yellow	blue
i	77.7±0.6	84.7±0.6
r_h	0.398±0.005	0.395±0.003
k	0.747±0.019	0.642±0.005
a_h	0.422	0.417
b_h	0.408	0.404
c_h	0.390	0.387
a_c	0.338	0.276
b_c	0.296	0.252
c_c	0.276	0.241
T_h(eq)	6910±110	6860±160
T_h(pol)	7200	7130
T_c(eq)	4740±40	4640±50
T_c(pol)	4820	4700
u_h	0.59	0.84
u_c	0.75	1.00
β_h	0.25	0.25
β_c	0.08	0.08
w_h	1	1
w_c	0.5	0.5
L_h	0.896	0.924
L_c	0.104	0.076
q	0.37±0.02	0.34±0.01
	1.59	1.36

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Budapest
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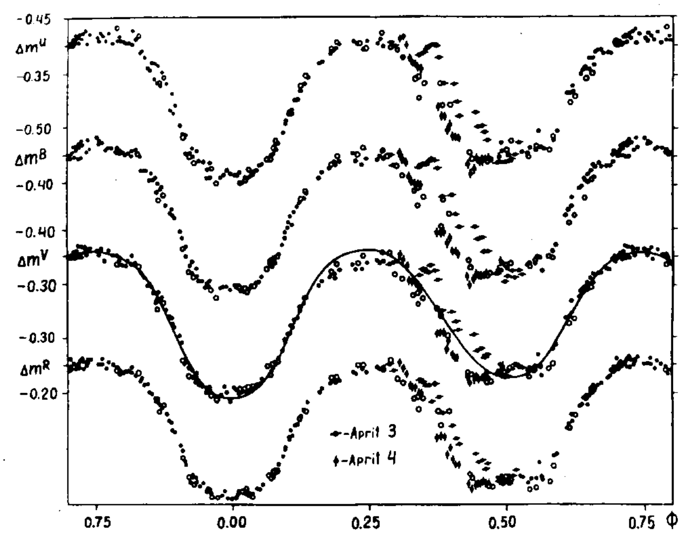
THE LIGHT VARIATION AND ORBITAL ELEMENTS OF AW UMa

1. The eclipsing system AW UMa has been observed through U, B, V and R filters from 1979 Aptil 1 - 4 to 1979 May 4 - 6 using the 20 inch reflector of Urals University Observatory.The comparison star was BD +30°2270. A total of 239 observations in each filter were obtained. The extinction coefficient for each filter was determined from the comparison star observations on each night and all the observations have been corrected for atmospheric extinction. The mean errors of a single Δm = m(var.)-m(comp.) were calculated: $0^{m}.009$; $0^{m}.009$; $0^{m}.007$ and $0^{m}.006$ in U, B, V and R, respectively. Epoch of primary minimum (determined by the method of Pogson) is J.D.hel= 2443966.3420. No significant difference was found between the times of minima determined from the U, B, V and R light curves. The O-C = -0.0097 has been computed with the ephemeris by Dworak and Kurpinska (1975). The phases, calculated from this ephemeris, were corrected by addition 0.0220 (what corresponds O - C =-0.00965). This value is arithmetical mean from April series and May series of the Min 1 observations. It is a very large value in comparison with O-C from the paper of Dworak and Kurpinska and it shows a change of the period. The individual observations are shown in Fig. 1 (dots represent April dates and circles denote May dates). All four wavelength regions show the difference in the heights of the maxima of the light curves. Large differences from observations April 3 and April 4 were obtained for the phase interval 0.30 - 0.50. It is interesting that Dworak and Kurpinska obtained the deviation of their own light curves from Paczynski's curve in the phase interval 0.25-0.45. The polarimetric observations (Oshchepkov, 1974) shows the dependence of the observed polarization degree on the phase in the same



phase interval. All these effects show the existence of non-stationary processes in this close binary system.

2. One of the authors (L.F. Istomin) derived the orbital elements of AW UMa from the yellow light curve by the method of Russell and Merrill (1952) and by the method of differential correction of Irwin (1947). Zero-point correction of $-0\overset{m}{.}36$ has been applied. The phase interval 0.67-0.83 was taken for the determination of the constants of rectification, because at maximum light at phase 0.25 a depression of light and large distortion of the descending branch of the secondary minimum have been observed. The final rectification in intensity then carried out as follow:

$$l_r = \frac{1 + 0.0145 + 0.0138\cos^2\theta}{1.0153 - 0.1203\cos^2\theta}$$

The term in the reflection effect $A_1=+0.0013 \pm 0.0027$ was discount. Constant term and the term $\cos^2\theta$ were obtained from preliminary studies. For a limb-darkening coefficient of 0.6 the rectification of the phase was made with $z = 0.1153$. The differential corrections for orbital elements a_1, a_2 and i were found by using the complete descending branch and a part of the ascending branch (0.05-0.14) of the primary minimum and the depth of the secondary minimum. The final results are: $\alpha_0^{tr}= 1.2228$ $\alpha_0^{oc}= 1.0$ $k= 0.2850 \pm 0.0024$ $i=79\overset{\circ}{.}0 \pm 1\overset{\circ}{.}1$ $a_1=0.7059 \pm 0.0030$ $a_2=0.2012 \pm 0.0008$

$b_1 = 0.6623$ $b_2 = 0.1888$ $L_1 = 0.94$ $L_2 = 0.06$ $J_1 = 1.27 J_2$.
In Fig. 1 the solid line is the theoretical light curve in V. Using b_1 and b_2 we find that the mass ratio $m_2/m_1 = 0.075$, and both components fill their Roche lobes (Plavec and Kratochvil, 1964).

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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR YZ CMi IN 1976

Continuous photoelectric monitoring of the flare star YZ CMi has been carried out at the Stephanion Observatory ($\lambda=-22^{\circ}49'44''$, $\varphi=+37^{\circ}45'15''$) during the year 1976, using the 30-inch Cassegrain reflector of the Department of Geodetic Astronomy, University of Thessaloniki. Observations have been made with a Johnson dual channel photoelectric photometer in the B colour of the international UBV System. The telescope and photometer will be described elsewhere. Here we mention only that the transformation of our instrumental ubv system to the international UBV system is given by the following equations:

$$V = v_o + 0.042(b-v)_o + 2.278,$$
$$(B-V) = 0.706 + 1.043(b-v)_o,$$
$$(U-B) = -2.550 + 1.490(u-b)_o.$$

The monitoring intervals in UT as well as the total monitoring time for each night are given in Table I. Any interruption of more than one minute has been noted. In the fourth column of Table I the standard deviation of random noise fluctuation $\sigma(\text{mag}) = 2.5 \log(I_o+\sigma)/I_o$ for different times (UT) of the corresponding monitoring intervals is given.

During the 4.53 hours of the monitoring time one flare was observed the characteristics of which are given in Table II. For this flare following characteristics (Andrews et al. 1969) are given: a) the date and universal time of flare maximum, b) the duration before and after the maximum (t_b and t_a, respectively), as well as the total duration of the flare, c) the value of the ratio $(I_f-I_o)/I_o$ corresponding of flare maximum, where I_o is the intensity deflection less sky background of the quiet star and

TABLE I

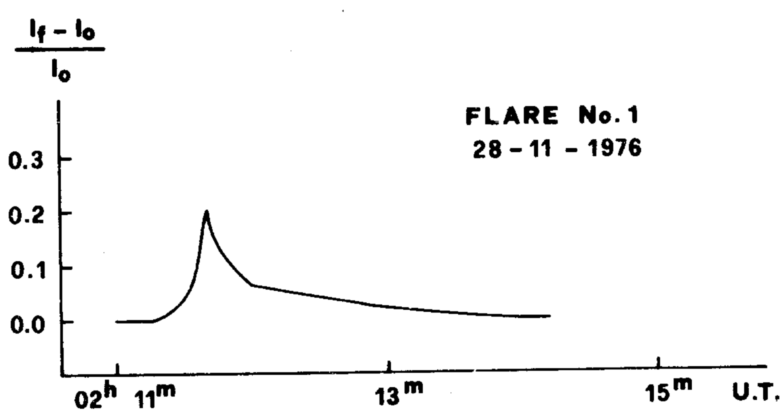
Monitoring Intervals in 1976

Date 1976 Nov	Monitoring intervals (U.T.)	Total Monitoring Time	σ(U.T.)
28	00^h54^m-01^h32^m, 01^h34^m-02^h20^m, 02^h22^m-03^h13^m.	2^h15^m	$0.05(01^h23^m)$, $0.04(02^h09^m)$, 0.04(02 51).
30	00 12 -00 56, 00 58 -01 20, 01 27 -01 33, 01 36 -01 59, 02 02 -02 15, 02 25 -02 54.	2 17	0.05(00 40), 0.06(01 13), 0.06(01 52), 0.05(02 39).
	TOTAL	4^h32^m	

TABLE II

Characteristics of the Flare Observed

Flare No	Date	U.T. max	t_b min	t_a min	Duration min	I_f-I_o/I_o max	P min	Δm mag	σ	Air mass
	1976 Nov.									
1	28	$02^h11^m.67$	0.38	2.33	2.71	0.20	0.12	0.20	0.04	1.22



I_f is the total intensity deflection less sky background of the star plus flare, d) the integrated intensity of the flare over its total duration, including pre-flares, if present, $p = \int(I_f - I_o)/I_o dt$, e) the increase of the apparent magnitude of the star at flare maximum $\Delta m(b) = 2.5 \log(I_f/I_o)$, where b is the blue magnitude of the star in the instrumental system, f) the standard deviation of random noise fluctuation $\sigma(mag) = 2.5 \log(I_o + \sigma)/I_o$ during the quietstate phase immediately preceding the beginning of the flare and g) the air mass at flare maximum. The light curve of the observed flare in the b colour is shown in Fig.1.
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Andrews, A.D., Chugainov, P.F., Gershberg, R.I. and Oskanian, V.S.: 1969, I.B.V.S. No. 326

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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR UV Cet IN 1976

Continuous photoelectric monitoring of the flare star UV Cet has been carried out at the Stephanion Observatory ($\lambda=-22^{o}49'44''$, $\varphi=+37^{o}45'15''$) during the year 1976, using the 30-inch Cassegrain reflector of the Department of Geodetic Astronomy, University of Thessaloniki. Observations have been made with a Johnson dual channel photoelectric photometer in the B colour of the international UBV System. The telescope and photometer will be described elsewhere. Here we mention only that the transformation of our instrumental ubv system to the international UBV system is given by the following equations:

$$V = v_o + 0.042(b-v)_o + 2.278,$$
$$(B-V) = 0.706 + 1.043(b-v)_o,$$
$$(U-B) = -2.550 + 1.490(u-b)_o.$$

The monitoring intervals in UT as well as the total monitoring time for each night are given in Table I. Any interruption of more than one minute has been noted. In the fourth column of Table I the standard deviation of random noise fluctuation $\sigma(\text{mag}) = 2.5 \log(I_o+\sigma)/I_o$ for different times (UT) of the corresponding monitoring intervals is given.

During the 6.20 hours of the monitoring time 2 flares were observed the characteristics of which are given in Table II.For each flare following characteristics (Andrews et al. 1969) are given: a) the date and universal time of flare maximum, b) the duration before and after the maximum (t_b and t_a, respectively), as well as the total duration of the flare, c) the value of the ratio $(I_f-I_o)/I_o$ corresponding to flare maximum, where I_o is the intensity deflection less sky background of the quiet star and I_f is the total intensity deflection less sky background of the star plus flare, d) the integrated intensity of the flare over

TABLE I

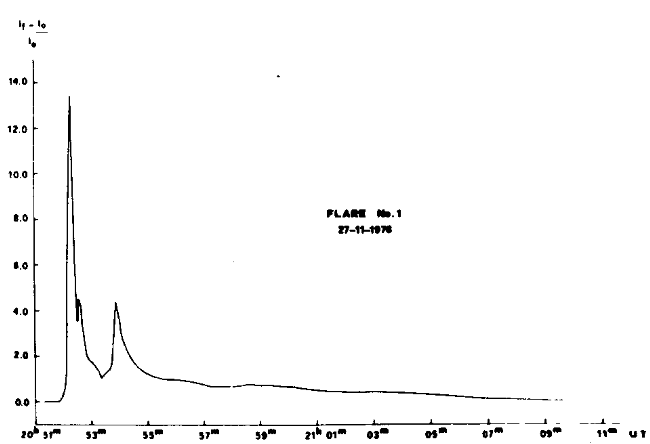
Monitoring intervals in 1976

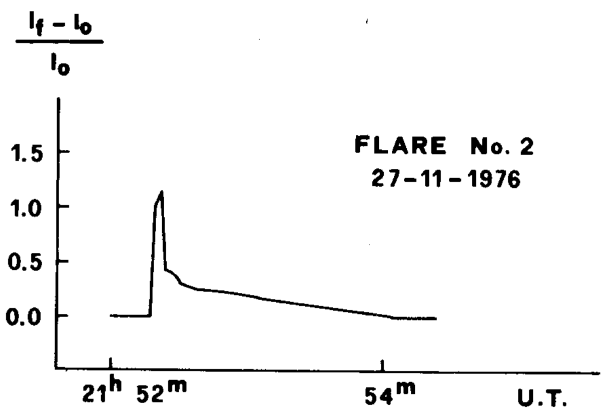
Date 1976 Nov.	Monitoring intervals (U.T.)	Total Monitoring Time	σ(U.T.)
21	$18^h44^m-19^h21^m$, $19^h23^m-20^h02^m$, $20^h05^m-20^h36^m$,		$0.13(19^h03^m)$, $0.13(19^h42^m)$,
	20 47 -21 08, 21 15 -21 46, 21 52 -22 12,		0.13(20 15),0.14(20 59),
	22 14 -22 27.	3^h12^m	0.14(21 33),0.16(22 02).
27	19 28 -20 00, 20 02 -20 32, 20 35 -21 09,		0.20(19 42),0.18(20 19),
	21 11 -21 31, 21 35 -21 43, 21 45 -22 03,		0.13(20 50),0.15(21 16),
	22 14 -22 26, 22 27 -22 38, 22 44 -22 55,		0.09(21 51),0.12(22 30).
	22 59 -23 03.	3^h00^m	
	TOTAL	6^h12^m	

TABLE II

Characteristics of the Flares Observed

Flare No	Date 1976 Nov.	U.T. max.	t_b min	t_a min	Duration min	I_f-I_o/I_o max	P min	Δm mag	σ mag	Air mass
1	27	$20^h52^m.29$	0.48	16.92	17.40	13.40	15.30	2.90	0.13	1.91
		20 53.89				4.39		1.83		1.91
2	27	21 52.36	0.07	1.73	1.80	1.16	0.39	0.84	0.09	2.28





its total duration, including pre-flares, if present, $p=\int(I_f-I_o)/I_o dt$, e) the increase of the apparent magnitude of the star at flare maximum $\Delta m(b)=2.5\log(I_f/I_o)$, where b is the blue magnitude of the star in the instrumental system, f) the standard deviation of random noise fluctuation $\sigma(mag) = 2.5\log(I_o+\sigma)/I_o$ during the quiet-state phase immediately preceding the beginning of the flare and g) the air mass at flare maximum. The light curves of the observed flares in the b colour are shown in Figs. 1-2.

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UBV - OBSERVATIONS OF SOME CATACLYSMIC VARIABLES

I. Observations

11 cataclysmic variables were observed in the four nights from July 15th to July 18th, 1979, with the 1 m-telescope of the Florence and George Wise Observatory of the University of Tel Aviv, Israel. Among them are seven old novae, two recurrent novae, one dwarf nova (WZ Sge, formerly considered a recurrent nova) and the novalike object Vulpecula 1979, which was near maximum during the time of observation. The telescope was equipped with a photoelectric two-channel-photometer. The measurements were made with UBV-filters. In order to determine the extinction and to tie the instrumental system to the international UBV-system some standard stars given by Landolt (1973) were observed several times each night.

As a rule the stars were observed during several nights for a few minutes at a time. Therefore statements about light and colour variations within one night are somewhat speculative. However, differences from night to night can be determined. Only HR Del (in four nights), V 841 Oph and V 603 Aql (each in one night) were observed for a longer time in order to obtain light curves. The B and V measurements were made with integration times of 5 seconds, the U measurements with those of 10 seconds.

The results of the observations are given in Table I. For each observing night the number of measurements for each star, the resulting V

TABLE I

Observational data

Star	Type	Number of obs.	Date (UT) 1979 July	V	B–V	U–B	Phase	Reference
V 603 Aql	N	21	16.91	11.58 ± 0.02	−0.06 ± 0.01	−0.98 ± 0.01		
		21	17.82	11.80 ± 0.03	−0.07 ± 0.02	−0.94 ± 0.01		
		217	18.79 – 18.85	11.44 ± 0.10	−0.07 ± 0.02	−0.99 ± 0.02		
T CrB	RN	36	15.79	9.90 ± 0.01	1.37 ± 0.02	0.58 ± 0.07		
		21	17.78	9.88 ± 0.01	1.40 ± 0.02	0.59 ± 0.06		
		21	18.77	9.95 ± 0.01	1.42 ± 0.01	0.71 ± 0.04		
Q Cyg	N	21	16.89	14.94 ± 0.18	0.31 ± 0.19	−0.71 ± 0.07		
		21	17.93	15.13 ± 0.20	0.29 ± 0.21	−0.83 ± 0.11		
HR Del	N	416	15.93 – 16.06	11.89 ± 0.06	0.15 ± 0.04	−1.03 ± 0.03	0.24 – 0.98	Hutchings (1979)
		341	16.96 – 17.06	11.95 ± 0.08	0.13 ± 0.05	−1.02 ± 0.03	0.21 – 0.84	Hutchings (1979)
		199	17.98 – 18.04	11.87 ± 0.04	0.14 ± 0.03	−1.03 ± 0.04	0.19 – 0.55	Hutchings (1979)
		377	18.94 – 19.06	11.86 ± 0.06	0.18 ± 0.02	−1.00 ± 0.02	0.84 – 0.51	Hutchings (1979)
DQ Her	N	21	16.79	14.72 ± 0.12	0.04 ± 0.13	−0.78 ± 0.05	0.47 – 0.50	Schneider, Greenstein (1979)
		21	17.89	14.78 ± 0.15	0.03 ± 0.13	−0.69 ± 0.06	0.15 – 0.18	Schneider, Greenstein (1979)
DI Lac	N	21	18.90	14.43 ± 0.12	0.13 ± 0.11	−0.75 ± 0.04		
HR Lyr	N	15	15.85	15.82 ± 0.28	0.01 ± 0.25	−1.06 ± 0.11		
		21	17.81	15.00 ± 0.28	0.30 ± 0.27	−0.60 ± 0.14		
RS Oph	RN	15	15.92	11.52 ± 0.04	0.98 ± 0.02	−0.09 ± 0.02		
		26	16.90	11.47 ± 0.05	0.93 ± 0.02	−0.16 ± 0.02		
		21	17.79	11.26 ± 0.03	0.92 ± 0.02	−0.21 ± 0.02		
		21	18.79	11.50 ± 0.04	0.92 ± 0.02	−0.17 ± 0.02		
V 841 Oph	N	192	16.81 – 16.87	13.50 ± 0.08	0.33 ± 0.08	−0.55 ± 0.05		
		21	18.86	13.36 ± 0.06	0.40 ± 0.05	−0.59 ± 0.04		
WZ Sge	UG	12	15.88	14.49 ± 0.13	0.00 ± 0.11	−1.07 ± 0.03	0.55 – 0.60	Robinson et al. (1978)
		21	17.91	14.75 ± 0.15	0.17 ± 0.14	−0.91 ± 0.08	0.42 – 0.51	Robinson et al. (1978)
Nova Vul 1979	N ?	11	15.91	8.814 ± 0.003	0.431 ± 0.004	0.321 ± 0.003		
		11	16.92	8.850 ± 0.005	0.445 ± 0.006	0.341 ± 0.005		
		21	17.95	8.856 ± 0.009	0.445 ± 0.008	0.361 ± 0.008		
		16	18.87	8.849 ± 0.007	0.447 ± 0.008	0.331 ± 0.008		

magnitudes and the B-V, U-B colour indices are listed. The noted errors are standard deviations resulting from the differences between the single measurements and the mean. In case of intrinsic light variations of the star, these errors contain a systematic contribution and are thus larger than the statistical error. This applies particularly to the objects observed for long time intervals, where the variations were sometimes considerable.

For binaries with known ephemerides (obtained from the references quoted) the table contains the phase during which the observations were made. In the case of T CrB the errors in the ephemerides of Paczynski (1965) are so large that it is not meaningful to give the phases of the observations.

II. Discussion

Almost all objects show significant light variations from night to night. Colour variations - though not in all cases significant - are also present. These results are in agreement with measurements of the same objects by other authors. For the fainter stars colour variations may be masked by the larger statistical errors. For objects with short duration of observing runs light variations on short time scales were not noticed. Only T CrB ond July 17th and RS Oph on July 15th, 16th and 17th show intensity variations within a few minutes. The corresponding fragmentary U light curves are reproduced in Figure 1. The scale of the abscissa is 5 minutes.

It is known that such flickering is typical for cataclysmic variables and confirmed by the longer observing runs of HR Del, V 841 Oph and V 603 Aql. The light curves of these stars are shown in Figure 2a-c. The large scatter of the data points in some light curves does not

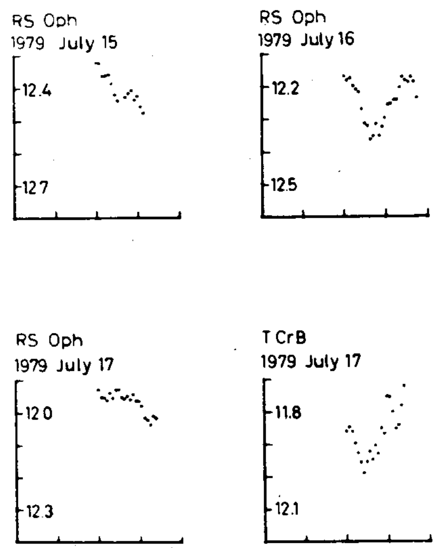

Fig. 1 Fragmentary U light curves of RS Oph and T CrB. The scale of the abscissa is 5 minutes.

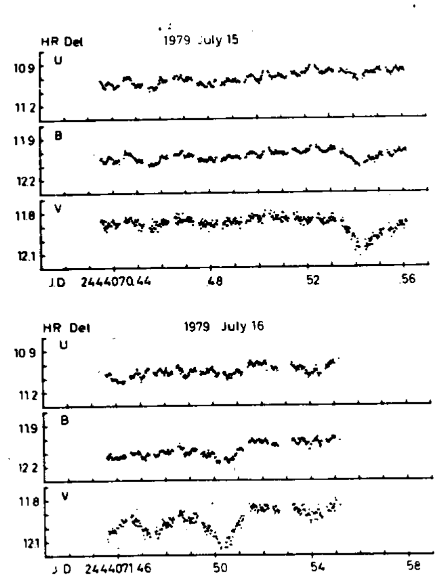

Fig 2a

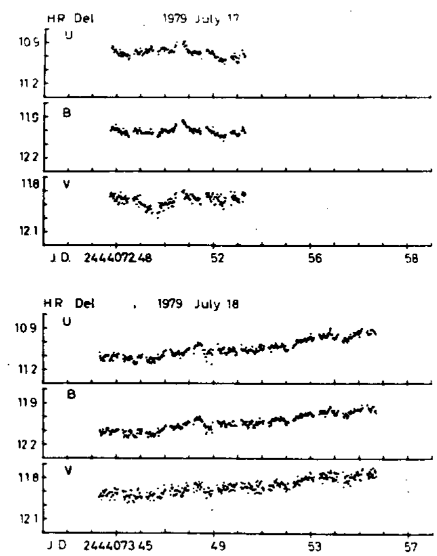

Fig 2b

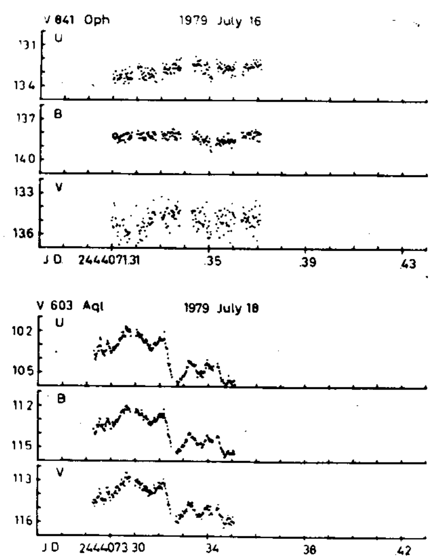

Fig. 2c

Fig. 2a-c UBV light curves of HR Del, V 841 Oph and V 603 Aql.

indicate intrinsic variability on a short time scale. There is a clear dependence of the amplitude of the scatter upon the mean counting rate of the photometer, proving that it arises from photon statistics. The light curves in different colours are quite similar for V 841 Oph and V 603 Aql, indicating that colour variations do not occur on time scales less than a few hours. For HR Del the short term low amplitude variations are also remarkably similar in all 3 colours. However, the "deep" minima show strong colour dependence and are increasingly stronger in the long wavelength bands.

None of the observed light curves exhibits strictly periodic phenomena, but the well defined minima in the light curves of HR Del may be related to each other. Since no period derived from these minima is in agreement with either Hutchings' (1979) or Tempesti's (1979) period, I refrain from giving still another value, especially since the geometry of the system as derived by Hutchings is unlikely to lead to eclipses. It is possible that HR Del shows transient quasi-periodic light minima, the cause of which is unknown.

The amplitudes of the light variations of HR Del are rather small compared to those of other cataclysmic variables as already noticed in (unpublished) observations of HR Del of September 1977, August 1978 and October 1978. The present variations of V 841 Oph are very small in contrast to observations made in August 1978, when in all colours amplitudes of up to $0\overset{m}{.}3$ within a few minutes were normal. Of all observed stars V 603 Aql shows the largest light variations (apart from the night to night variations of HR Lyr). In this case no light curves from other epochs are available for comparison.

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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR UV Cet IN 1975

Continuous photoelectric monitoring of the flare star UV Cet has been carried out at the Stephanion Observatory ($\lambda=-22^{\circ}49'44''$, $\varphi=+37^{\circ}45'15''$) during the year 1975, using the 30-inch Cassegrain reflector of the Department of Geodetic Astronomy, University of Thessaloniki. Observations have been made with a Johnson dual channel photoelectric photometer in the B colour of the international UBV system. The telescope and photometer will be described elsewhere. Here we mention only that the transformation of our instrumental ubv system to the international UBV system is given by the following equations:

$$V = v_o + 0.059(b-v)_o + 2.368,$$
$$(B-V) = 0.737 + 1.035(b-v)_o,$$
$$(U-B) = -1.675 + 1.122(u-b)_o.$$

The monitoring intervals in UT as well as the total monitoring time for each night are given in Table I. Any interruption of more than one minute has been noted. In the fourth column of Table I the standard deviation of random noise fluctuation $\sigma(\mathrm{mag}) = 2.5\log(I_o+\sigma)/I_o$ for different times (UT) of the corresponding monitoring intervals is given.

During the 13.12 hours of the monitoring time 3 flares were observed the characteristics of which are given in Table II. For each flare following characteristics (Andrews et al. 1969) are given: a) the date and universal time of flare maximum, b) the duration before and after the maximum (t_b and t_a, respectively), as well as the total duration of the flare, c) the value of the ratio $(I_f-I_o)/I_o$ corresponding to flare maximum, where I_o is the intensity deflection less sky background of the quiet star and I_f is the total intensity deflection less sky background of the

TABLE I

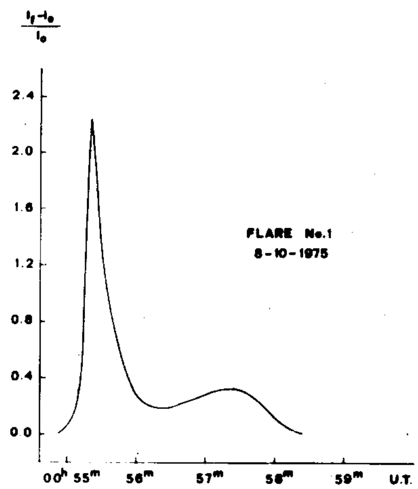
Monitoring intervals in 1975

Date 1975	Monitoring intervals (U.T.)	Total Monitoring Time	σ(U.T.)
Oct.			
2	00^h36^m-01^h16^m, 01^h20^m-01^h42^m, 01^h46^m-02^h14^m.	01^h30^m	0.09(00^h37^m),0.13(01^h23^m), 0.12(01 48).
3	00 37 -01 05, 01 08 -01 35, 01 38 -02 05.	01 22	0.13(00 48),0.12(01 22), 0.13(01 51).
4	00 19 -01 01, 01 08 -01 34, 01 37 -01 59.	01 30	0.14(00 39),0.12(01 21), 0.15(01 48).
8	00 07 -00 41, 00 43 -01 16, 01 22 -01 59.	01 44	0.14(00 24),0.14(00 58), 0.22(01 40).
9	00 00 -00 42, 00 45 -01 13, 01 17 -01 43.	01 36	0.18(00 21),0.16(00 59), 0.16(01 30).
12	00 07 -00 46, 00 49 -01 18, 01 21 -01 51.	01 38	0.20(00 27),0.17(01 05), 0.17(01 36).
Dec.			
8	21 07 -21 38, 21 42 -22 00.	00 49	0.11(21 09),0.09(21 45).
9	18 17 -18 53, 18 56 -19 27, 19 31 -20 00, 20 19 -20 44, 20 50 -21 20, 21 25 -21 41, 21 44 -21 55.	02 58	0.18(18 18),0.22(18 51), 0.21(19 33),0.23(20 20), 0.18(20 52),0.17(21 26).
	TOTAL	13^h07^m	

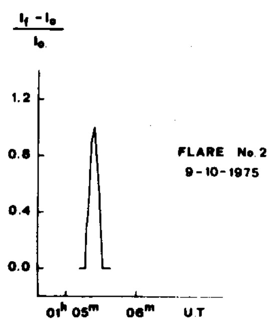
TABLE II

Characteristics of the Flares Observed

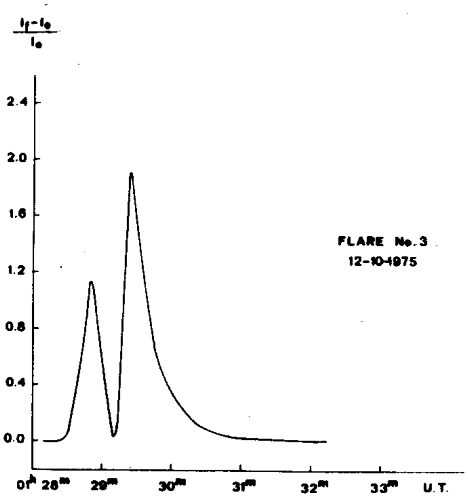
Flare No	Date	U.T. max	t_b min	t_a min	Duration min	I_f-I_o/I_o max	P min	Δm mag	σ mag	Air mass
	1975 Oct.									
1	8	$00^h55^m.36$	0.48	3.08	3.56	2.28	1.44	1.29	0.14	2.11
2	9	01 05.38	0.08	0.12	0.20	1.04	0.17	0.77	0.16	2.22
3	12	01 29.39	1.00	3.13	4.13	1.90	1.13	1.16	0.17	2.63



$\frac{I_f - I_o}{I_o}$
2.4
2.0
1.6
1.2
0.8
0.4
0.0
FLARE No.1
8-10-1975
00h 55m
56m
57m
58m
59m
U.T.



$\frac{I_f - I_o}{I_o}$
1.2
0.8
0.4
0.0
FLARE No.2
9-10-1975
01h 05m
06m
U.T



$\frac{I_f - I_o}{I_o}$
2.4
2.0
1.6
1.2
0.8
0.4
0.0
FLARE No.3
12-10-1975
01h 28m
29m
30m
31m
32m
33m
U.T.

star plus flare, d) the integrated intensity of the flare over its total duration, including pre-flares, if present, $p = \int (I_f - I_o)/I_o dt$, e) the increase of the apparent magnitude of the star at flare maximum $\Delta m(b) = 2.5 \log(I_f/I_o)$, where b is the blue magnitude of the star in the instrumental system, f) the standard deviation of random noise fluctuation $\sigma(mag) = 2.5 \log(I_o+\sigma)/I_o$ during the quiet-state phase immediately preceding the beginning of the flare and g) the air mass at flare maximum. The light curves of the observed flares in the b colour are shown in Figs. 1-3.

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Reference:

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Budapest
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RADIUS VARIATION OF TEN CLASSICAL CEPHEIDS

In a recent paper by Caccin et al. (1980) a method has been presented which, under essentially the same physical assumptions than the Baade-Wesselink one (Wesselink, 1946), allows a more accurate and unique determination of the mean radius of classical cepheids, through a global treatment of light, colour and velocity curves. We have used this method to determine the radii of ten well observed cepheids of various period. For the light and colour curves we have used the V and B-V data from the Tonantzintla Catalogue by Mitchell et al. (1964), whereas for the radial velocity u we used data from different authors (see note).

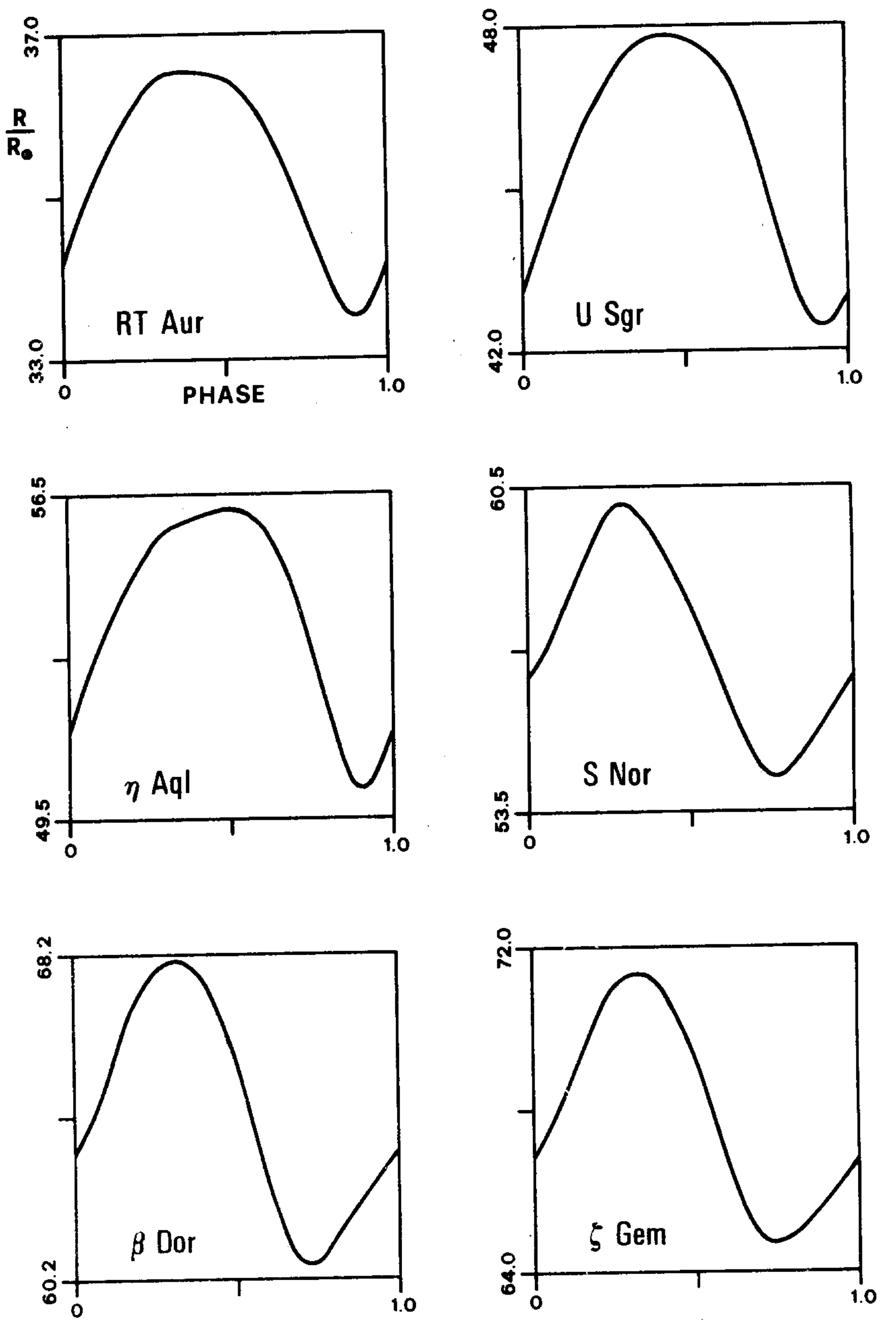
Following the procedure described by Caccin et al., Fourier series have been fitted to these data, and the radius R_o at the phase ϕ_o of minimum radial velocity has come out from numerical solution of the equation

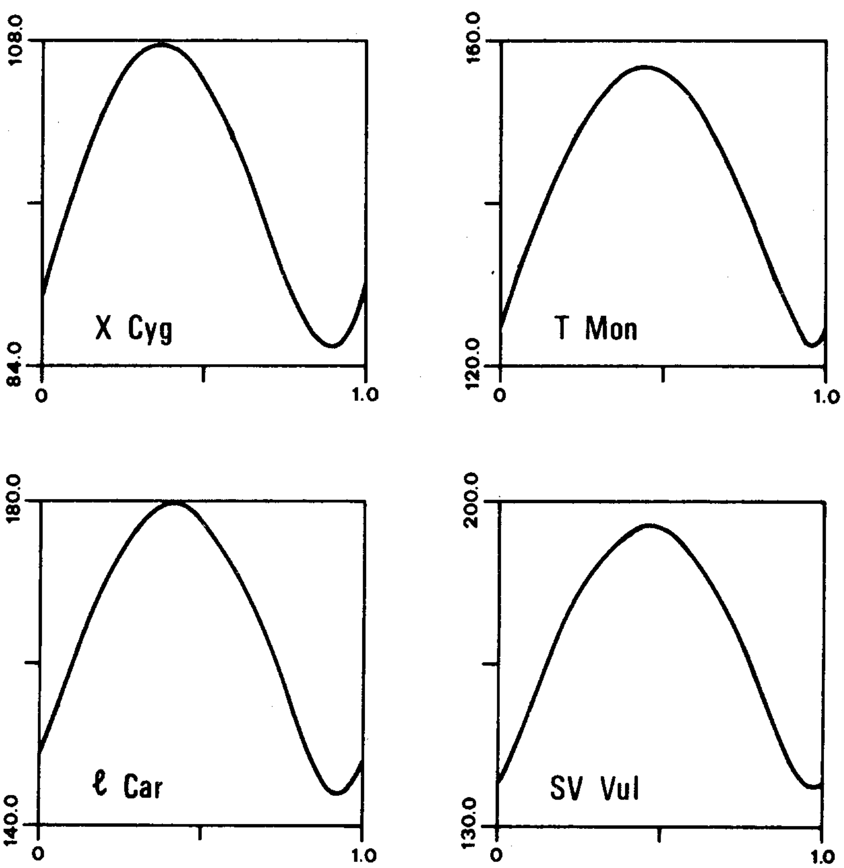
$$2.1715 \cdot \int_o^1 \left\{ \log_{10} \{R_o - KP \int_{\phi_o}^{\phi} u(\phi')d\phi'\} \frac{d(B-V)}{d\phi} \right\} d\phi - \int_o^1 \frac{dV(\phi)}{d\phi} (B-V) d\phi = 0$$

using the value K = 1.31 (Parsons, 1972) for the conversion factor from radial to pulsational velocity. The mean radius <R> then comes out from numerical integration of the radial velocity curve:

$$\langle R \rangle = - KP \int_o^1 u(\phi) d\phi$$

We have also computed the slope "b" of the relation surface brightness vs. colour index. In Table I we give, for each star, the ephemeris used for reducing the observations (P, T_o); the mean radius <R>; the order N1, N2, N3 of the Fourier series for light, colour and velocity curves, respectively; the area B of the loop (V,B-V) and the coefficient b defined


37.0
R/R⊙
33.0
RT Aur
0
PHASE
1.0
48.0
42.0
U Sgr
0
1.0
56.5
49.5
η Aql
0
1.0
60.5
53.5
S Nor
0
1.0
68.2
60.2
β Dor
0
1.0
72.0
64.0
ζ Gem
0
1.0



above. In Figure 1 we present, for each star, the function R(ϕ).

The radius determination presented here have been used in the paper by Caccin et al.(1980) to determine a new period-radius relation, whose slope seems in agreement with theoretical computations by Cogan (1978).

Table I

Name	TO	Period	<R>	N1	N2	N3	B	b
RT Aur	20957.466	3.728261	36.2	3	4	4	0.047	2.113
Π Sgr	36761.956	6.744925	45.7	5	5	3	0.057	2.283
Eta Aql	33292.674	7.176641	53.3	4	4	4	0.067	2.106
S Nor	36849.51	9.75494	56.5	5	5	3	0.048	1.858
Beta Dor	26013.93	9.844235	63.9	5	5	7	0.051	2.040
Zeta Gem	33442.665	10.153507	67.6	6	6	6	0.036	2.050
X Cyg	32573.990	16.3861	97.0	4	4	7	0.159	1.874
T Mon	28193.08	27.018	146.8	5	7	7	0.174	2.221
l Car	35619.7	35.5412	163.2	5	5	3	0.124	2.121
SV Vul	29020.87	45.145	170.0	4	4	3	0.262	1.949

Note: the sources of radial velocity.

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U Sgr - Jacobsen, T.S.: 1970, Ap.J. 159,569.

η Aql - Schwarzschild, M., Schwarzschild, B. and Adams, W.S.: 1948, Ap.J.,108,207

S Nor - Breger, M.: 1970, A.J., 75,239.

β Dor - Parsons, S.B.: 1970, A.J., 76,562.

ζ Gem - Scarfe, C.D.: 1976, Ap.J., 209,141.

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T Mon - Sanford, R.F.: 1956, Ap.J., 123,201.

l Car - Dawe, J.A.: 1969, M.N.R. astr.Soc.145,377.

SV Vul - Sanford, R.F.: 1956, Ap.J. 123,201.

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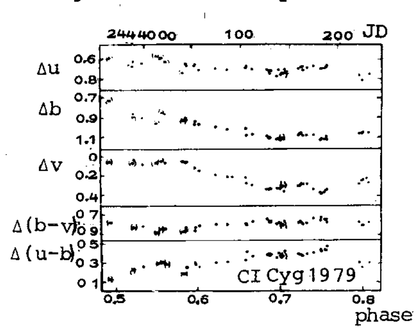
OBSERVATIONS OF CI Cyg IN 1979

Photometric observations of the symbiotic eclipsing-binary star CI Cyg have been continued in 1979 from March 31 to December 24 (Belyakina, 1979 a, b).

The results of these observations in instrumental system as regards the comparison star BD+35°3821 ($V=10^{m}.49$, $B-V=+0^{m}.31$, $U-B=+0^{m}.13$) are plotted in Fig.1. From 1978 November 22 to 1979 March 31 the brightness of CI Cyg in v,b,u-bands decreased by $0^{m}.3$, $0^{m}.4$, and $0^{m}.6$, respectively, as can be seen by the comparison of the observations of CI Cyg in 1978 (Belyakina, 1979 b) and in 1979.

During 1979 the registered radiation of the variable has changed smoothly with maximum amplitude in v-band ($\Delta v=0^{m}.35$, $\Delta b=0^{m}.25$, $\Delta u=0^{m}.20$). It is interesting to note that only the yellow and blue light-curves are synchronous.



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ONE MORE CRITERION FOR DISTINGUISHING BETWEEN W VIRGINIS STARS (CW) AND CLASSICAL CEPHEIDS (Cδ)

As is known the study of morphological peculiarities and space-kinematical characteristics of cepheids cannot always lead to a reliable distinguishing between the CW and Cδ stars, due to which about 1/3 of cepheids from GCVS (1969) have no corresponding designation.

We proposed a criterion of cepheids distinguishing according to the maximum width of the loop in the U-B, B-V plane, namely L_{U-B}. The dependence of the L_{U-B} from log P was investigated for all cepheids with available U,B,V photometry. Fig. 1 shows that the CW loops are wider than the Cδ ones of corresponding periods. However, the loop width of some reliable CW, such as UY Eri, V553 Cen, ϰ Pav, AP Her and AL Vir is comparable with that of Cδ.

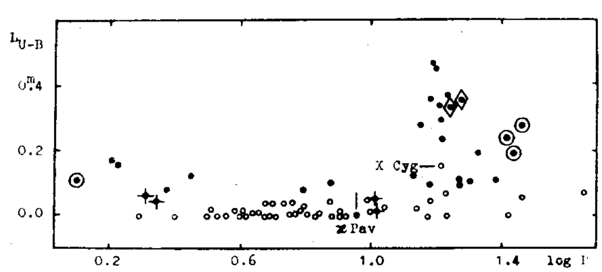

Fig. 1. The loop width L_{U-B} in the U-B, B-V diagrams vs. logarithm of the period. The filled and open circles show the Cepheids of types CW and Cδ, respectively. The signes marked with crosses mean the cepheids without hydrogen emission lines in their spectra, ones placed in the circles and rhombes - the presence of weak and strong hydrogen emission, respectively.

According to Wallerstein (1958) and Lloyd Evans et al.(1972) there is no hydrogen emission of these stars (κ Pav lacks for information of hydrogen emission). In the same paper Wallerstein found that the hydrogen emission seems to have a marked maximum among stars of period 20-30 days. Among CW stars of short period a weak hydrogen emission was found by Abt and Hardie (1960) for BL Her. We know of the only classical cepheid which was found to have very weak hydrogen emission (Kraft, 1956), X Cyg. All the other Cδ stars have only metall emission lines in their spectra and no hydrogen emission.

As Fig.1 shows, there is a correlation between the loop width L_{U-B} and the strength of the hydrogen emission lines. Hydrogen emission and the ultraviolet excess are likely to display one and the same phenomenon connected with the shock wave propagation in the atmosphere of these stars. The effect of the shock waves on the colour indices is considered by Klimishin (1972). Our calculations of the shock wave front emission provide the value of the ultraviolet excess, which agrees in the order with the observed L_{U-B} (Batyushkova, in press).

The dependence L_{U-B} on log P shown in Fig.1 may be used as a criterion of distinguishing between CW and Cδ variables in addition to the existing criteria. However, our criterion is not simple. The presence of the ultraviolet excess, which exceeds $0^m.05$ and $0^m.08$ for the stars of $P<10^d$ and $P>10^d$, respectively, is the cause for classifying them as CW. The lack of such excess in a cepheid variable cannot be the evidence of its adherence to Cδ class.

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Konkoly Observatory
Budapest
1980 July 1

ON THE LARGE-SCALE VARIATIONS OF MV LYRAE

A deep minimum of MV Lyrae was detected by Romano and Rosino on Asiago plates (1). I therefore inspected our homogeneous series of sky patrol plates of the interval August 1956 to June 1980 (n=429) and the longer focus plates of the field R Lyrae, taken with the astrographs 17/120 cm , 40/160 cm and 40/190 cm essentially between 1964 and 1967 and sporadically up to 1979 (n=115). The patrol plates in general cover the time interval mentioned above without marked seasonal gaps.

Our findings can be summarized as follows:

1. The irregular fast changes (occurring from night to night) which were observed by Parenago (2), Walker (3), Weber (4) and Romano and Rosino (1) seem to be of varying intensity. For example in 1964 and 1965 we find small changes only (about 0.5 mag around mpg = $12^{m}.4$), strong variations hovewer in 1960 (from $12^{m}.1$ to $13^{m}.7$).-The rapid (hourly) variations will not be discussed here.

2. The mean brightness varies (even without considering the deep minima) in time-scales of months. For instance in 1968 the brightness without exception fluctuated below $12^{m}.4$, in 1969, 1971 and 1972 preferably above $12^{m}.4$.

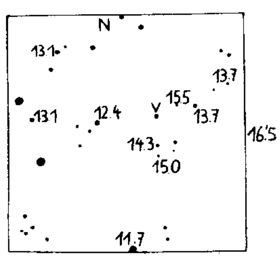
3. The minimum of ref. (1) is confirmed: The brightness was only slightly fainter than $12^{m}.4$ on 1979 June 26, but $14^{m}.5$ and $14^{m}.1$ on August 15 (2 consecutive plates) and never distinctly brighter than $14^{m}.0$ up to 1980 June 6.

4. A second minimum occurred 1956 to 1957 July 4 (star sometimes invisible fainter than $14^{m}.5$, ascent to $12^{m}.4$ 1957 August to November), a third one 1976 (1976 June 28 invisible fainter than $15^{m}.8$, descent with fluctuations 1974 and 1975, ascent winter 1976/77).

5. Because the minima on the whole last 1 year and even longer, the probability is small that further minima since 1956 have remained undetected.

Although some features of the light-curve remind one of the HdC stars of R CrB type rather than of old novae, the spectroscopic findings (5) and details of the variability certainly exclude the former suggestion and to the same degree the latter one. More probable however is a relation to the polars of AM Her type. This assumption was emphasized already by Vojkhanskaya et al. (6),(7) on the basis of polarimetric observations, and now gains high importance because of the similarity of the light-curves of MV Lyr and AM Her (8). X-ray observations are urgently recommended.

Our comparison stars (see chart) were linked to the Mt. Wilson photographic system of Selected Area 38. The brighter ones are in good agreement with the B data of (3).



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Erratum (IBVS No. 1789)

As is quoted correctly in the text, the nebulous object lies at $\alpha=5^h44^m.1$ in the field of β Aur and not at 15^h44^m. Readers should delete the "1" in the heading.

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ON THE VARIABILITY OF THE OLD NOVA HR DELPHINI 1967

Photometry

Photoelectric observations of the old nova HR Del 1967 were carried out with the 61cm Bochum telescope at the European Southern Observatory in Chile on May 28 and 31, 1979.

The photometer was furnished with standard Johnson UBV filters. In order to improve the time resolution, the nearby field star HD 197397 (=BD+18°4591 = SAO 106418; Sp=A0 V) was used as comparison star. As the separation of both stars is less than eight arcminutes, no extinction correction was applied; the brightness of the postnova was determined by means of differential photometry. The individual measurements were obtained with an integration time of 20 seconds. Means of observations with the V, B, and U filters are presented in columns 2 to 4 of Table 1, respectively; the Julian dates corresponding to the times of mid-observation are given in the first column. The standard deviations from the mean value of n measurements, and the number n are given in the last two columns.

Continuous observations with the B filter conducted on May 28, 1979 revealed variations between B=12$^{m}_{.}$38 and 12$^{m}_{.}$51, obviously covering a brightness minimum of the old nova. During the UBV measurements obtained on May 31, 1979 the B magnitude of the postnova was brighter by at least 0$^{m}_{.}$20; B-V$\approx$-0$^{m}_{.}$06, and U-B$\approx$-0$^{m}_{.}$90.

Table 1: UBV Photometry of HR Del

JD (mid-obs.) 244....	V	B	U	Error	n
4021.8028		$12^m.383$		$0^m.019$	6
.8045		12.406		.011	6
.8099		12.449		.017	6
.8116		12.436		.011	6
.8167		12.444		.014	6
.8184		12.481		.020	6
.8311		12.501		.015	6
.8327		12.515		.011	6
.8381		12.485		.018	6
.8397		12.515		.023	6
.8452		12.462		.008	6
.8469		12.460		.011	6
.8802		12.378		.005	4
.8815		12.397		.006	5
4024.8164	$12^m.270$	12.205	$11^m.328$	.011	2
.8259	12.209	12.166	11.268	.011	2
.8350	12.219	12.161	11.249	.008	2

Optical Spectroscopy

From optical spectroscopic data, Hutchings (1979) found evidence that HR Del is a close binary system with a 0.5 $M_\odot$ main-sequence star and a 1.0 $M_\odot$ white dwarf as probable components, and with a fairly high inclination close to $i \approx 45^\circ$. Thus, only slight photometric variability can be expected. Our observations might have covered a shallow eclipse; the combination with further photoelectric data is useful for an improvement of Hutchings' ephemeris. Light variations with an amplitude of $0^m.2$ are also reported by Tempesti (1979), but do not fit the spectroscopic period of 0.17 days.

UV Spectroscopy

Variations in the line intensities are noticeable in IUE satellite spectra of HR Del. A comparison of our low resolution short wavelength (1100-2000 Å) spectrum taken on July 10, 1979, with the one obtained by Hutchings (1979), shows a varying intensity ratio of the He II (1640 Å) to C IV (1550 Å) emission lines, as well as variations in the Si III (1303 Å) absorption; the relative strengths of the Si III (1368 Å) line and Si IV doublet (1398 Å), however, appear to remain essentially constant.

Phase-dependent spectroscopic observations have recently been made by Hutchings (1980).

Simultaneous photometry and spectroscopy of the classical nova V 603 Aql (1918) with the FES-instrument and UV spectrometer aboard the IUE satellite, revealed correlated periodic variations in the optical light curve and the UV spectra (Boggess et al., 1980). Additional comprehensive photometry of HR Del might similarly yield new information on the binary nature of this system.

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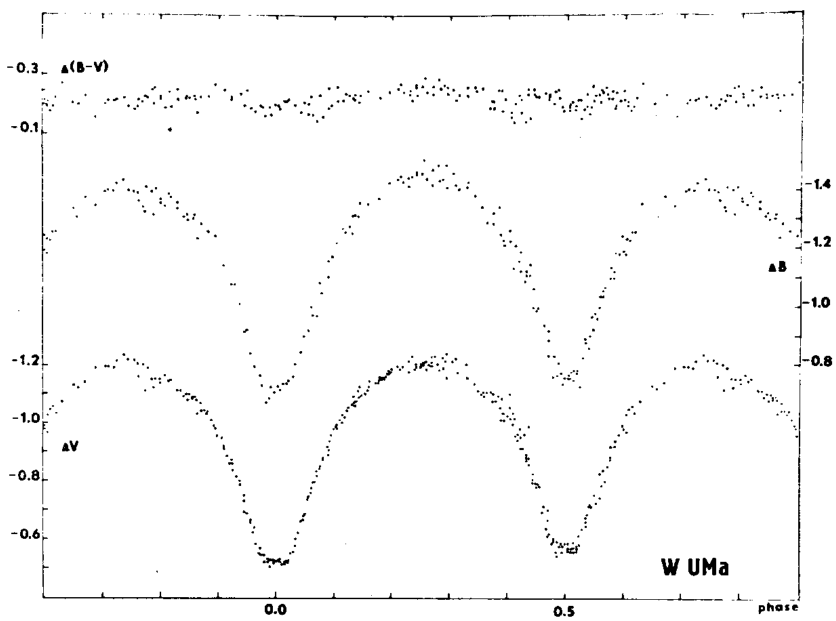
NEW BV LIGHT CURVES AND MINIMA OF THE ECLIPSING BINARIES: W UMa, AW UMa AND 44i Boo

We made 1318 photoelectric observations in B and V light of three W UMa type systems between February and May 1980. A photometer equipped with an unrefrigerated RCA 1P21 photomultiplier tube and standard Johnson B, V filters have been used, attached to the 20 cm Zeiss refractor of the Torun Observatory in Piwnice. In the observations following stars were used as comparison stars: BD +56°1397 for W UMa, BD +31°2270 for AW UMa and BD +48°2261 for 44i Boo, respectively. From these data times of minima have been calculated by using the Kwee and van Woerden (1956) method.

The Table gives the heliocentric minima with their standard errors (σ), filters, the interval of the period (ΔP) used for calculating the minima and corresponding (O-C)'s. (O-C) values for W UMa were calculated from the ephemeris given by Cester and Pucillo (1973); for AW UMa from Dworak and Kurpinska (1975); for 44i Boo from Pohl (1967). AW UMa has been observed only in V light.

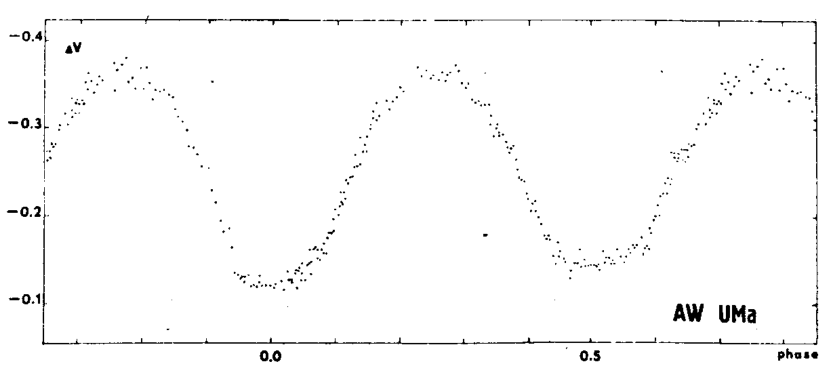
Times of minima

Star	Min.	JD Hel. 2444000+	σ $\times 10^{-5}$	Filter	ΔP	(O-C)
W UMa	II	291.56544	11	BV	$0^d.065$	+0.0020
	I	302.40708	23	BV	0.050	+0.0004
	II	302.57509	11	BV	0.060	+0.0016
	I	303.40786	10	V	0.070	+0.0002
	II	303.57460	24	V	0.030	+0.0002
	I	313.41757	1	BV	0.070	+0.0008
AW UMa	I	320.39578	58	V	0.130	-0.0130
	II	343.43098	64	V	0.100	-0.0112
44i Boo	II	345.50670	12	BV	0.030	+0.0320
	I	365.45694	33	BV	0.058	+0.0300
	I	366.52904	16	BV	0.060	+0.0309



-0.3
Δ(B-V)
-0.1
-1.4
-1.2
ΔB
-1.0
-0.8
-1.2
-1.0
ΔV
-0.8
-0.6
W UMa
0.0
0.5
phase

Fig. 1



-0.4
ΔV
-0.3
-0.2
-0.1
AW UMa
0.0
0.5
phase

Fig. 2

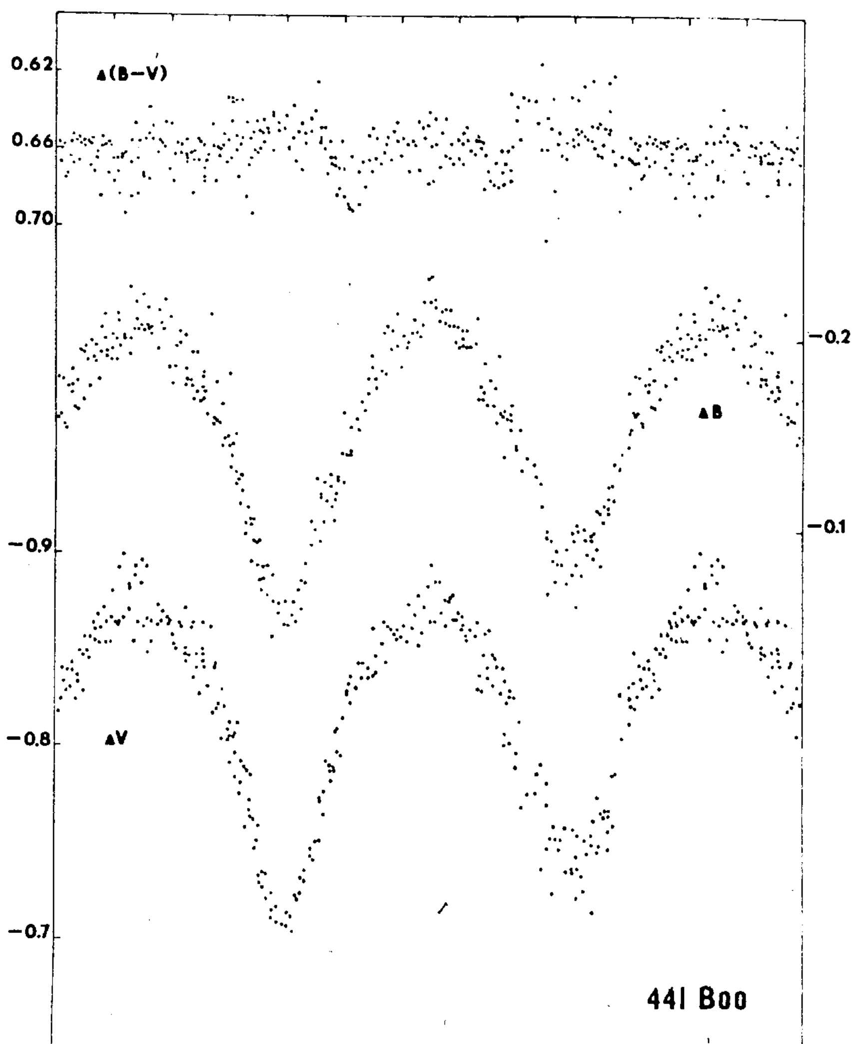


Fig. 3

The observations have been reduced in phase by using:

Hel. JD Min. I = 2444302.40692 + 0.3336559 · E, for W UMa;

Hel. JD Min. I = 2444320.39578 + 0.43873234 · E, for AW UMa;

Hel. JD Min. I = 2444366.52904 + 0.2678158 · E, for 44i Boo.

The obtained light curves are shown in Figs. 1-3.

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PHOTOELECTRIC OBSERVATIONS OF SYMBIOTIC STARS

The brightness variability is one of the criteria for the symbiotic stars. Their brightness can vary with an amplitude up to 3 magnitudes and a period of several years. The light variations are irregular and the features of the lightcurves can vary from time to time. A definite period can be found for many stars, but for some of these objects it is possible to assume an approximate mean period only; superimposed on this periodicity there is a complex of small simultaneous flares, which give rise to the irregular shape of the lightcurves.

From the list of Boyarchuk (1969) some symbiotic objects were chosen to fill the gaps in time among the stars of the main programs, being of interest to make a photoelectric monitoring of their variability.

All the observations were made by an analogical B-V photometer employing an EMI 9502 photomultiplier, the filters Schott GG14 + GG13 (2mm) for the V light, and Schott BG12 + GG13 (2mm) for the B one, with the Teramo Observatory's 40 cm refractor at Collurania. In Table I are reported the comparison and check stars used for every symbiotic object, the coordinates and the magnitudes V and B-V, as determined by comparison with several standard stars in more nights of good quality. In Table II the observations are listed: each value is the mean of several points and the mean nightly errors are also reported.

It should be noted that the reported values of the magnitudes are relative to the response curve of the used photometer, as in all cases of broad-band observations of stars having emission lines in their spectra.

The following stars have been observed:

Table I

Comparison and check stars

Symbiotic stars	Comparison and check stars	R.A. (1975)	Decl. (1975)	V	m.e.	B−V	m.e.
RW Hya	1-CPD −24°5104 =CoD 10984	13h33m42s	−25°10!6	9.00	0.01	0.54	0.02
AG Dra	1-BD +67°925	16 05 14	+66 51.2	9.86	0.01	0.55	0.01
FR Sct	1-BD −12°5023	18 21 48	−12 39.3	10.07	0.01	1.48	0.02
	2-BD −12°5028	18 22 11	−12 40.4	9.997	0.002	0.98	0.04
BF Cyg	1-Anon.	19 21 22	+29 44.0	11.31	0.02	0.51	0.02
	2-Anon.	19 23 26	+29 37.2	11.10	0.02	0.32	0.01
MHα80-5	1-Anon.	19 45 22	+18 30.4	10.83	0.01	0.41	0.02
AG Peg	1-BD +11°4677	21 50 29	+11 55.1	7.609	0.004	0.167	0.004
	2-BD +11°4681	21 51 12	+12 25.7	8.178	0.001	1.011	0.004

Table II

Photometry of symbiotic stars

Star	Jul.Day 2440000.+	V	m.e.	B−V	m.e.
RW Hya	702.486	8.80	0.01	1.56	0.01
	704.453	8.80	0.01	1.51	0.01
	720.404	8.83	0.01		
	731.356	8.82	0.01		
AG Dra	686.441	9.85	0.01	1.38	0.02
	689.340	9.84	0.01	1.39	0.02
	701.311	9.87	0.01		
	702.434	9.857	0.004	1.45	0.01
	704.391	9.84	0.01	1.47	0.01
	710.483	9.848	0.003	1.37	0.02
	715.461	9.86	0.01	1.43	0.02
	720.431	9.85	0.01		
	731.378	9.85	0.01		
	741.374	9.849	0.002	1.41	0.01
	748.376	9.82	0.01		
	764.364	9.82	0.02	1.43	0.02
	767.393	9.83	0.02	1.45	0.05
	773.375	9.810	0.005	1.37	0.01
	800.377	9.78	0.01		
	824.328	9.74	0.01	1.32	0.02
	837.421	9.76	0.01		
FR Sct	741.541	10.21	0.01	2.14	0.02
	748.520	10.16	0.02		
	765.489	10.20	0.01		
	772.448	10.26	0.01		
	798.366	10.34	0.01	2.57	0.04
	802.363	10.20	0.01		
	824.354	10.09	0.01		
BF Cyg	769.389	11.12	0.01	0.80	0.01
	775.382	11.22	0.02	0.73	0.01
	798.396	11.42	0.02	0.81	0.03
	809.361	11.44	0.02		
	833.373	11.34	0.03		
	865.311	11.40	0.02		
MHα80-5	770.380	10.619	0.005	0.43	0.01

Table II (cont.)

Star	Jul.Day 2440000.+	V	m.e.	B-V	m.e.
AG Peg	834.410	8.30	0.01		
	865.345	8.241	0.005		
	866.477	8.252	0.004	0.76	0.01

RW Hya = HD 117970. Extended photometric observations are not reported for this star, which has a spectroscopic period of about 376 days.

AG Dra = BD +67°922. In 1970 its behaviour is the same as in the years 1962-67 with an amplitude of $0^m.12$ and $0^m.15$ for U and B light, respectively.

FR Sct. In 1970 its mean magnitude is greater ($10^m.21 \pm 0^m.03$) than previously reported ($11^m.7$ to $12^m.5$). It is much more likely to be a VV Cep star than a symbiotic one.

BF Cyg. It is a typical symbiotic star (Z And type) in which the quasi-periodic variations are smaller and the non-periodic part is very important.

MH_α80-5. The star may be symbiotic. The V magnitude in 1970 is greater than that previously known at the maximum.

AG Peg = HD 207757 = BD +11°4673. The star may be regarded as a binary system involving an M giant, a hot emission object, gaseous streams and an enveloping nebulosity. The period is about 820 days.

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THE LIGHT CURVE OF STEPANIAN'S STAR

Photoelectric observations of Stepanian's star were made on April 19-22 of this year. The two-beam, multi-mode, nebular-stellar photometer of the National Observatory of Athens was used attached to the 48-inch Cassegrain reflector at Kryonerion Station. Dry ice was used to freeze the photomultiplier. The filters used, B and V, are in close accordance with the standard ones.

Horne et al. (1980a) discovered that this star is an eclipsing binary. Using Horne et al. (1980a) and Horne et al. (1980b) ephemeris formulae the following values for the residuals $(O-C)_a$ and $(O-C)_b$ were found, respectively, for the observed primary minimum:

Hel. J.D.	$(O-C)_a$	$(O-C)_b$
2444349.5908	-0.0028	-0.0070

RA $= 15^h\ 35^m\ 44^s$
Decl. $= +19^\circ\ 01'\ 30''$

Fig.1. The field of Stepanian's star. (After Stepanian, 1979).
The underlined star is that one which served as comparison.

Figure 1 gives the variable's field (after Stepanian, 1979) where the star which served as comparison (the underlined) and the variable itself are denoted. Since the two stars are very close to each other, no extinction reduction has been made. Moreover, no colour reduction has been made since the colour indices for both stars are not known.

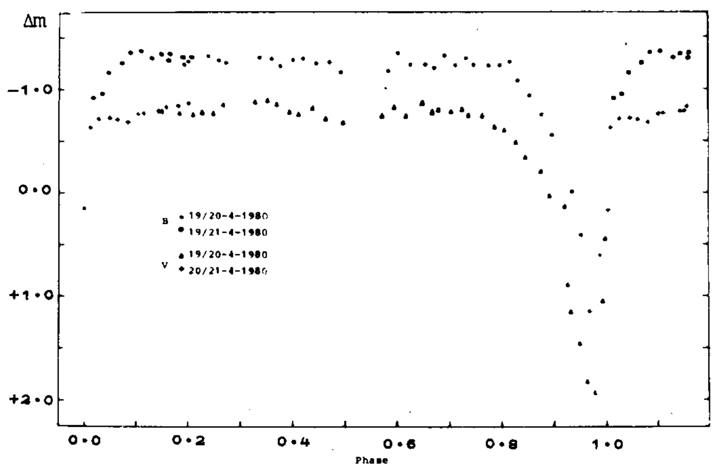

Fig.2. The light curve of Stepanian's star in B and V.

In Figure 2 the obtained light curve is represented in B and V. One can notice a lot of irregularities outside eclipses. Unfortunately there are no observations around secondary minimum. The observations will be continued during August and September.

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Stepanian, J.A.: 1979, I.B.V.S. No. 1630

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A LIST OF ECLIPSING BINARIES TO BE CONTINUOUSLY MONITORED

The study of apsidal motion in eclipsing binaries depends very strongly on timings of minimum light observed along many years. These measurements are very easy to accomplish with normal photoelectric equipments and may be included within other scientific programs without much extra work. The usefulness of this kind of studies has been already stressed by many authors since apsidal motion in eclipsing binaries remains as one of the best ways to approach empirically the interior of the stars.

For this reason, a list of 55 binary systems is presented in this communication including not only those eclipsing binaries already known to exhibit apsidal motion but also those candidates with promising characteristics that for the moment have not been analyzed because of the lack of sufficient observed data. The present list has been made as a selection from a more extended compilation of binaries suspected of apsidal motion at any time, eliminating the systems with photometric, theoretical or any other type of complication blocking the possibility to reach confident conclusions from the observations.

In the table is given the name of the star as a variable (although some of them are probably better known through their HD, HR, VV or other names). Also the position in the sky is included using the Right ascension and the Declination for the epoch 1900.0 as given in the "General Catalogue of Variable Stars". The period of the binary is listed to four decimals and another column gives approximated values of the visual magnitude outside eclipses and during primary minimum. All these figures are given as an indication for observers when planning their work. Many of the systems are also included in the "Rocznik Astronomiczny Ob-

Table I

1	V539 Ara	17^h	42^m	18^s	-53°	25'.0	5.66-6.19	3.1691^d
2	AS Cam	05	24	18	69	27.0	8.2-8.8	1.7155
3	GL Car	11	10	21	-60	06.9	8.9-9.6	2.4222
4	GR Car	10	34	59	-57	41.4	13.6-14.0	17.1359
5	QX Car	09	51	20	-57	56.9	6.46-7.0	4.4772
6	PV Cas	23	05	45	58	39.6	9.9-10.6	1.7505
7	V459 Cas	01	05	12	60	36.9	11.4-12.0	8.4583
8	KT Cen	11	43	14	-61	47.8	12.0-12.4	4.1304
9	V346 Cen	11	38	04	-61	52.8	8.3-8.7	6.3223
10	V384 Cen	11	34	37	-61	37.1	11.8-12.4	12.6352
11	CW Cep	23	00	01	62	51.5	7.6-8.06	2.7291
12	EK Cep	21	39	38	69	14.2	8.2-9.5	4.4278
13	TV Cet	03	09	25	02	22.9	8.6-9.3	9.1033
14	UX Cru	12	12	40	-62	08.7	11.7-12.1	12.2975
15	Y Cyg	20	48	04	34	16.9	7.2-7.8	2.9963
16	V380 Cyg	19	47	11	40	20.7	5.5-5.62	12.4257
17	V453 Cyg	20	02	49	35	27.2	8.3-8.6	3.8898
18	V477 Cyg	20	01	31	31	41.2	8.3-9.2	2.3470
19	V541 Cyg	19	38	35	31	05.3	10.2-10.9	15.3381
20	V1136 Cyg	19	33	49	28	37.1	12.2-12.9	3.4628
21	V1143 Cyg	19	36	27	54	44.5	5.9-6.4	7.6408
22	DI Her	18	49	17	24	09.3	8.3-9.0	10.5502
23	AI Hya	08	13	38	00	35.6	9.0-9.5	8.2897
24	SS Lac	22	00	42	45	56.5	10.1-10.5	14.4163
25	CO Lac	22	42	27	56	18.6	10.4-11.0	1.5422
26	ES Lac	22	28	18	53	27.0	11.4-12.0	4.4593
27	MZ Lac	22	24	06	53	10.2	11.2-12.1	3.1588
28	V345 Lac	22	14	58	54	10.4	10.7-11.4	7.4918
29	RR Lyn	06	17	59	56	20.3	5.6-6.0	9.9450
30	UX Men	02	51	37	-76	11.9	8.6-9.4	4.1811
31	GM Nor	15	44	09	-55°	03.7	11.6-12.1	1.8845
32	GN Nor	15	47	16	-54	13.8	12.6-13.3	5.7034
33	HH Nor	15	36	05	-51	31.6	10.3-11.5	8.5831
34	V451 Oph	18	24	32	10	49.6	7.86-8.46	2.1966
35	EW Ori	05	14	57	01	56.5	10.4-11.2	6.9368
36	FH Ori	05	18	00	04	11.0	10.5-11.5	2.1512
37	FL Ori	05	02	45	-02	53.0	10.5-13.2	1.5510

Table I (cont.)

38	FT Ori	06	07	58	21	27.3	9.1-9.7	3.1504
39	GG Ori	05	38	05	-00	44.3	10.0-10.6	6.6315
40	AG Per	04	00	32	33	10.6	6.5-6.8	2.0287
41	IQ Per	03	52	30	47	51.9	7.5-8.0	1.7436
42	Tseta Phe	01	04	11	-55	46.8	4.0-4.5	1.6699
43	KX Pup	07	47	51	-26	07.5	11.6-12.0	2.1468
44	NO Pup	08	22	37	-38	43.9	6.7-7.1	1.2569
45	YY Sgr	18	38	42	-19	29.4	9.8-10.5	2.6285
46	V523 Sgr	18	56	35	-29	17.1	10.1-10.4	2.3238
47	V526 Sgr	19	01	49	-31	30.3	9.9-10.7	1.9194
48	V1647 Sgr	17	52	26	-36	55.7	7.0-7.15	3.2828
49	V2283 Sgr	17	57	51	-36	55.0	10.1-10.9	3.4714
50	V629 Sco	17	11	27	-38	57.2	11.9-12.4	3.2491
51	AP Tau	04	48	33	26	45.6	13.4-14.1	0.9720
52	AO Vel	08	08	55	-48	26.6	9.6-10.0	1.5846
53	EO Vel	08	35	35	-43	22.7	11.1-11.7	5.3296
54	DR Vul	20	09	36	26	26.9	8.6-9.3	2.2508
55	FQ Vul	19	31	30	26	03.7	12.3-12.9	6.2624

serwatorium Krakowskiego" where ephemerides and predicted times of minimum for each year can be found.

Information concerning these stars like unpublished data, re-discussions, new orbits, times of minimum, etc., should be most acknowledged by the authors.

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INFRARED PHOTOMETRY OF HR 1099 DURING LATE 1979

The RS CVn type double-lined spectroscopic binary system HR 1099 (≡ V711 Tau ≡ADS2644A) was observed in the near infrared (mainly J, K and L) at the South African Astronomical Observatory from 1979 November 17 - December 31. The observations were made with the 0.75 m telescope, using the MkII Infrared Photometer similar to that described by Glass (1973).

The photometric measures included both the components of the visual pair ADS 2644 AB and were relative to the same comparison star (10 Tau) used for the visual and our previous infrared observations (Antonopoulou and Williams 1980, Paper I). The effects of atmospheric extinction were allowed for using mean coefficients, but were not significant because of the angular proximity of the comparison star to the variable. A total of 137 observations was obtained in each colour in 24 nights.

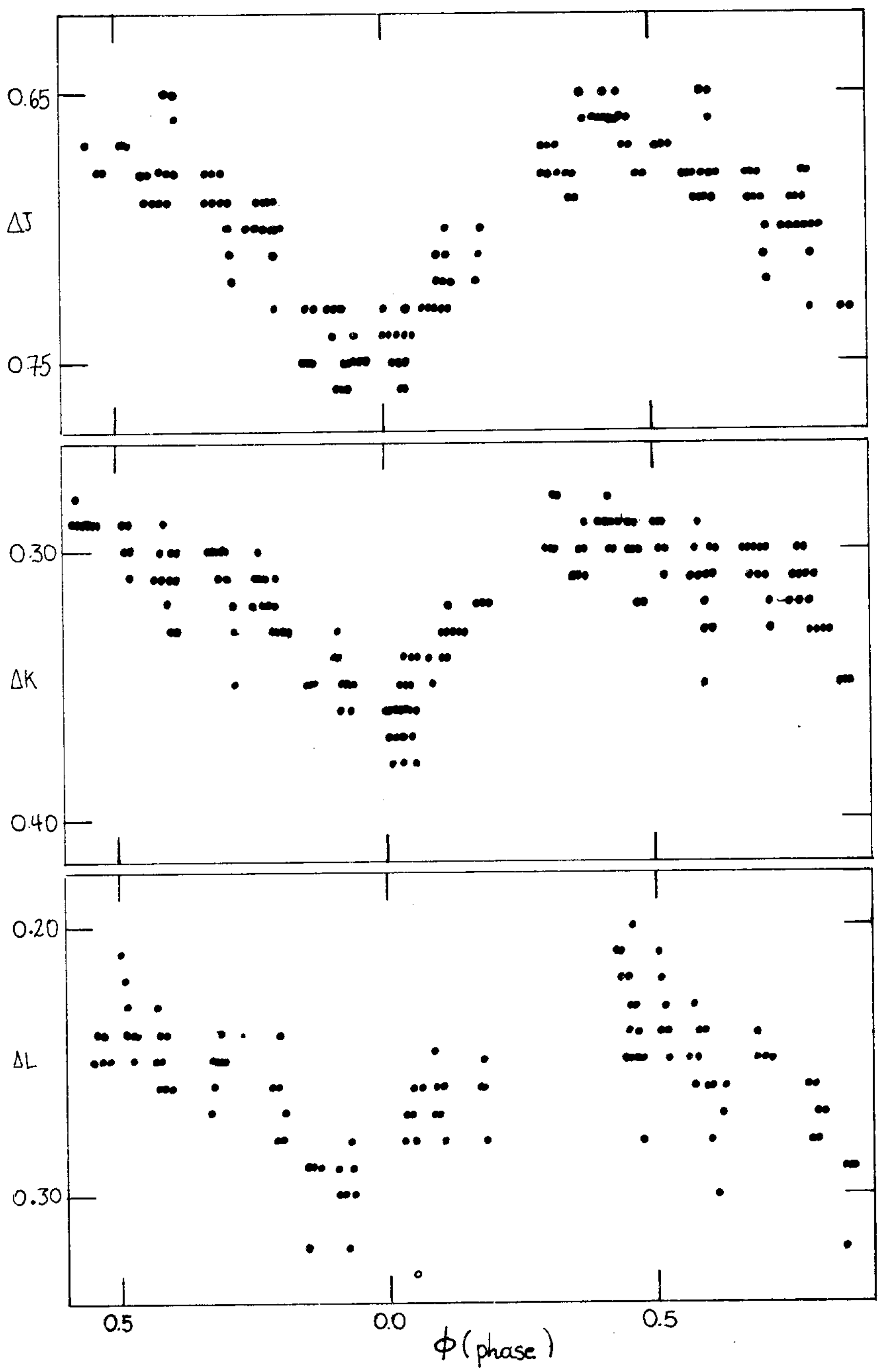
The phase of each observation was computed according to the elements:

$$T_o(JD) = 2442766^{d}.069 + 2^{d}.83782 \cdot E,$$

where the period is the spectroscopically determined orbital period (Bopp and Fekel 1976) and zero phase corresponds in conjunction with the more active component, believed to carry the spot complex, in front.

The differential observations, taken as variable minus comparison, are plotted against phase and are shown in the Figure.

It is clearly seen that the phase of the minimum is at phase 0.95 in agreement with the phase of the minimum given by the visual data taken at around the same time (Guinan et al. 1979). This means that the phase of the minimum has shifted by 0.055 forwards, comparing these observations with the ones we took one year earlier (Paper I).


0.65
ΔJ
0.75
0.30
ΔK
0.40
0.20
ΔL
0.30
0.5
0.0
0.5
φ (phase)

The amplitudes of the light variation in J, K and L are about 0.09 mag, 0.07 mag and 0.06 mag, respectively.

Assuming the simplified spot model for HR 1099 as described in Paper I, our preliminary calculations, from the combination of the present infrared data and the visual data given by Guinan et al. 1979, give the results:

The spots are 1250K ± 100K cooler than the surrounding photosphere and cover 0.16 ± 0.02 of the projected area of the two stars or approximately one third of the hemisphere of the active component assuming the two components to be the same size.

A full discussion will be published later elsewhere.

We are grateful to the Director and the Staff of the South African Astronomical Observatory for their help and to the UK Science Research Council for travel and subsistence.

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ROTHNEY ASTROPHYSICAL OBSERVATORY PUBLICATION
SERIES B, No. 4

UBV PHOTOMETRY OF DN CASSIOPEIAE

Hoffmeister (1947) first described the system as Algol type and assigned it a period of 1.55479 days. Hiltner (1956) has classified the spectrum as O8V. The last study of the system known to us was by Frazier and Hall (1974) whose comparison star was found to be variable thereby compromising the usefulness of the light curve.

Observations were made on 9 nights during the fall of 1979 with the 40 cm reflector at the Rothney Astrophysical Observatory. An RCA 1P21 photomultiplier tube cooled to -75°C was used with standard UBV filters. The comparison and check stars were chosen to be BD 60°467 and BD 60°471 respectively. The mean square errors of the mean differential magnitudes in V, B, and U were ±0.010, ±0.005, and ±0.007 magnitudes respectively.

In the light curves (Figures 1-3) curvature of the maxima is apparent, indicative of a β Lyrae type light curve. Study of primary minimum revealed that O-C = +0.0056 at JD 2444191.765.

Of particular interest is the asymmetry in the maxima apparent in the B light curve (figure 2). The secondary eclipse also appears to be asymmetric in all three wavelengths.

The color curves generally reveal little change from the minima suggesting that both components are of approximately equal temperature.

Further photometric and spectroscopic observations are being carried out at RAO and a more complete study will appear elsewhere.

The author would like to express appreciation to Dr. E. F. Milone and R. M. Robb for guidance and assistance during this study, which was begun as a senior student research project at the University of Calgary, and is supported by the Department of Physics at the University of Calgary and NSERC of Canada research grants.

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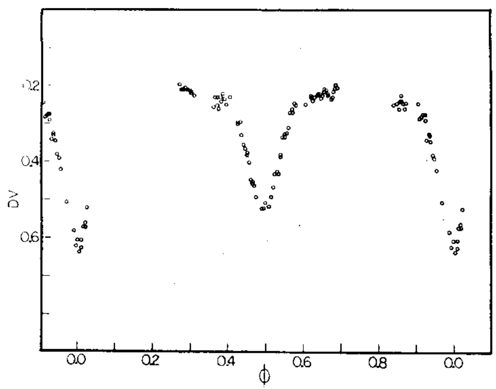

Figure 1. V light curve.

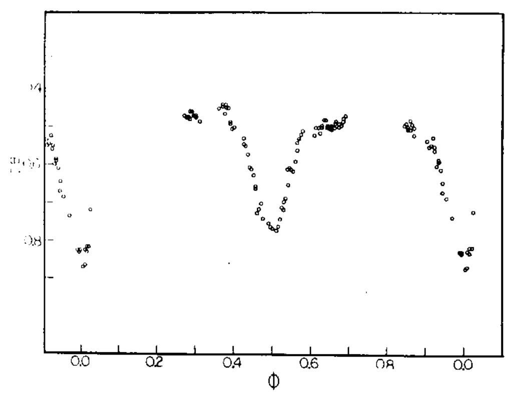

Figure 2. B light curve.

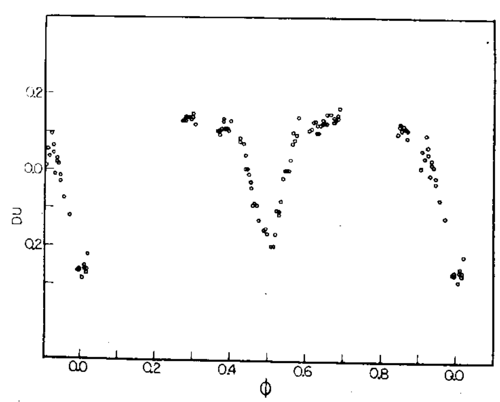

Figure 3. U light curve.

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UBV PHOTOMETRY OF THE NOVA CYGNI 1975 ON SEPTEMBER 1975
A PHOTOELECTRIC LIGHTCURVE

Photoelectric observations of the Nova Cygni 1975 in the UBV-international system have been carried out at the Stephanion Observatory using the 30-inch Cassegrain reflector equipped with a dual channel photoelectric photometer. The photomultiplier used was an RCA 1P21 refrigerated with dry ice. The transformation of our instrumental ubv system to the international UBV system is given by the following equations:

$$V = v_o + 0.059(b-v)_o + 2.368 ,$$
$$B-V = 0.737 + 1.035(b-v)_o ,$$
$$U-B = -1.675 + 1.122(u-b)_o .$$

One or two differential measurements of the nova were done each clear night from September 22 up to September 30, 1975. The nearby star BD +47°3322 was selected as a comparison star, because of its resemblance in magnitude and colour as well with the nova at that stage. For the best accuracy of our measurements, provision was made for the evaluation of the second order extinction coefficient at the moment of each nova observation and for the best estimation of the magnitude and colour indices of the comparison star in use. To this purpose a second red comparison star was involved in the scheme of the observation. This star was BD +47°3321, an M star, visual companion of the star BD +47°3322. Finally, in order to deduce the magnitudes and the colour indices of these two comparison stars, two well known standard stars ε Cyg and α Del (Johnson et al. 1966) were measured more than twice each observational night.

The magnitudes and colour indices of the comparison stars, computed as the weighted means of the respective values which have been derived from all the observations of these stars during the whole period, are given in Table I.

Table I

Star	V	s_V	B-V	s_{B-V}	U-B	s_{U-B}
BD +47°3322	6.456	0.009	+0.010	0.007	-0.381	0.007
BD +47°3321	7.306	0.006	+1.549	0.004	+1.095	0.009

From the small r.m.s. errors we may deduce that both stars show no variability, at least for that period when our observations of the Nova Cygni 1975 were made.

The magnitudes and colour indices of the Nova Cygni 1975 for the respective time of observation are given in Table II.

Table II

1975 September	U.T.	J.D. 2442600 +	V	B-V	U-B
	22.87	78.365	7.455	+0.096	-0.519
	22.91	78.409	7.413	+0.105	-0.482
	24.86	80.364	7.581	+0.080	-0.442
	24.93	80.425	7.581	+0.100	-0.457
	25.92	81.416	7.625	+0.064	-0.449
	27.86	83.362	7.785	+0.040	-0.446
	28.81	84.310	7.845	+0.036	-0.439
	28.95	84.449	7.854	+0.023	-0.382
	30.95	86.444	7.972	+0.005	-0.439

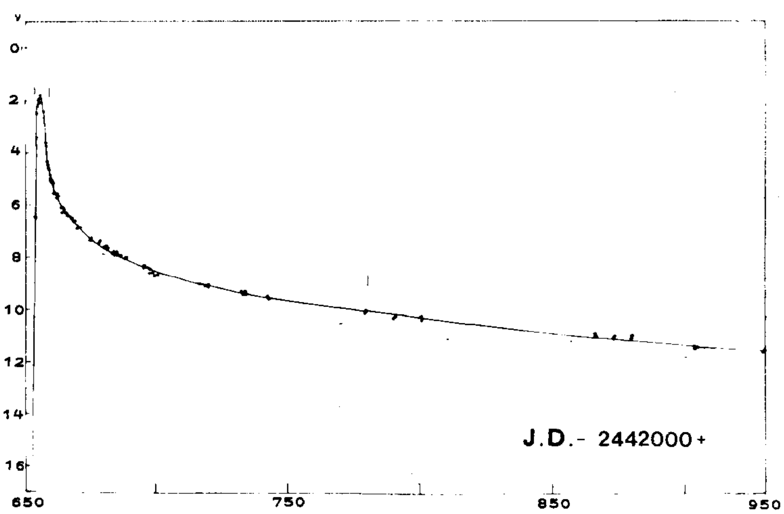
The r.m.s. errors for the V magnitude and the B-V, U-B colour indices are $s_V=\pm0.009$, $s_{B-V}=\pm0.007$ and $s_{U-B}=\pm0.007$.

It is well known that small differences in the visual passband between two instrumental systems result into significant differences in the deduced V magnitude of a nova, due to the strong and broad emission lines (H_α, H_β and N_1, N_2 of [OIII], mainly). Therefore, in order to construct an homogeneous lightcurve, we have used the published V magnitudes by Margrave and Doolittle (1975), French (1975), Piirola (1975) and Williamon (1977) together with the V magnitudes of this work. All these observations show no systematic differences in overlapping time intervals, where the emission lines dominate in the spectrum of the Nova Cygni 1975. For the early phases of the nova outburst i.e. before the 4.00 U.T. of September no such selection need to be done, so we have used the published V-magnitudes of the Nova Cygni 1975 in the IAU Circulars Nos. 2826,2828,2832,2839.

By a least square fitting we find that the V lightcurve of the Nova Cygni 1975 may be represented by the following equations

$t \leq -1^d$	$V = -6.104t - 4.463$	(1)
$-1^d < t < 3^d$	$V = 1.83 \exp(0.29\|t\|)$	(2)
$3^d < t < 125^d$	$V = 2.954 + 3.392 \log t$	(3)
$125^d < t < 280^d$	$V = 0.603 + 4.499 \log t$	(4)

In these equations t is expressed in days and is measured from the time of the maximum brightness i.e. 31.00 U.T. of August, 1975 (JD 2442655.5). Equation (4) holds 1000 days after maximum. At that time the observed V magnitude of the nova is $14^m.14$ (Kleine et al. 1979) while the calculated V magnitude from this equation is 14.10 magnitude. If we assume that the equation (4) is valid until the end of the nova eruption, then the star will reach its prenova magnitude i.e. 21^m about 94 years after the time of maximum brightness.



The Figure displays the lightcurve of Nova Cygni 1975. The points represent the observed V magnitudes and the continuous lines the four equations.

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V AND B - V MAGNITUDES OF BRIGHT CEPHEIDS FROM ELECTROSPECTROPHOTOMETRIC OBSERVATIONS

At the high-altitude station "Terskol" (Main Astronomical Observatory of the Ukrainian Academy of Sicences) over the period 1974-1978 a number of variables were observed with a Seya-Namioka scanner. Scannograms were treated by the relative electrospectrophotometry method (1) with use of eleven standards of the Odessa spectrophotometry system OAO -77 (2), (3) as the comparison stars. The system is based on the calibration of α Lyr, by Heyes and Hatham (4). Energy distribution in the radiation spectra of classical cepheids δ Cep, ζ Gem and η Aql have been obtained in the range 3200-7700 ÅÅ with a step of 50 Å in absolute units.

The V and B-V magnitudes were calculated using the curves of the UBV correction of the Johnson system by Straizys (5).

Light variation phases were obtained from the second edition to GCVS (6) and from Scarfe (8) for ζ Gem. The moments of observations to the solar centre are not given. The V and B-V magnitudes are in good agreement with the mean curves (Nikolov,7) for δ Cep and η Aql and with the data by Scarfe (or Eggen) for ζ Gem. A significant scattering of points was observed on the curves of the B-V and η Aql in the area of the descending branch. The curves of V and B-V of ζ Gem satisfy better Scarfe's elements than those of GCVS. The observational results are given in Tables I-III.

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Table I

δ Cep

	J.D. 244...	φ	V	B-V
1	2334.341	0.324	$4^m_.055$	$0^m_.800$
2	2506.561	0.417	4.115	0.828
3	2507.561	0.603	4.288	0.893
4	3722.520	0.007	3.490	0.490
5	3725.416	0.547	4.220	0.895
6	3791.365	0.836	4.168	0.808
7	3792.314	0.013	3.509	0.462
8	3797.313	0.944	3.600	0.528
9	3814.356	0.120	3.718	0.594

Table II

ζ Gem

	J.D. 244...	φ	V	B-V	φ_{Sc}
1	1997.545	0.828	$3^m_.790$	$0^m_.692$	0.847
2	2108.438	0.752	3.848	0.796	0.771
3	2112.354	0.138	3.789	0.778	0.157
4	2113.362	0.237	3.887	0.839	0.257
5	2437.331	0.151	3.814	0.797	0.173
6	2443.361	0.748	3.865	0.760	0.768
7	2445.421	0.950	3.697	0.713	0.970
8	2476.330	0.995	3.624	0.655	0.016
9	2479.332	0.291	3.944	0.861	0.311
10	2481.331	0.487	4.124	0.927	0.508
11	2776.494	0.565	4.081	0.966	0.588
12	2778.526	0.765	3.861	0.724	0.787
13	2779.496	0.861	3.712	0.701	0.883
14	3791.571	0.565	4.107	0.954	0.592
15	3792.575	0.664	3.994	0.851	0.691
16	3795.572	0.959	3.664	0.706	0.986
17	3797.580	0.157	3.781	0.811	0.184
18	3813.462	0.720	3.867	0.785	0.749
19	3839.597	0.296	3.923	0.873	0.324
20	3840.604	0.395	4.125	0.950	0.423

Table III

η Aql

	J.D. 244...	φ	V	B-V
1	1847.439	0.992	$3^m_.515$	$0^m_.639$
2	1868.496	0.926	3.736	0.728
3	1900.383	0.369	3.900	0.911
4	1906.389	0.206	3.768	0.800
5	1907.327	0.337	3.849	0.832
6	1935.385	0.246	3.798	0.855
7	2139.564	0.697	4.368	1.046
8	2141.553	0.974	3.523	0.644
9	2150.551	0.228	3.836	0.865
10	2166.460	0.444	4.148	1.023
11	2168.522	0.732	4.291	1.017

Table III (cont.)

	J.D. 244...	φ	V	B-V
12	2175.516	0.707	4.331	1.059
13	2327.200	0.842	4.016	0.874
14	2329.188	0.119	3.694	0.794
15	2330.270	0.270	3.859	0.844
16	2331.214	0.401	3.984	0.921
17	2332.267	0.548	4.247	1.017
18	2333.233	0.683	4.348	1.053
19	2760.124	0.165	3.735	0.793
20	3242.567	0.390	4.001	0.945
21	3243.552	0.527	4.201	0.982
22	3244.550	0.666	4.324	1.085
23	3245.543	0.805	4.148	0.939
24	3274.518	0.842	3.994	0.865
25	3275.509	0.980	3.485	0.695
26	3280.482	0.673	4.348	1.037
27	3291.470	0.204	3.860	0.876

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HR 3593, A NEW BRIGHT β CEPHEI STAR

HR 3593 (HD 77320, BD-42.4875) is a 6th magnitude star classified B2Vnn(e) by Houk (1978). The star has been measured more than 400 times in the Geneva photometric system from the Swiss station of La Silla Observatory, Chile, between 1975.9 and 1980.3. The mean apparent magnitudes in the seven filters of the Geneva system, with their standard deviations, are the following:

Filter	U	B1	B	B2	V1	V	G
λ_0[Å]	3456	4024	4245	4480	5405	5500	5805
Mean magnitude	5.321	5.673	4.889	6.486	6.727	6.040	7.257
Standard dev.	0.033	0.028	0.027	0.028	0.026	0.026	0.026

From the values of the standard deviations we see that the star is variable and that the amplitude of variation is almost the same in the whole optical range (a slightly larger amplitude in the U filter can even be noted).

The light variation of HR 3593 has been recorded during several nights. Figures 1 to 3 give three examples of variations in the V magnitude. On the basis of the data obtained during the two consecutive nights (Figures 1 and 2), a period of about 7 h can be derived. However, the light curve shown in Figure 3 is quite different (value of the maximum and shape). Thus, at least two frequencies are necessary to describe the observed light variations.

On the basis of its spectral type and because of the existence of a beat phenomenon in the light curve, we can state that HR 3593 is a new β Cephei star. The amplitude of

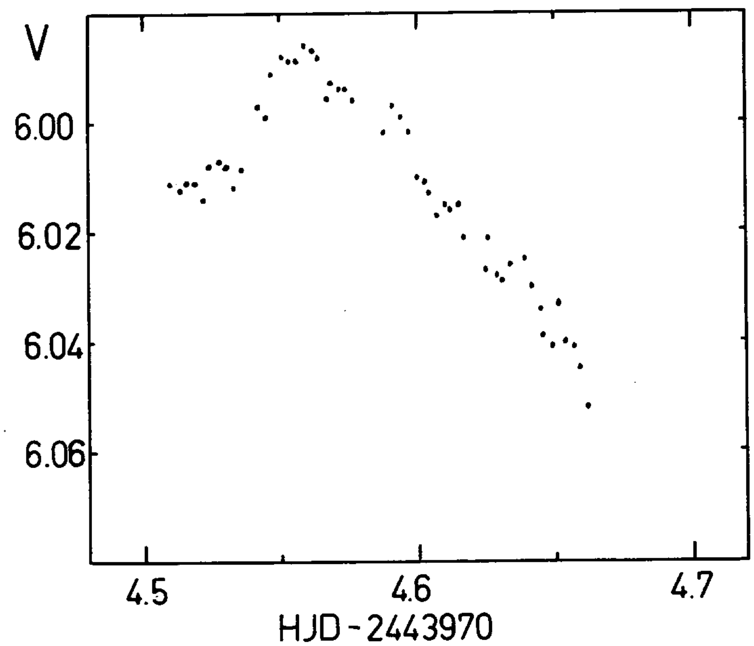
V
6.00
6.02
6.04
6.06
4.5
4.6
4.7
HJD-2443970

Fig. 1

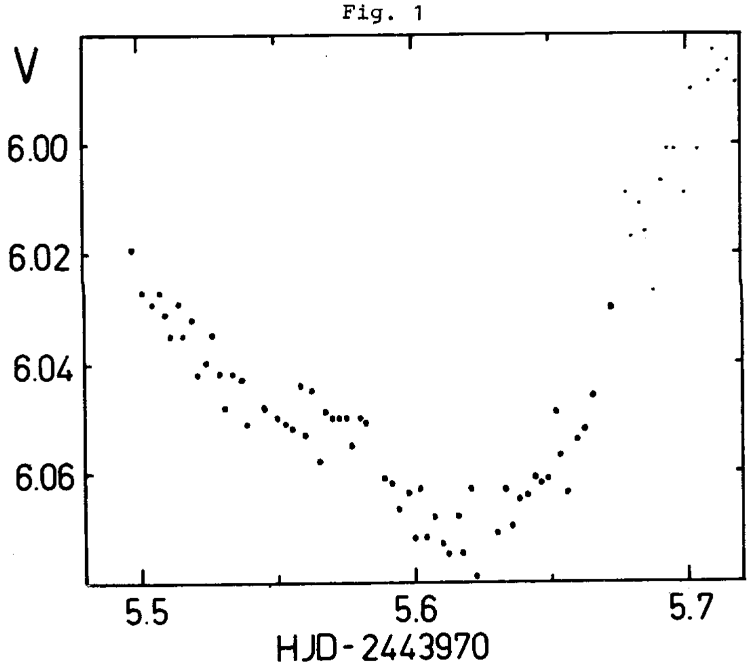
V
6.00
6.02
6.04
6.06
5.5
5.6
5.7
HJD-2443970

Fig. 2

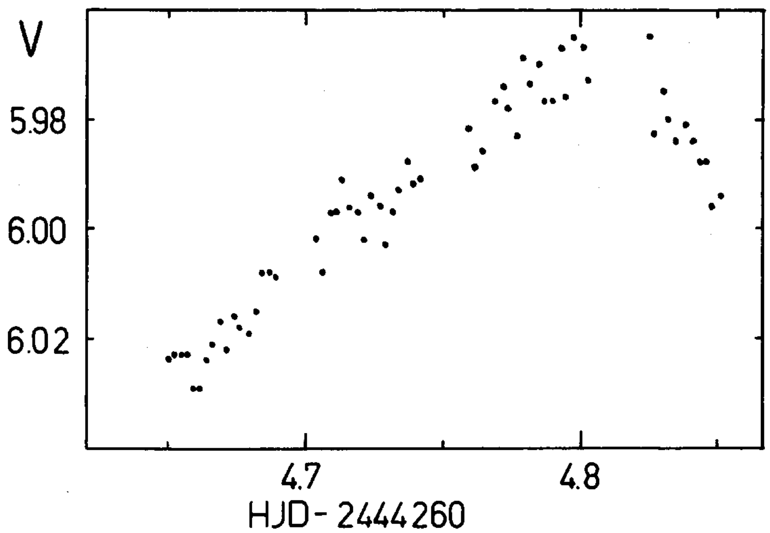

Fig. 3

the light variation ($\Delta V \cong 0^m.1$) is among the largest and the period ($P \cong 7$ h) could be the longest presently known for this class of pulsating stars (cf. Lesh and Aizenman, 1978).

In order to determine the various frequencies of the pulsation, it is necessary to follow continuously several successive cycles. Such a program requires cooperation between various observatories in the Southern hemisphere, located on sites sufficiently remote from each other.

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HD39917: A NEW, PROBABLY NON-ECLIPSING RS CVn-TYPE VARIABLE

In 1977 a four-colour uvby survey of the southern sky, designed to find F and early G stars belonging to the intermediate population II, was finished. Among many other object, HD 39917 ($7^m.6$, GO) was found to show photometric indications of low metallicity; cf. Olsen (1979), table 14, where it was tentatively predicted to be a G8 dwarf star with weak lines. It was consequently included in a spectroscopic programme by two of us (JA and BN) to determine the radial velocities of the presumed metal-poor stars identified in the photometric survey. These observations are made with the ESO 1.5 m telescope and coudé spectrograph on La Silla, Chile, at a dispersion of 20 Å/mm. Baked IIa-O emulsion is used, and one spectrogram (0.4 mm wide) is taken of each star.

The plate taken of HD39917 (F 6570, Oct.7 1978, HJD $2443789^d.8801$) showed the spectrum to be double-lined, with both double absorption lines and double emission components in the CaII H and K lines reaching almost to the continuum level. The two components show no gross difference in spectral type or rotation, the latter corresponding roughly to v sin i ≈ 50 km/s, but they are clearly of different brightness, the measured line ratios corresponding to a luminosity ratio of 0.7-0.8. The spectral type given by Houk (1978) is G8V, in approximate agreement with our spectrum, although we cannot make precise classification at this dispersion of a spectrum with rather diffuse double lines. The measured radial velocities are

$V_1 = +16.2 \pm 1.2$ km/s (brighter comp.)
$V_2 = -63.1 \pm 4.5$ km/s (fainter comp.)

The appearance of the spectrum seemed typical of RS CVn binaries in view of the dwarf classification and rather large rotation, the latter implying a period of the order of a couple of days. It was therefore natural to search for the light variations and possible eclipses characteristic of RS CVn systems.

During 1979 additional uvby and β photometry was therefore obtained (by EHO). No eclipses were detected, but HD 39917 shows the intrinsic variations characteristic of RS CVn-type variables. The uvby photometry (standard system) is given in Table I with mean values and r.m.s. dispersions (one observation).

Table I

HJD 2440000+	V	b-y	m_1	c_1
3226^d.54547	7^m.895	0^m.508	0^m.232	0^m.320
3236.52057	7.895	0.516	0.234	0.304
3931.54434	7.969	0.511	0.236	0.303
3931.61838	7.963	0.519	0.234	0.316
3932.53845	7.869	0.520	0.236	0.326
3933.56253	7.910	0.513	0.242	0.299
3934.55934	7.883	0.509	0.256	0.282
3935.53944	7.856	0.511	0.244	0.300
3935.57493	7.854	0.510	0.243	0.305
3936.55226	7.962	0.512	0.244	0.301
3937.56892	7.856	0.508	0.259	0.296
3938.56645	7.924	0.509	0.246	0.312
3939.51807	7.895	0.507	0.249	0.309
3939.56293	7.886	0.510	0.241	0.317
3940.53901	7.847	0.515	0.237	0.319
3940.59465	7.869	0.509	0.252	0.291
3941.54215	7.942	0.525	0.222	0.338
3941.58864	7.950	0.523	0.229	0.310
4120.89730	7.811	0.514	0.236	0.311
4127.90271	7.855	0.516	0.225	0.328
4129.89667	7.879	0.515	0.217	0.308
4134.89047	7.867	0.519	0.223	0.297
Mean	7.893	0.514	0.238	0.309
Scatter	0.043	0.005	0.011	0.013

The corresponding over-all errors for the 3067 observations made with the same equipment in 1979 are 0^m.004, 0^m.007, and 0^m.007 for b-y, m_1, and c_1, respectively. Thus, b-y shows no indication of variation, while the variations in the u and v bands are somewhat larger than in b and y. This is not due to a lower-than-average number of counted photons in u and v since a minimum of 40 000 photons was uniformly collected in u from all stars in the general programme.

Four β observations were made. The resulting value on the standard system is 2^m.559 ± 0^m.010 (r.m.s. scatter). Generally, the r.m.s. error for 2626 β observations made in 1979 is $0\overset{m}{.}007$. We are tempted to suspect a slight change in the strength of H_β from March 1979, where β was $2\overset{m}{.}551 \pm 0\overset{m}{.}001$ (2 obs.) to October 1979, where β was $2\overset{m}{.}568 \pm 0\overset{m}{.}004$ (2 obs.).

The combined spectrographic and photometric evidence leave little doubt that HD 39917 is a RS CVn-type variable. No further work on this system is planned.

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PHOTOELECTRIC PHOTOMETRY OF THE ECLIPSING BINARY DM Del

The variability of DM Delphini = BD +13°4478 = 137.1935 was discovered by C. Hoffmeister (1). H. Schneller (2) observed DM Del in 1958-59 photoelectrically, deriving the physical parameters of this system. These observations were recorded in the instrumental system and in only one colour. Although H. Schneller mentioned further observations in more colours, no publication of these measurements has come to the writer's attention.

When I started observing DM Del visually in 1968, I was not aware of H. Schneller's work. My estimates led me to the formulation of entirely different elements of variability (3). Several observers have questioned these new elements, and of course, Schneller's work proves their objections to be correct.

In order to check on the current behaviour of DM Del, I decided to observe it photoelectrically during the summer of 1979. The single channel RGUBV-photometer of Basel University, attached to the 1 meter reflector of Gornergrat Station, Switzerland (operated by "Stiftung Hochalpine Forschungsstation Jungfraujoch und Gornergrat") was employed during ten nights, most of them of good photometric quality. Since the principal purpose of this photometer lies in the definition of the RGU-system with bright standard stars, it is not well suited to high-precision photometry of variable stars. The internal accuracy of the 63 observations each in the V- and B-band is therefore only in the order of $0^m.02$ in both V and B-V.

BD +13°4479 (V=9.18±0.02, B-V=0.45±0.02) was used as comparison star while BD +14°4379 served as check star. Since the variable lies only 3'north of the comparison star, the use of standard first order extinction coefficients was sufficient.Standard reduction procedures were employed and the transformation of the instrumental system into the BV-system was checked throughout the observing run.

Table I lists all photometric values.

Table I

JD hel 2400000+	V	B-V	JD hel 2400000+	V	B-V
44062.4384	8.62	0.21	44073.4232	8.63	0.19
.4829	8.68	0.16	.4587	8.67	0.19
.5127	8.71	0.15	.4767	8.68	0.20
.5349	8.75	0.22	44076.3654	8.62	0.19
44063.3648	8.71	0.19	.3862	8.65	0.19
.3766	8.76	0.22	.4147	8.71	0.19
.4065	8.78	0.21	.4425	8.82	0.17
.4336	8.80	0.17	.5001	9.09	0.21
.4579	8.79	0.16	.5307	9.10	0.20
.4836	8.76	0.21	.5571	9.04	0.21
.5058	8.74	0.19	.5723	8.97	0.19
.5266	8.71	0.19	44077.3660	9.10	0.23
.5468	8.68	0.19	.3854	9.09	0.19
44069.4269	8.73	0.19	.4139	8.98	0.18
.4443	8.70	0.20	.4396	8.84	0.16
.4720	8.66	0.19	.4549	8.76	0.18
.4964	8.64	0.19	.4764	8.70	0.17
.5130	8.61	0.19	.4910	8.67	0.20
.5415	8.59	0.19	.5042	8.63	0.17
.5602	8.57	0.19	.5313	8.61	0.17
44070.3991	8.58	0.19	.5556	8.58	0.18
.4200	8.60	0.17	.5847	8.57	0.19
.4491	8.62	0.16	44078.4562	8.60	0.17
.4901	8.68	0.18	.4756	8.56	0.19
.5288	8.79	0.19	.5027	8.65	0.19
.5540	8.94	0.18	.5360	8.70	0.19
.5845	9.09	0.21	.5784	8.76	0.18
44072.4171	8.68	0.20	44079.4110	8.75	0.18
.4470	8.63	0.16	.4694	8.82	0.19
.4900	8.58	0.18	.5103	8.74	0.19
.5275	8.60	0.17	.5826	8.69	0.19
.5525	8.60	0.20			

The GCVS 1969 elements Min.JD Hel=2430663.067+0.8446725·E were used to compute phases. The lightcurve is covered quite well by the observations as can be seen in Fig.1, which compares very well with Schneller's photometry. The totality of the primary minimum as well as the slight asymmetry of the secondary minimum are confirmed. A Fourier-analysis of the V-observations yields the following light curve parameters:

type : EB

$V_{min\ I}$= 9.11 $V_{min\ II}$= 8.80

$V_{max\ I} = V_{max\ II} = 8.58$

$A_I = 0.53 \qquad A_{II} = 0.22$

Min II - Min I = $0^p.50$.

The B-V colour curve shows only a slight difference in temperature between the two components, and possibly indicated reddening during both minima could be attributed to the reflection effect present in this close system.

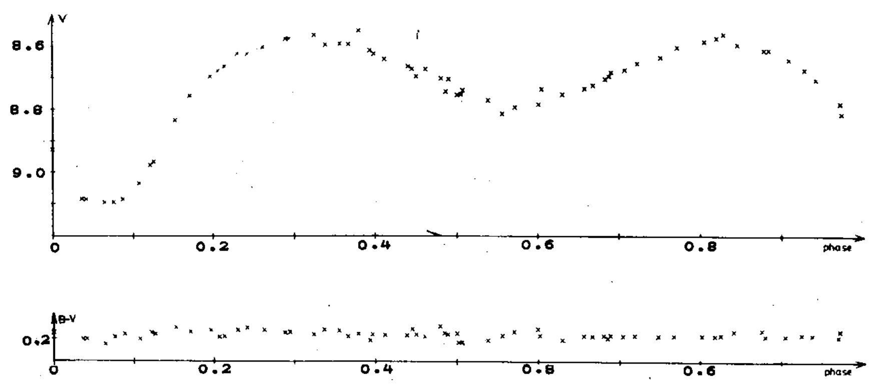

Figure 1. Light- and colour curve of DM Del, reduced with the elements in the GCVS 1969.

Compared to the elements mentioned above, my observations give an O-C value of $+0^d.055$. An improvement of these elements from the current observations alone is not possible.

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PHOTOELECTRIC MINIMA OF AB ANDROMEDAE

Photoelectric observations of the W Ursae Majoris-type eclipsing binary, AB And, were carried out in April 1979. The observations were made using the two-beam, multi-mode, nebular-stellar photometer of the National Observatory of Athens attached to the 48-inch Cassegrain reflector at Kryonerion Astronomical Station.

The filters used, B and V are in close accordance to the standard ones and reduction of the observations were made using Hardie's (1962) method.

During our observations 5 new minima (2 primaries and 3 secondaries) were observed. The following Table gives the Hel. J.D. of these minima, the residuals (O-C) according to three different ephemeris formulae ($(O-C)_I$ Kukarkin's et al. (1969) ; $(O-C)_{II}$ Quester's (1967); $(O-C)_{III}$ Rigterink's (1973)) and the type of minimum.

Table

Hel. J.D. 2444000+	$(O-C)_I$ days (Kukarkin et al)	$(O-C)_{II}$ days (Quester)	$(O-C)_{III}$ days (Rigterink)	Type of Min.
136.3931	+0.0298	+0.0022	-0.0100	p.
136.5579	+0.0287	+0.0010	-0.0116	s.
137.3871	+0.0282	+0.0005	-0.0116	p.
137.5525	+0.0276	-0.0001	-0.0122	s.
138.5486	+0.0281	+0.0004	-0.0118	s.

The times of minima have been computed using Kwee and Van Woerden's method (1956) and are the mean values from both B and V observations.

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NOUVELLE RECHERCHE DE PÉRIODES D'ÉTOILES Ap OBSERVÉES A L'ESO.-V

Il y a dans l'hémisphère sud plusieurs étoiles Ap de magnitudes pas trop élevées qui sont par hasard groupées en α vers 10h-14h et dont les périodes n'étaient pas encore connues. Une mission à l'ESO commencée le 11 mars de cette année et prolongée jusque dans les premiers jours d'avril nous a permis de déterminer les périodes de quelques-unes d'entre elles. Ces déterminations sont faites de la manière habituelle (cf. IBVS 1280,1391,1451, 1658,1755) à partir de mesures uvby au télescope danois de 50 cm. Voici les résultats:

étoile	type spectral	période (j)	grandeur approx. de la variations (mag) y	b	v	u
HD 90044=25 Sex	B9pSiCr	4.37±0.04	0.025	0.04	0.03	0.06
HD 90763=HR 4109	A1pSr	longue?		0		
HD 96616=4 G.Cen	A3pSr	2.433±0.008	0.03	0.035	0.02	0.075
HD 103192=β Hya	B9pSi	2.344±0.009	0.03	0.045	0.04	0.06
HD 110073=ℓ Cen	B8pMn	(0.46j?)		très faible		
HD 112381=GC 17563	A0pSiCr	2.84 ± 0.04	0.005	0.01	0.01	0.01
HD 114365=179 G.Cen	A0pSi	1.272±0.002	0.035	0.03	0.052	0.075
HD 119419=HR 5158	A0pSi	2.605±0.010	0.025	0.04	0.035	0.05
HD 122532=307G.Cen	A0pSi	1.837±0.008	0.045	0.045	0.045	0.05
HD 125630=GC 19369	A2pSiCr	2.205±0.004	0.14	0.06	0.17	0.06

Les étoiles 4 G.Cen et β Hya ont été mesurées avec leur compagnon, dont la distance est de l'ordre de 1"; les amplitudes réelles sont donc plus grandes que celles indiquées ci-dessus, surtout pour β Hya où Δm est petit.

Certaines variations étant remarquables, notamment celle de la dernière étoile par sa double vague et sa grande amplitude en y et en v, nous commentons ci-dessous le cas de chacune.
25 Sex - En y, b et v, le minimum est double, avec un maximum secondaire, dont la phase coïncide avec le maximum de u. La courbe de cette dernière couleur est tout à fait différente:

vague unique avec passage rapide du minimum au maximum. D'autre part, il semble bien y avoir, pour toutes les couleurs, un bref minimum secondaire à une même phase (entre le maximum et le minimum de u) comme on en trouve pour d'autres Ap, notamment juste avant la phase 0.5 pour GC 17353 (Renson 1978) et à la phase 0.6 pour HD 83625 (Renson et Manfroid 1978); mais ici le phénomène est plus marqué.

HR 4109 - Cette étoile est restée constante, dans les limites d'erreur, durant 23j. C'est peut-être une Ap de période très longue.

4 G.Cen - La variation est en phase dans les quatre couleurs et a un minimum très plat, avec même, semble-t-il, un léger maximum secondaire en u, où la variation est plus grande (et en c_1).

β Hya - Les quatre courbes sont aussi en phase et le maximum est un peu plus aigu que le minimum. Il semble y avoir, vers le début de la branche ascendante de chaque courbe, un bref minimum secondaire analogue au phénomène signalé ci-dessus pour 25 Sex.

ℓ Cen - L'amplitude est extrêmement faible et il est presque impossible de déterminer la période. Elle est peut-être d'un peu moins de 0.46j, ce qui serait la plus courte période observée pour une étoile Ap.

HD 112381 - La variation est aussi faible que pour l'étoile précédente, bien que celle-ci soit au Si et la précédente au Mn. La variation est en phase pour y, b et v, mais déphasée pour u.

179 G. Cen - La variation de cette étoile présente une remarquable double vague en y, b et u, mais pas en v. A la phase du maximum de v, ont lieu en y le maximum secondaire, en b le maximum principal et en u de nouveau le maximum secondaire, presque égal au maximum principal. Il résulte de ceci une grande amplitude en c_1 (0.14 mag) avec évidemment un maximum principal à la phase du minimum de v et du maximum principal de u.

HR 5158 - Les quatre courbes sont en phase, avec une descente un peu plus lente que la montée (comme pour v à l'étoile précédente) et un maximum un peu plus aigu que le minimum.

307 G.Cen - Les quatre courbes sont aussi en phase et ont cette fois presque les mêmes amplitudes; le minimum est un peu plat.

HD 125630 - Cette étoile a une des plus grandes amplitudes de variation qu'on connaisse en y pour une Ap et elle n'est dépassée en v que par GC 17353 (Renson 1978). C'est d'autant plus remarquable ici qu'il y a une double vague. En y, b et u, il y a deux minima égaux et des maxima inégaux; le maximum principal de y correspond au maximum secondaire de u, tandis que b est intermédiaire avec un maximum principal à la même phase que y, mais guère plus grand que la maximum secondaire. Comme pour 179 G.Cen, v a un comportement tout différent: il y a un profond minimum juste après le maximum principal de y et un petit minimum secondaire à une phase intermédiaire, entre deux maxima inégaux. La variation de c_1 (environ 0.345 mag) est aussi remarquablement grande, ressemblant à celle de y pour la forme et la phase.

Pour deux des étoiles etudiées, une des deux étoiles de comparaison a été trouvée légèrement variable; ce sont HD 90994=β Sex et HD 103789=HR 4571.

Plus de détails et les graphiques seront publiés ailleurs.

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VARIABILITY OF HD 137147 (COMPARISON STAR OF UCrB) AND "A FLARE" OF HD 137050

Photoelectric light curves of U Cr B have been published by Wood (1958), Catalano et al. (1966), and Svolopoulos and Kapranidis (1972). These light curves show larger-than-normal scatter, which varies from $\pm$ 0.05 mag to $\pm$ 0.1 mag. All observers used comparison star HD 137147 (= BD + 32^{o}2578, Sp Tp F0). We have monitored this star against HD 136654 (= BD + 31^{o}2724, Sp Tp F8V (Buscombe 1977)) and HD 137050 (= BD + 32^{o}2577, Sp Tp F8). We report a "flare" on HD 137050 and light variation of the comparison star HD 137147. All evidence suggests that HD 136654 is truly constant in brightness, and we refer to it below as the "reference" star.

Observations were obtained on small portions of six nights at Kitt Peak National Observatory between UT May 19 and May 26, 1980, using the No. 4 0.4M and No. 2 0.9M reflectors, and on larger portions of six nights at Prairie Observatory between May 5 and June 30, 1980, using the 1.0M reflector. Single channel pulse-counting photometers with RCA 031034A-02 photomultiplier tubes were used for all observations. Five color uvby I_K photometry was obtained by repeated cycling among the three stars and sky. Standard stars were observed on three nights at KPNO and two nights at PO to determine transformation and extinction coefficients. Differential magnitudes (relative to the reference star) were corrected for differential extinction and transformed to the standard Strömgren-Crawford and Kron systems; yellow magnitudes were converted to Johnson V.

a) "FLARE" OF HD 137050

A slow, low-amplitude flare was observed on HD 137050 on May 21 1980 at KPNO with the No. 4 0.4M reflector. The night was photometric, and the mean error per differential measurement, HD 137147-reference, was $\sim$ 0.006 mag. Sky

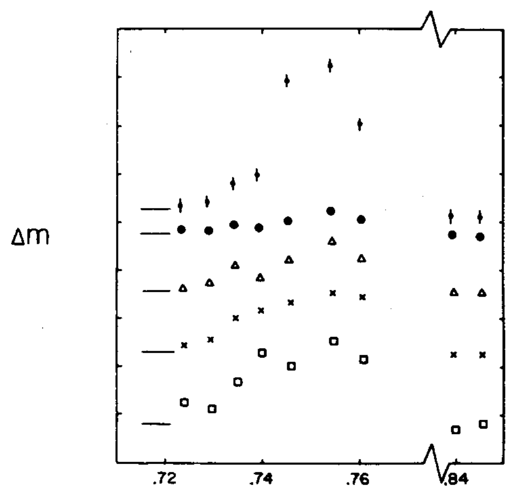

Figure 1: Light curve of the flare in HD 137050. Top to bottom, infrared to ultraviolet. Curves have been shifted vertically for clarity; Δm = HD 137050 - reference, and steps are 0.1 mag. Quiescent light levels are indicated by horizontal lines. Mean errors are shown on the I - curve, and are somewhat smaller in other colors.

counts were uniformly low and the flare event, shown in Figure 1, was undoubtedly real. The event was not recognized at the telescope and observations were stopped during light decline; a brief check two hours later showed the star at quiescent light level. This was the only flare-like event observed in 16.4 hours of monitoring on 12 nights. On the other 11 nights, HD 137050 was constant in all colors to $\lesssim$ 0.005 mag (Figure 2), except on June 26 and 28 when a slow variation $\sim$ 0.02 to 0.03 mag was noted in v and u. Quiescent levels are noted in Figure 1. Classical flare stars are typically dMe stars, though a few cases of unusual flare-like activity are known in B and A stars, (Kunkel 1975). It is of interest to inqure how similar the HD 137050 flare was to the UV Ceti phenomenon.

The reference star was tied to the standard systems on three photometric nights at KPNO, yielding: V = 6.920 $\pm$ 0.007 (m.e.), (b-y) = 0.314 $\pm$ 0.002, m_1 = 0.182 $\pm$ 0.002, c_1 = 0.426 $\pm$ 0.011, (u-b) = 1.418 $\pm$ 0.010, $(V-I_K)$ = 0.37 $\pm$ 0.02. From the mean quiescent Δmag, we find for HD 137050: V = 8.644, (b-y) = 0.336, m_1 = 0.186, c_1 = 0.348, (u-b) = 1.392, and $(V-I)_K$ = 0.42, with mean errors equal to the reference star values. All indices for HD 137050 are consistent with unreddened spectral class F8. An M dwarf companion could be present without changing these colors significantly, and could flare intensely enough to give the observed flare amplitude. However, $T_{0.5}$, the flare duration at half-peak light, appears to be $\gtrsim$ 30 min, assuming that our poor time resolution has not lowered the observed peak significantly. Typical UV Ceti-type flare durations have mean values $\lesssim$ 1 min, and range from fractions of a minute to $\sim$ 10 minutes in rare cases (Kunkel 1973). Recently, though, Contadakis et al. (1980) observed a flare of EV Lac with $T_{0.5} \sim$ 30 min. It does seem likely that the flare was associated with the F8 star. If the M star relation between increasing flare duration and luminosity (Kunkel 1975) can be extrapolated to F8, this association becomes still more probable. Observed flare amplitudes are: u, 0.18; v, 0.11; b, 0.10; V, 0.05; I_K, 0.30 mag, giving rather uncertain excess flare light colors (b-y) $\approx$ -0.5 $\pm$ 0.2 and (u-b) $\approx$ +0.8 $\pm$ 0.1. These colors translate roughly to (B-V) $\approx$ -0.9 $\pm$ 0.4 and (U-B) $\approx$ -0.5 $\pm$ 0.1, and place the flare somewhat to the left of the UV Ceti region on the color-color plot of Cristaldi and Rodonò (1975). It is uncertain how valid the intermediate- to broad- band transformation is, given the probable emission-line nature of the spectrum. Peak flare luminosity $\approx 4 \times 10^{32}$ erg sec^{-1}, which is near the maximum radiation rate found by Cristaldi and Rodonò for UV Ceti flares. The total energy radiated by the event $\approx 7 \times 10^{35}$ erg. By the few criteria described here, it seems possible that this flare did occur on the F8 star, and that its properties roughly fit extrapolations from the UV Ceti region.

b) U Cr B COMPARISON STAR HD 137147

Except for the flare and for small violet and ultraviolet variations noted above, HD 137050 was constant relative to the reference state on all nights in all colors. Visual differential magnitudes are shown in Figure 2.

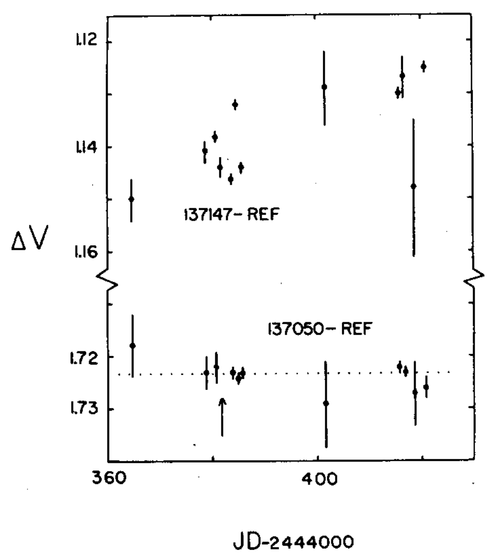

Figure 2: Differential visual magnitudes for U Cr B comparison star (above) and flare star (below). Vertical arrow marks the time of the flare. Nightly mean errors are shown.

Similar data for HD 137147 show a secular brightening of ∿ 0.025 mag over the 56-day interval, on which smaller, more rapid, fluctuations are superimposed. The secular brightening ranges from ∿ 0.01 mag in the ultraviolet to ∿ 0.03 mag in the near infrared. Since the full variation in HD 137147 has probably not been observed, it is possible that most of the scatter in published light curves of U Cr B originated in comparison star variability.

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PHOTOELECTRIC PHOTOMETRY OF THE BRIGHT METALLIC-LINE ECLIPSING BINARY δ CAPRICORNI

δ Capricorni (HR 8322; HD 207098; ADS 15314) is one of the nearest (d~15pc) and brightest (V_{max}=+2.83) eclipsing binary systems, consisting of a metallic-line A7-type primary and a cooler, less massive component.Although it has been known to be a variable star for about 25 years, little attention has been paid to it, and no light curve has yet been published. Spectrographic studies of the system have been made by Crump (1921), Stewart (1958), and Batten (1961) where only the spectrum of the Am star has been seen. The light variability of δ Cap was discovered by Eggen (1956) when the primary eclipse with a depth of about 0.16 mag in V was observed. Subsequent photoelectric observations made by Wood and Lampert (1963) confirm Eggen's result and reveal possible variations in the depth of the primary eclipse.They suggest that this may be due to variations in the light of the comparison star.

Photoelectric observations of δ Cap were obtained on 39 nights from September 1977 through October 1978 at Biruni Observatory using the 51 cm reflector and at Villanova University Observatory using the 38 cm reflector. The Biruni telescope is equipped with an RCA 4509 photomultiplier tube and a chart recorder was used to record the observations. The photoelectric photometer employed with the Villanova telescope is equipped with a thermoelectrically cooled (to -10^{o}C) RCA C31034A gallium-arsenide photocell and a microprocessor-controlled integrating system. Pairs of matched intermediate- and narrow band interference filters centered near the wave-length of the Balmer Hα line (λ 6563) were used at both observatories. The Hα filter pairs are similar to those used by

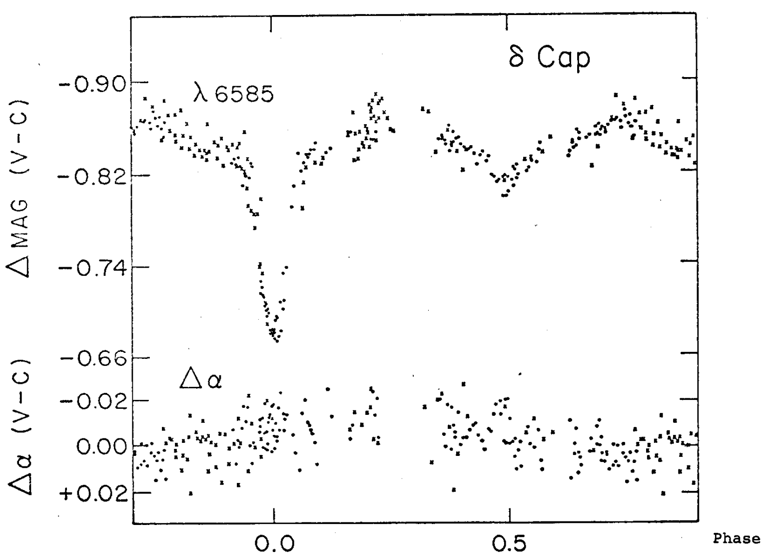

Figure 1. The λ6585 light curve and α-index of δ Capricorni plotted against orbital phase. Circles (•) are Biruni observations, crosses (×) are Villanova observations.

Baliunas, Ciccone and Guinan (1975) in the definition of the Villanova Hα system.The Hα intermediate bandpass filter is centered at 6585Å. with a FWHM = 280Å. It is broad enough to be little affected by the presence of the Hα feature within the bandpass. Additional observations were obtained at Biruni Observatory using a Strömgren u filter and at Villanova using an intermediate-band filter centered near 7790Å, with a FWHM = 180Å.

The comparison star was γ Cap while κ Cap and μ Cap served as check stars. The observing sequence was the standard pattern of sky-comparison-variable-comparison-sky with each observation lasting about 50 seconds. The effects of differential atmospheric extinction were removed, and 2 point normals were formed. In Fig. 1, differential magnitudes in the Hα intermediate bandpass are plotted against the phase, computed from the ephemeris given by Eq. 1 where zero phase corresponds to the time of mid-primary eclipse. Also shown in Fig. 1 is the α-index, defined in the usual way (Dorren et.al, 1980) which yields a measure of the net strength of the Hα line.

As shown in the figure, the light curve is well defined and shows two minima of unequal depths and two rounded maxima. The secondary minimum appears to occur close to 0.50 phase in agreement with the circular orbit indicated spectroscopically by Batten. The depths of primary and secondary minima are about 0.18 mag and 0.05 mag, respectively. The depths of primary and secondary minima for the u and the λ 7790 bandpasses are essentially identical with the values given above for λ 6585.

It is clear that there is considerable scatter in the observations. No significant variations were found between the comparison star and the check stars above the level of ±0.008 mag, however, so that the observed scatter in the light curve appears intrinsic to δ Cap. Light variations on a time scale of several hours also appear in the data. As shown in the figure, the scatter in the α-index is relatively large. A peculiar phase-dependent variation appears to be present with Δα having the smallest (negative) values from 0.1 to 0.5 phases and its largest value from about 0.7 to 0.9 phase. This behaviour indicates that the net Hα (absorption) line strengh is weakest from 0.1 to 0.5 phase and strongest at 0.7 to 0.9 phase. A small decrease in the α-index is expected at primary eclipse when the A7m star with its strong Hα line is partially eclipsed by a cooler star with relatively weak hydrogen lines. Although the effect of the eclipse can be seen in the α-index from 0.95 to 0.05 phases, the behaviour of the α-index described above is anomalous and could indicate the presence of a gas stream or a hot (or cool) spot on the surface of the hotter component. Similar behaviour in Hβ and Hα has been observed by Guinan (1971) for the 0.667 day eclipsing binary V1010 Oph.

A more refined light ephemeris was determined by combining the two previous times of primary minimum given by Eggen and by Wood and Lampert with our own timings to obtain:

$$T\ (\text{MIN.I}) = \text{HJD}\ 24356 56.\underset{\pm 2}{913} + 1\overset{d}{.}02276\underset{\pm 3}{88} \cdot E \qquad (1)$$

There is no evidence of any significant change in the apparent period.

A preliminary analysis of the observations indicates an orbital inclination of $i \sim 67^{\circ}$, with the primary eclipse a partial transit. It would appear that the system is composed of an A7m primary and a cooler ($\sim 4700^{\circ}$K) secondary near its Roche lobe. A detailed analysis of the light curves using the Wilson-Devinney program will be published later.

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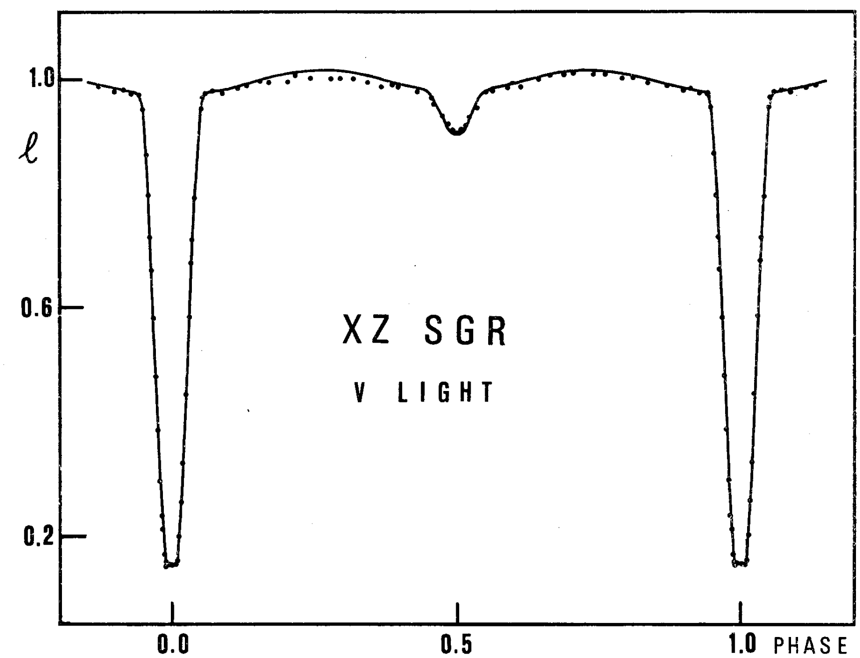
REVISED PHOTOMETRIC ELEMENTS OF XZ Sgr

The eclipsing variable XZ Sagittarii is an Algol-type system with a period of 3.28 days, composed of a main sequence A3 star and a G5 subgiant. Photoelectric observations of this binary have been performed by Knipe (1974) in V and B, and later by Kappelmann and Walter (1979) in V, B and U. Knipe found some problems in the solution of the light curves, mainly because of the unexpected absence of a normal reflection effect and the non-evidence of the orbital eccentricity found spectroscopically by Sahade (1945,1949). Suspecting that the problems that Knipe found were caused by gas streams in the system, Kappelmann and Walter did not use any conventional method, but applied the procedure described by Walter (1976) to take into account the absorption of the gas stream.

The orbital elements obtained by both Knipe and Kappelmann and Walter are however based on the rectifiable models of Kitamura (1965) and Russell and Merrill (1952), respectively, which we know have often led to misleading results (Mardirossian et al., 1980).

Therefore we decided to obtain new geometric and photometric elements for XZ Sgr, using the direct method developed by Wilson and Devinney (1971), whose original computer code has been modified in order to run on a DEC PDP-11/34A minicomputer (Maceroni et al., 1980). In this model, based on the Roche geometry, the light curve is computed as a function of the following parameters: i (inclination), $\Omega_{h,c}$ (surface potentials), $T_{h,c}$ (polar temperatures), $q=m_c/m_h$ (mass ratio), $L_{h,c}$ (unnormalized monochromatic luminosities), $g_{h,c}$ (gravity darkening parameters), $x_{h,c}$ (limb darkening parameters), $A_{h,c}$ (reflection parameters). The subscripts h and c refer to hotter and cooler component, respectively. Using the 75 normal points in V light given by Kappelmann and Walter (1979) and performing the solution using the second of



1.0
ℓ
0.6
0.2
XZ SGR
V LIGHT
0.0
0.5
1.0
PHASE

the seven modes offered by the program (cfr. Leung and Wilson, 1977) the following elements have been derived:

i	= 88.5 ± 0.2	$L_h/(L_h+L_c)$	= 0.1787
Ω_h	= 7.706±0.055	$L_c/(L_h+L_c)$	= 0.8213±0.0050
Ω_c	= 2.112±0.021	T_h	= 9200°K
q	= 0.14 ± 0.02	T_c	= 5150 ± 20°K
r_h(pole)	= 0.1321	x_h	= 0.53
r_h(point)	= 0.1324	x_c	= 0.73
r_h(side)	= 0.1323	A_h	= 1.0
r_h(back)	= 0.1324	A_c	= 0.5
r_c(pole)	= 0.1994	g_h	= 1.0
r_c(point)	= 0.2459	g_c	= 0.32
r_c(side)	= 0.2061		
r_c(back)	= 0.2295		

The agreement with the solutions of the previous investigations is very good, but the absence of the rectification procedure ensures that effects such as reflection and polar brightening have been taken into the proper account. However, the not very good fitting in the maxima that can be seen from the Figure, validates the hypotheses of gas streams in the system and of a hot region on the A star advanced by Kappelmann and Walter (1979). New photoelectric and spectroscopic observations could allow a more detailed study of these effects, not rare in Algol systems.

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PERIODS AND PHOTOGRAPHIC MEAN LIGHT CURVES OF 17 LONG PERIOD VARIABLES IN A FIELD AROUND $\alpha = 17^h$, $\delta = -70°$

This bulletin summarizes the results of an investigation of 17 long period variables situated in Apus, Ara, and Triangulum Australe. Six out of these stars were already known to be variable (CF Aps, EF Tr A, FS Tr A, CQ Aps, DN Aps, and XX Aps), but up to now no periods or mean light curves have been determined for these stars. The remaining eleven variables have been discovered with a blink microscope. The light variability of the present 17 long period variables has been measured on 401 photographic plates that were taken with the 10-inch telescope of the Boyden Observatory. The observations span 11 years. The apparent magnitudes of the variables were estimated with Pogson's method using at least six comparison stars for each variable star. When a variable becomes fainter the the limiting magnitude of the photographic plates, which is about $16^{m}.1$, it is given the apparent magnitude $16^{m}.1$. The apparent magnitudes of the comparison stars have been derived from stars counts on one square degree around each variable and from interpolations in the tables of the Groningen Publication Nr. 43. The periods and the mean light curves have been determined by means of computer analysis using the Phase Dispersion Minimization (PDM) method (Stellingwerf, 1978), which is extremely adequate for the determination of the periods and the mean light curves of long period variables. The PDM method has been used with a bin structure $N_b = 20$, $N_c = 2$.

The variables are indicated on identification charts 1 - 17. These identification charts cover a field of about 30 minutes of arc square and have North on top. On Table 1 we have listed for each variable the program number, the provisional coordinates, the period, the apparent magnitude of maximum light of the mean photographic light curve, the number of observed moments of maximum light, and the epoch. No amplitude is given for stars that become fainter than the limiting amplitude of the photographic plates. Note that the maximum of the mean light curves underestimates the true maximum by an amount of about $A/N_b \simeq 0^m.2$ which is about the accuracy of the magnitude determination of the comparison stars. On Table 2 we have summarized the basic quantities of the PDM analysis of the light curves. θ_{min} is typically of the order of 0.1 or smaller so that generally 90% or more of the initial variance has been removed by the mean light curve at the indicated period. The signal to noise ratio is typically 4 to 5.

We have also given a list of remarks on individual variables. In this list we have identified the six variables which were already known in the literature, and we have also indicated the stars that are invisible during a considerable fraction of the total phase intervals.

Light curves are shown in Figures 1 - 17. Individual observations are indicated by an asterisk *, bin means by +, the spline fit to the bin means, which is used to remove the oscillation from the data and to calculate the residuals, by ×; when two of or all three symbols coincide, the symbol Q is used.

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Reference:

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Table I

Nr	α 1900	δ 1900	P	V_{max}	A	NE	Nm	JD 2438000+
1	$16^h08^m03^s$	$-68^\circ18'.7$	206.3	12.4		219	3	729
2	16 21 08	- 72 22.0	233.9	11.6		295	4	769
3	16 27 51	- 69 04.0	265.5	14.45		326	1	644
4	16 30 12	- 68 03.1	224.7	10.9	3.25	316	4	796
5	16 30 50	- 66 22.2	271.6	12.95		321	2	717
6	16 32 22	- 69 49.3	202.0	14.5		289	2	760
7	16 35 01	- 71 49.7	249.6	13.0	1.5	302	5	781
8	16 36 00	- 64 58.2	206.8	13.05		225	1	826
9	16 44 03	- 66 43.2	253.6	14.8		334	1	806
10	16 47 42	- 71 19.5	137.0	10.8	2.15	314	4	700
11	16 55 17	- 72 17.2	390.5	12.8		350	4	696
12	16 56 25	- 65 08.1	279.2	12.15		229	1	710
13	16 59 19	- 72 04.5	209.9	13.95		329	1	765
14	17 11 13	- 66 57.9	204.9	13.8		319	1	737
15	17 13 52	- 66 11.8	178.6	14.1		284	2	713
16	17 14 23	- 69 12.8	170.0	12.3	2.95	322	5	720
17	17 26 24	- 66 49.9	225.8	11.65		322	4	687

Nr : program number which refers to the identification chart; α δ: provisional coordinates for 1900; P : period in days; V_{max}: apparent magnitude of maximum light of the mean photographic light curve; A : total variation of the mean photographic light curve; NE : number of estimates; Nm : number of observed moments of maximum light; JD : mean epoch.

Table II

Characteristic quantities of the PDM analysis of the light curves

Nr	σ^2	σ_N^2	σ_0^2	θ_{min}	ϵ
1	1.523	0.042	1.481	0.035	5.9
2	1.807	0.193	1.614	0.118	2.9
3	0.132	0.005	0.127	0.064	5.0
4	1.279	0.053	1.226	0.053	4.8
5	1.206	0.063	1.143	0.074	4.3
6	0.439	0.008	0.431	0.022	7.4
7	0.314	0.003	0.311	0.100	3.3
8	1.438	0.048	1.390	0.043	5.4
9	0.250	0.009	0.241	0.052	5.1
10	0.426	0.025	0.401	0.069	4.0
11	1.475	0.025	1.450	0.024	7.6
12	1.781	0.051	1.730	0.038	5.9
13	0.577	0.040	0.537	0.091	3.6
14	0.696	0.031	0.665	0.059	4.6
15	0.437	0.039	0.398	0.106	3.2
16	1.121	0.047	1.074	0.062	4.8
17	2.926	0.072	2.854	0.033	6.3

Individual remarks

Var. 2. = CF Aps. Var. 3. = Invisible during about 2/3 of the total phase interval. Var. 4. = EF Tr A. Var. 5. = FS Tr A. Invisible during about 1/2 of the total phase interval. Var. 7.= CQ Aps. Var. 9. = Invisible during about 7/10 of the total phase interval. Var. 13. = DN Aps. Var. 15. = Invisible during about 3/5 of the total phase interval. Var. 16.= XX Aps. Semiregular variable, brightness at minimum light is variable.

5 6 7

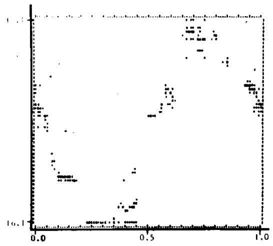


FIG. 1 Variable 1

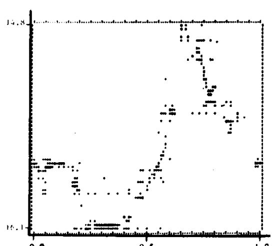


FIG. 2 Variable 2

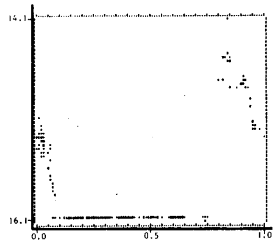


FIG. 3 Variable 3

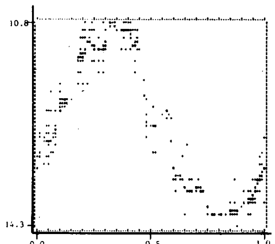


FIG. 4 Variable 4

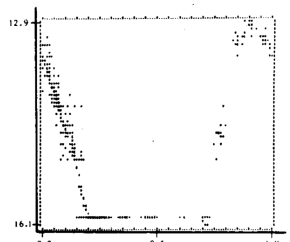


FIG. 5 Variable 5

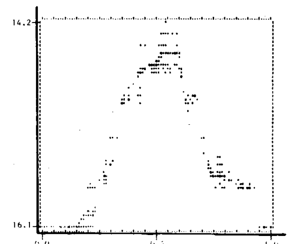


FIG. 6 Variable 6

8 9 10

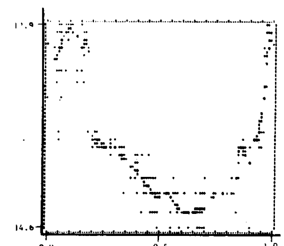


FIG. 7 Variable 7

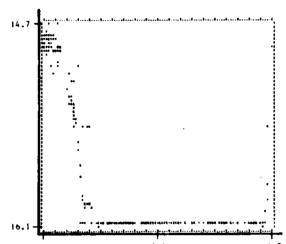


FIG. 9 Variable 9

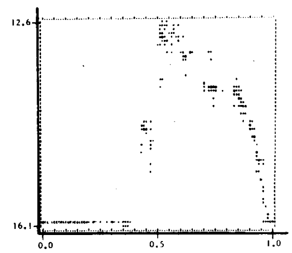


FIG. 11 Variable 11

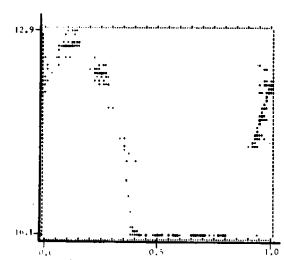


FIG. 8 Variable 8

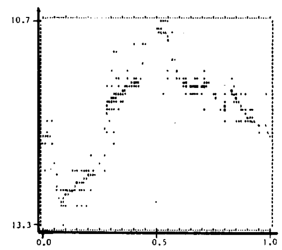


FIG. 10 Variable 10

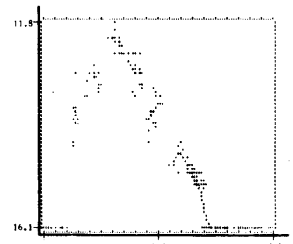


FIG. 12 Variable 12

11

12

13

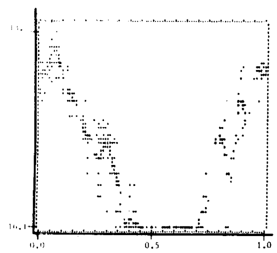


FIG. 13 Variable 13

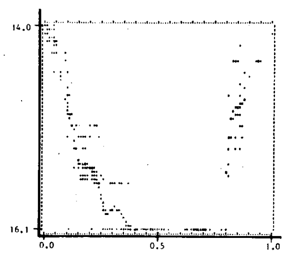


FIG. 15 Variable 15

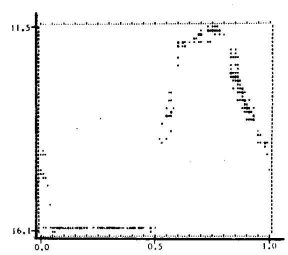


FIG. 17 Variable 17

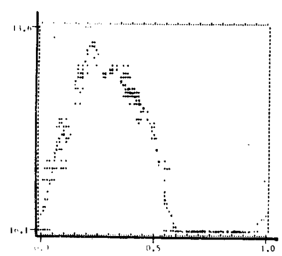


FIG. 14 Variable 14

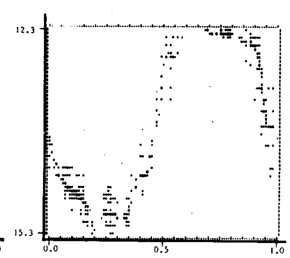
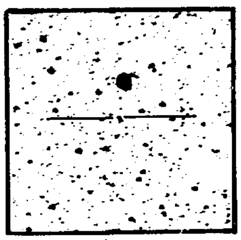


FIG. 16 Variable 16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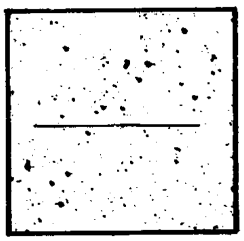
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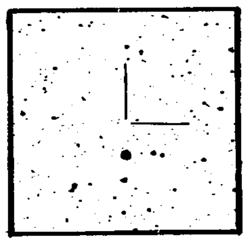
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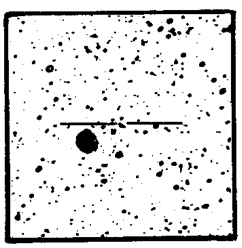
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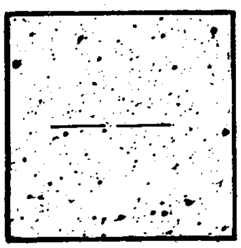
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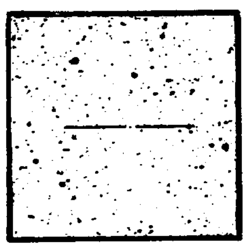
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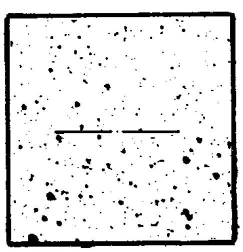
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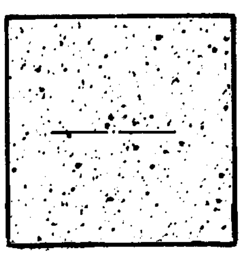
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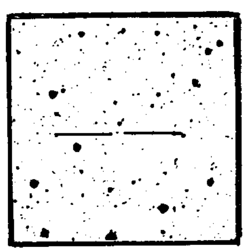
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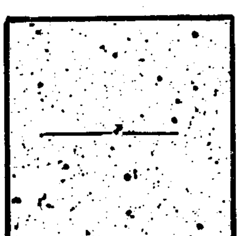
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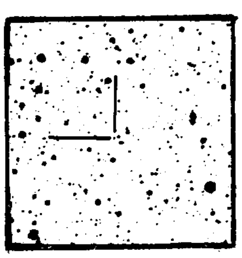
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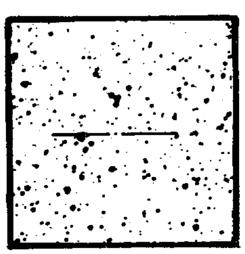
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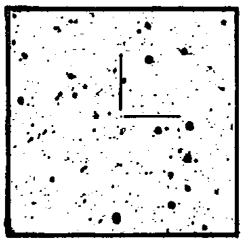

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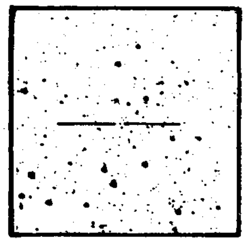

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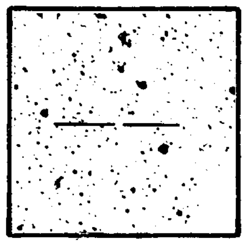

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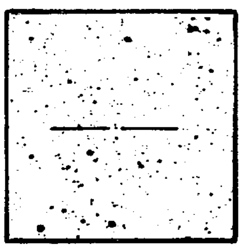

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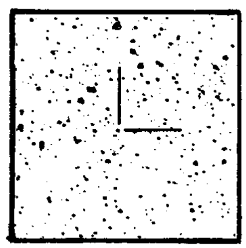

Var. 17

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THE VARIABILITY OF HR7442

HR 7442 (GC27045,HD184786) was selected for photoelectric monitoring from a list of potentially variable stars (Hoffleit, 1979). This bright star ($V=6^m.2$) has a spectral type of M4.5 III (Buscombe, 1977) and is well placed for Northern hemisphere observers (1950: R.A. $19^h32^m19^s$, Dec. $49^o9'.2$).

This star was observed during the second half of 1979 from two observatories.The observations consist of 119 delta manitudes in the V band, taken on 28 nights scattered over this time interval. The nightly averages are plotted in Figure 1, and they show an irregular variability on time scales of tens of days, with an amplitude of about two tenths of a magnitude. Between JD2444192 and JD2444223 the comparison star (GC27078) was measured differentially with respect to GC26990 on five nights, and was found constant to 0.01 magnitude.

Since this was a search for variability, the data have not been reduced to the standard UBV system. One observer (DRS) used a 1P21 photomultiplier and standard V filter, and this instrumental system is quite close to the UBV standard. The other observer (TGM) used a silicon photodiode detector and filter, and this instrumental system had a sufficiently different response so that $0^m.13$ had to be subtracted from its delta magnitudes to bring them into agreement with the 1P21 data.

The variations in HR 7442 seem to have cycle length that range from 29 to 45 days, and this would lead to a tentative classification of SRb (Hoffleit, 1980). The SRb class is defined as having semiregular periods of 20 to 50 days, amplitudes under $0^m.5$, and spectral classes M3.5 III to M5 III. An Lb star, such as Gamma Ret, also bears a strong resemblance to HR 7442, so the SRb classification remains tentative.

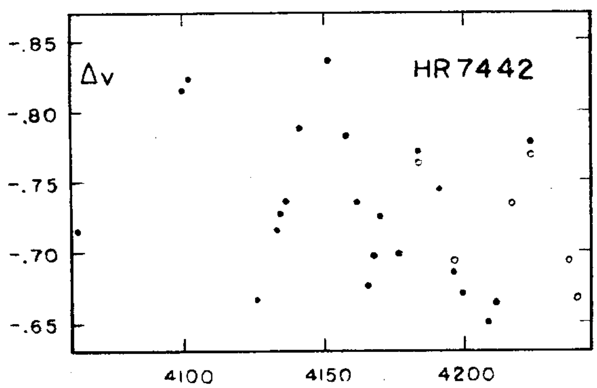

Figure 1. Observations of HR 7442 plotted as nightly averages of instrumental delta V magnitudes vs. Julian day (+2440000). Filled circles are measurements taken by DRS and open circles are measurements taken by TGM.

One of us (TGM) has observed this star again in May and June of 1980, and finds that HR 7442 continues to vary, with characteristics similar to those noted last year.

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LIGHT ELEMENTS OF AG PHOENICIS

The variability of AG Phe=BV 1488=SAO 215098=HD 2320 (A3) was discovered by Strohmeier (I.B.V.S. No. 610, 1972) on sky patrol plates. He describes the star as an EB-type variable showing an amplitude of $0^m.5$ and a deep secondary minimum. From 14 times of minimum light he obtained a period of $1^d.510653$.

The variable (BV 1488) was listed as AG Phe by Kukarkin et al. (GCVS, 2nd Suppl., 1974).

Eggen (A.J. 83, 288, 1978) obtained u,v,b,y,β observations of the system, showing constant light of $V_E=8^m.9$ at maximum, in disagreement with EB characteristics. Also, he found a midsecondary minimum of $V_E= 9^m.4$ suggesting a shift from phase 0.5, or a slightly incorrect period.

In this note I present 7 photoelectric times of minimum light covering 524 cycles derived from about 1000 UBV observations made between September 1978 and August 1979. Of these observations 200 were made with the 154 and 76 cm reflecting telescopes of Bosque Alegre and El Leoncito, respectively in Argentina; and the rest with a 40 cm telescope of Cerro Tololo Observatory in Chile*.

The present photoelectric observations show the existence of a shallow secondary minimum, instead of a deep one, and that therefore the period is half of the value previously derived by Strohmeier.

Individual minima are listed in Table I. The standard errors given in parentheses were determined from the light curves on each pass-band. A least squares linear ephemeris using the mean values of the minima in the UBV bands, gives

$$\text{Min I} = \text{JDHel } 2444170.79481 + 0^d.75533809 \cdot E \qquad (1)$$
$$\pm.00018 \quad \pm.00000059$$

Table I .Individual times of Minima

V	JDHel 2440000+ B	U
3778.7749(04)	3778.7745(03)	3778.7756(03)
3781.7957(03)	3781.7954(04)	3781.7956(09)
3902.6494(03)	3902.6487(03)	3902.6483(10)
4170.7951(08)	4170.7949(04)	4170.7948(03)
4171.5509(03)	4171.5507(07)	4171.5501(03)
4173.8161(04)	4173.8157(04)	4173.8144(09)
4174.5715(04)	4174.5717(03)	4174.5721(08)

Table II .Photographic and Photoelectric times of Minima

JDHel 2400000+	w	cycles	(O-C)	(O-C)'
38309.365	0.5	-7760.0	0.030	
38315.369	0.5	-7752.0	-0.008	
38318.369	0.5	-7748.0	-0.030	
38340.292	0.5	-7719.0	-0.012	
38614.528	0.5	-7356.0	0.035	
38642.446	0.5	-7319.0	0.005	
38670.374	0.5	-7282.0	-0.015	
38695.340	0.5	-7249.0	0.025	
39053.350	0.5	-6775.0	0.003	
39361.490	0.5	-6367.0	-0.073	
39383.418	0.5	-6338.0	-0.014	
40415.233	0.5	-4972.0	0.002	
40526.302	0.5	-4825.0	0.036	
40823.093	0.5	-4432.0	-0.023	
43778.77502(49)	1.5	- 519.0	0.0024	0.0007
43781.79559(14)	1.8	- 515.0	0.0015	-0.0001
43902.64902(37)	1.6	- 355.0	0.0001	-0.0008
44170.79486(09)	1.9	0.0	-0.0008	0.0000
44171.55052(39)	1.6	1.0	-0.0005	0.0004
44173.81577(47)	1.5	4.0	-0.0012	-0.0004
44174.57167(16)	1.7	5.0	-0.0007	0.0002

The photographic minima given by Strohmeier and the present observations lead to the following ephemeris:

$$\text{Min I} = \text{JDHel } 2444170\overset{d}{.}7956 + 0\overset{d}{.}7553429 \cdot E \qquad (2)$$
$$\pm.0045 \quad \pm.0000011$$

The data for both ephemeris are listed in Table II; weights w=0.5 are given to photographic minima, while w=0.1 ln(1/σ) to the colour-averaged photoelectric values; (O-C) and (O-C)' are the residuals from (1) and (2), respectively. It is seen that the errors of the photoelectric elements are smaller than the photographic ones. The period including all observations over 16 years is slightly larger than the present value determined from photoelectric data alone. This would indicate that the period

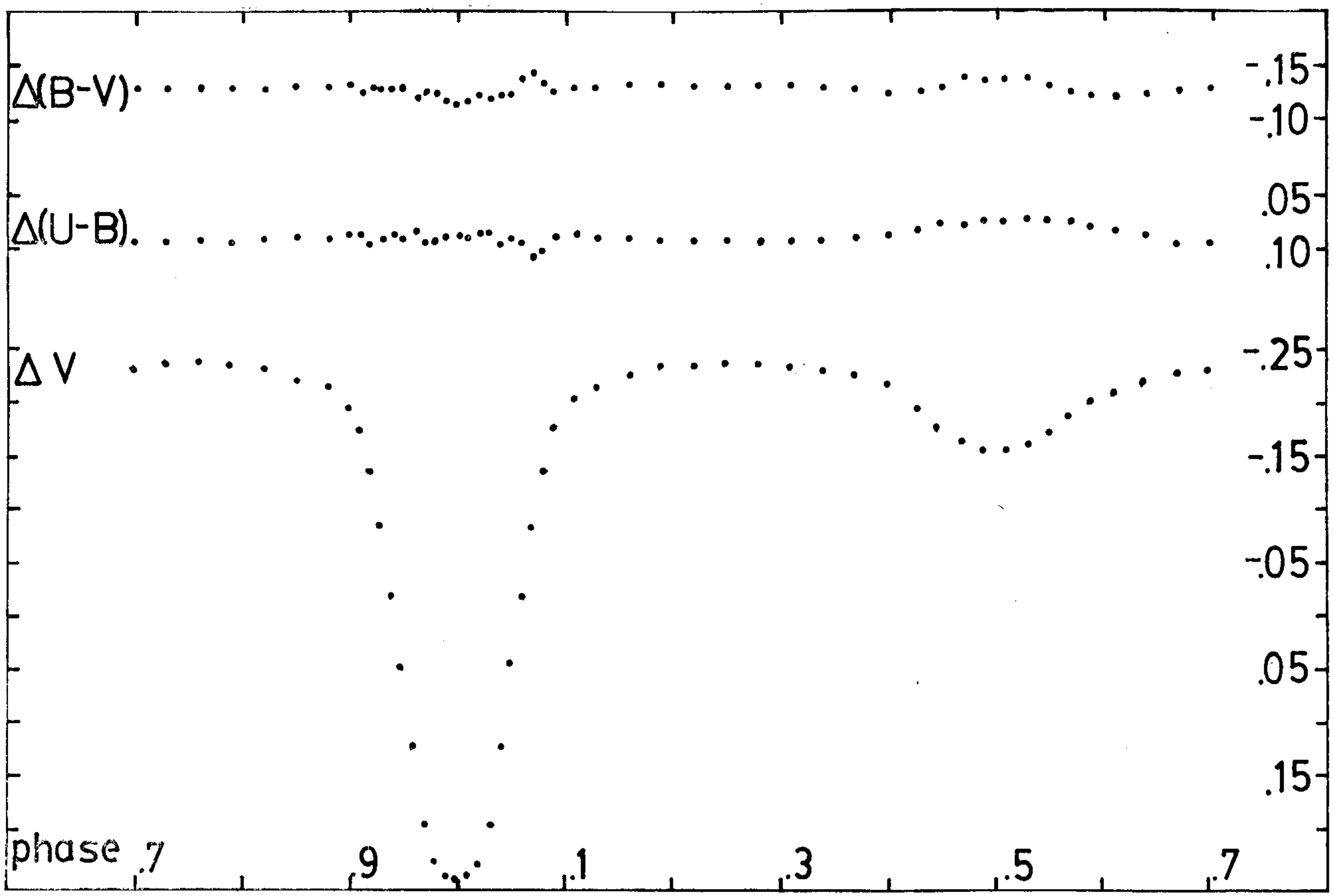

Figure 1. Mean light and colour curves of AG Phe.

is decreasing at a ratio of about 2.6×10^{-2} sec/year. However photographic residuals are very large, therefore more photoelectric observations are needed in order to establish the period-decrease.

The light curves (Figure 1) show partial eclipses with minima fairly different in depth, the amplitude of the symmetrical primary minimum is $0^m.49$, while that of the secondary is $0^m.08$, displaying its descending branch steeper than the ascending one. The secondary eclipse is centered around phase 0.5, but due to its asymmetry and shallowness small eccentricities are not excluded. The light and colours outside eclipses are almost constant.

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VARIABILITY OF COOL CARBON STARS SITUATED NEAR OR IN INTERMEDIATE-AGE OPEN CLUSTERS

Absolute magnitudes and masses of carbon stars are still very poorly known. Individual parallaxes of carbon stars - members of double or multiple systems or stellar clusters might substantially improve the situation. To get more reliable photometric data for carbon stars situated near or in open clusters, photographic monitoring of these stars have been carried out at Baldone with the Schmidt telescope (80/120/240 cm) of the Radioastrophysical Observatory. The observations have been made in three passbands: R(0.63) - ORWO ZPI plates + Schott RG1 filter, V - A 600 films + ZHS 17 filter, B - ZU2 or ZU21 plates + GG13 filter.

Summary of the photometry of the carbon stars - apparently associated with the intermediate-age (10^9-$0.4x10^8$ years) open clusters are presented in Table I. Of the eleven carbon stars studied eight are named variable stars, the other three have also shown definite light variations. Some additional information for all of the stars follow.

V532 Cas = CCS 3210 = MSB 75 - stable cycle length and light amplitude.

V533 Cas = BC 38 - stable cycle length and light amplitude.

CCS 414 - irregular light variations.

CCS 184 - the interval of observations is too short to determine the type of variability.

FR Per = CCS 183 = neither R(0.63)- nor V- and B-magnitudes showed variations during the observing interval. Only on one plate taken much earlier than others (in the year 1968) the B-magnitude was $0\overset{m}{.}6$ fainter. This result does not contradict the statement that light variations of the star have long waves (1).

SY Per = CCS 194 = IRC+50115 = AFGL 558. The elements of semiregular light variations in Table I are given according to the GCVS (7). Our observations confirm them.

HN Aur = CCS 252 - semiregular light variations, average cycle length about 165 days superimposed on very slow variations with the cycle length of about 1400 days.

VZ Per = CCS 112 - nonvariable according to (7). Our photometry, however, indicates light variations with a small amplitude. To get a definite conclusion photoelectric observations are necessary.

DY Per = CCS 107 - in accordance with the GCVS (7) the star had semiregular light variations with a large amplitude and a long period.

OQ Aur = CCS 339 - irregular or semiregular light variations.

BC 89 - extremely red star. Light cycles are rather stable, but maximum (or minimum) magnitude is very different for different cycles.

In Table II some characteristics of the observed carbon stars and related open clusters are presented which might give evidence on cluster membership of the stars.

Of the eleven stars six are included in the membership classes 1 and 2. Three of these six stars have large amplitude long-period variations, two - semiregular variation with smaller amplitudes and one - irregular variations. According to Eggen (5), Hartwick and Hesser (6), two further irregular variable carbon stars with small amplitudes are probable members of clusters of similar age with those discussed here. Thus there are eight photometrically studied carbon stars - probable members of intermediate-age open clusters. They are practically equally distributed among the types of variability M, SR, and Lb. It would be of importance to improve the statistics by studying the variability of carbon stars in intermediate-age clusters of southern sky, for example, in NGC 5822 and NGC 3114.

The photometric data obtained from our earlier observations have been published for some of the stars (2,4). Additional data on the photometry of carbon stars near the clusters NGC 7789, NGC 2099, NGC 1528, NGC 1664, and NGC 744 will appear in papers submitted for publication in the serial editions:"Investigations of the Sun and Red Stars" and "Nautchnije Informacii".

Table I

Photometric data and spectra of the observed carbon stars

1 Star	2 Obs.time	3 V	4 B-V	5 V-R	6 Max.JD24...	7 P	8 Sp
V532 Cas	1968-80	$9^m.9-11^m.1$	$5^m.1$	$1^m.5$	41238	450^d	Ne;C6,3e
V533 Cas	"	12.1-14.3	3.6:	1.4	41250	305	N*
CCS 414	1972-80	12.2-13.0	5.4:	1.7	-	-	N*
CCS 184	1977-80	13.5-14.1	5:	1.9	-	-	-
FR Per	"	10.3	3.0	1.4	-	-	R3;C3,3
SY Per	"	9.1-10.2	5.0	1.6	30525	476	Ne;C4,6
HN Aur	1971-80	11.2-11.7	4.4	1.4	-	165:	N5
VZ Per	1975-78	10.6-10.8	2.2	-	-	-	R4;C4,5J
DY Per	"	10.6-13.2	2.2	-	-	800:	R8;C4,5
OQ Aur	1969-75	14.6-15.3	3.7:	1.6	-	-	-
BC 89	1975-79	11.4-14.4	6:	2.0	42800	470	N*

1. Name of the star in the General Catalogue of Variable Stars (7), or, if the star is not named as a variable, its number in the General Catalogue of Cool Carbon Stars (CCS) (11) or in the lists of carbon stars found at Baldone (BC).
2. Time interval of photometric observations.
3. The range of V-magnitude according to observations made at Baldone.
4. Mean colour index B-V, for fainter stars it refers to the maximum light (symbol :).
5. Mean colour index V-R(0.63).
6. Time of light maximum in Julian days for periodic variable stars.
7. Length of the period or cycle of light variations in days.
8. Spectral class from CCS (11), Larsson-Leander (8) and Yamashita (12,13) or from objective prism spectra taken at Baldone (*).

Table II

Data on the observed carbon stars and related clusters

1 Star	2 Cluster	3 Age 10^8y	4 ρ	5 ρ/r	6 V_r	7 $M_V$max	8 Mbsh.
V532 Cas	NGC 7789	9.1	22′	2.3	-46 ± 3	-2.3	1
V533 Cas	"	"	28	2.9	-	-0.1	2
CCS 414	NGC 2099	1.6	20	1.7	-	+0.6	3
CCS 184	NGC 1528	1.0	29	2.6	-	+3.0	4
FR Per	"	"	37	3.3	-11 ± 3	-0.3	2
SY Per	"	"	39	3.5	-1 ± 8	-1.5	2
HN Aur	NGC 1664	0.89	1	0.2	-	-0.3	2
VZ Per	Tr 2	0.5	17	1.9	-16 ± 5	+0.8	3
DY Per	"	"	22	2.4	-39 ± 5	+0.8	4
OQ Aur	NGC 1912	0.43	20	2.3	-	+3.0	4
BC 89	NGC 744	0.39	15	2.2	-	-0.7	2

1. Name of the star as in Table I.
2. Name of the related cluster.
3. Age of the cluster according to Lindoff (9), in 10^8 years.
4. Angular distance between the star and the cluster centre, in arc minutes.

5. The same distance expressed in angular diamater (according to Trumpler) of the cluster.
6. Radial velocity of the star according to Stanford (10) or Dean (3).
7. Visual magnitude of the carbon star at maximum light, assuming that the star belongs to the cluster. For this estimation the data from col. 3 Table I and published data on the distance of the cluster are used.
8. Membership class, estimated from ρ/r, the place of the star in H-R diagram relative to the observed or expected red giant sequence of the cluster, and the data on radial velocities. Class 1 corresponds to the most probable cluster members, class 4- to likely nonmembers.

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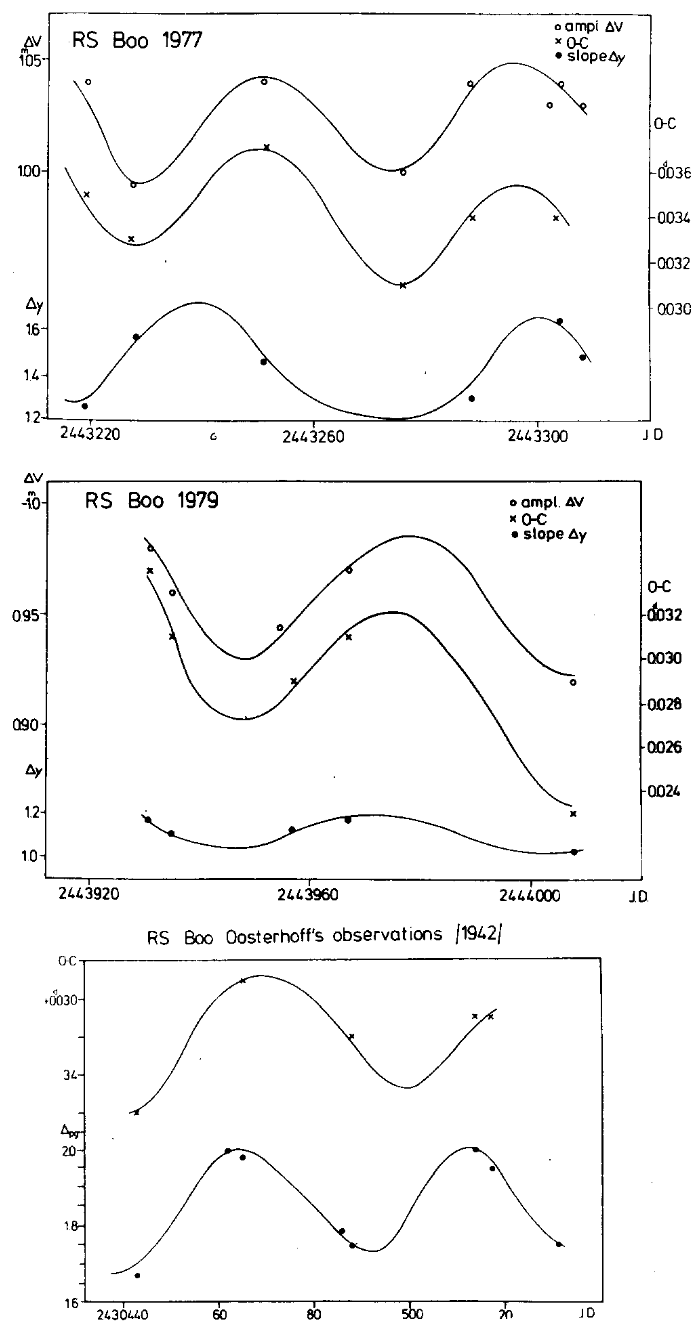
SHORTER SECONDARY VARIATION OF RS BOOTIS

The secondary light variabilty of 537^d of the RR Lyrae star RS Bootis has been ascertained by P.Th. Oosterhoff in Leiden from his great number of light curves photographically observed between 1938 and 1944. He already suspects that the assumed sine-curve of the secondary period exhibits a "minor variation" since this was larger than the estimated observational errors.

Investigations on RS Boo were undertaken at Konkoly Observatory in an attempt to verify this minor variation of the secondary period. The observations were carried out systematically on 45 nights between 1971 and 1979 with a 60 cm telescope in UBV photoelectric photometry. The data obtained were transformed to the international UBV system. The comparison star was BD $+32^o2486$.

The difficulty in determining the shorter period or cycle is due to the smallness in amplitude variations during the suspected cycle. The shorter regular variations are concealed particularly because of the rapid variations of the increasing and decreasing branches of the longer cycle. Fortunately, the shorter variations of the light amplitude, of the O-C curve and of the slopiness of the ascending branch of the fundamental period are more significant and synchronous in the relatively still phases of minima and maxima of the longer cycle. In view of this, our investigations were limited to the above phases of longer cycle.

The data of the above mentioned parameters are given in Table I and are shown in Figure 1; these data derive from the observations carried out by us between 1975 and 1979 and by Oosterhoff in 1942.



RS Boo 1977
o ampl ΔV
× O-C
• slope Δy
ΔV
105
1.00
O-C
0036
0034
0032
0030
Δy
1.6
1.4
1.2
2443220
2443260
2443300
J D
RS Boo 1979
o ampl. ΔV
× O-C
• slope Δy
ΔV
-1.0
0.95
0.90
0.032
0.030
0.028
0.026
0.024
Δy
1.2
1.0
2443920
2443960
2444000
J.D.
RS Boo Oosterhoff's observations /1942/
O-C
+0030
34
Δpg
2.0
1.8
1.6
2430440
60
80
500
20
J D

Fig. 1

We have derived new elements of the longer cycle, viz.

Lowest maximum: 2442500 + 533^d

For the shorter cycles we found an average length of 62^d from our own observations and 58^d from Oosterhoff's observations; these are shown in Figure 2.

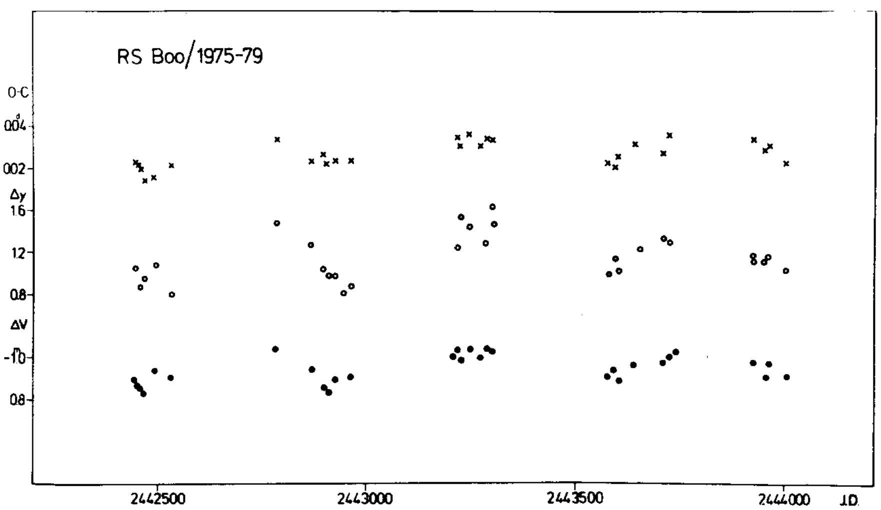


Fig. 2

The amplitudes of the shorter cycles in any parameter are smaller than the amplitudes of the longer ones, respectively. Nevertheless the amplitudes of the shorter variation are much higher than the errors of the observational values. At the same time, the amplitudes of the shorter cycles change during the longer cycle. Their highest values are to be found in the maxima of the longer cycles.

Our results do not give evidence for definite periodicity of any cycle. Consequently, the occurrence of the Blashko effect is not certain.

A physical interpretation of the two different long cycles of RS Boo and the relationship between them is not manifested but the multivarying behaviour of this star may be connected with the uncertainty regarding its classification since RS Boo belongs to RR_c according to its period and to RR_a according to the shape of its light curve.

On the other hand, its fundamental period suggests that RS Boo

Table I

Parameters of RS Bootis

J.D. (day)	Amplitude ΔV(m)	O-C (day)	Slopiness Δy	J.D. (day)	Amplitude ΔV(m)	O-C (day)	Slopiness Δy
2442443	-0.90	0.024	1.06	2443298	-1.08	-	-
449	0.87	0.023	-	302	1.03	0.034	-
454	0.86	0.021	0.88	304	1.04	0.034	1.64
465	0.83	0.015	0.95	308	1.03	0.037	1.48
493	0.94	0.017	1.09	580	0.91	0.023	-
532	0.91	0.022	0.80	583	0.90	0.022	1.00
786	1.04	1.034	1.49	597	0.94	0.021	1.21
870	0.95	0.028	1.24	599	0.89	0.020	1.15
899	0.87	0.027	1.06	608	0.89	0.026	1.03
905	0.87	0.023	1.03	645	0.97	0.032	-
910	0.84	0.022	0.99	659	-	-	1.24
927	0.90	0.024	0.99	716	0.98	0.027	1.34
947	-	-	0.82	727	1.00	0.035	1.16
964	0.91	0.024	0.89	730	0.97	0.036	1.29
2443219	1.04	0.035	1.26	744	1.02	0.035	-
227	0.99	0.031	-	931	0.98	0.034	1.17
228	1.00	0.034	1.56	935	0.96	0.031	1.11
251	1.04	0.037	1.46	957	0.91	0.029	1.13
276	1.00	0.031	-	967	0.97	0.031	1.17
288	-1.04	0.034	1.30	2444008	-0.91	0.023	1.03

Oosterhoff's observations

J.D.	O-C	Slopiness (Δ_{pg})
2430443	0.036	1.67
462	-	2.00
465	0.029	1.98
486	-	1.79
488	0.032	1.75
514	0.031	2.00
517	0.031	1.95
531	-	1.75

is a close relative of the dwarf Cepheids which are strongly inclined to have multivariation.
The observational data and a detailed analysis of RS Boo will be published elsewhere.

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93 LEONIS

Hall et al. (1980) have recently announced that the light of 93 Leonis is variable. They have classified the system as an RS CVn binary.

This system has been observed spectroscopically from Victoria since 1976 in an attempt to determine velocity amplitudes for both components. Measurements made so far indicate that Cannon's value for the period was remarkably accurate. Any given value for the velocity occurs 2d-3d earlier than predicted from his ephemeris. About 355 cycles separate the Victoria observations from Cannon's epoch, so the period is probably not more than $0^d\!.008$ shorter than his value.

The composite spectral type was first recognized by Slettebak (1955), who gave A + G5 III-IV as an approximate classification. On the Victoria spectrograms, the relative prominence of the Balmer series increases towards the UV. In the normal photographic region, the three Balmer lines are just strong enough to explain why earlier observers classified a G-type spectrum as F8. Slettebak's classification is probably still the best that can be made. Thus, the secondary component is the one of earlier spectral type. It probably is also the less massive star of the pair, but velocity measurements of it are still very uncertain.

The emission at H and K detected by Young and Koniges (1977) is not obvious on any of the Victoria plates, but fairly certainly present on those obtained in 1978. That it originates in the early-type secondary is unlikely: it must almost certainly be part of the spectrum of the component measured by Cannon. It may vary in strength, but, since the Victoria spectrograms are of different dispersions and densities, no variation can yet be considered established.

The system is undoubtedly an interesting one, and the variation of its light is a significant new discovery. Assigning 93 Leonis to the RSCVn group, however, seems questionable. Spectroscopic observations are continuing at Victoria.

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DY PEGASI - A DOUBLE MODE DWARF CEPHEID ?

Many of the variables in the lower instability strip pulsate with more than one period. Among them there are about fifteen stars which can be identified as radial pulsators with two successive modes excited (Breger 1979, Table III). Usually, these are fundamental and first overtone modes and the amplitude of weakly excited mode amounts a considerable fraction of the greatest one (Broglia and Conconi 1975, Table 5). Additionally, several large amplitude δ Scuti (or dwarf cepheid) variables show non-repetitiveness from cycle to cycle exceeding the observational error. The star DY Peg was reported by Masani and Broglia (1954) and by Hardie and Geilker (1958) as showing such a behaviour. The variation of amplitude of brightness of DY Peg is clearly seen from observations of Hardie and Geilker (1958). An example of their V magnitude observations is shown in Fig. 1.

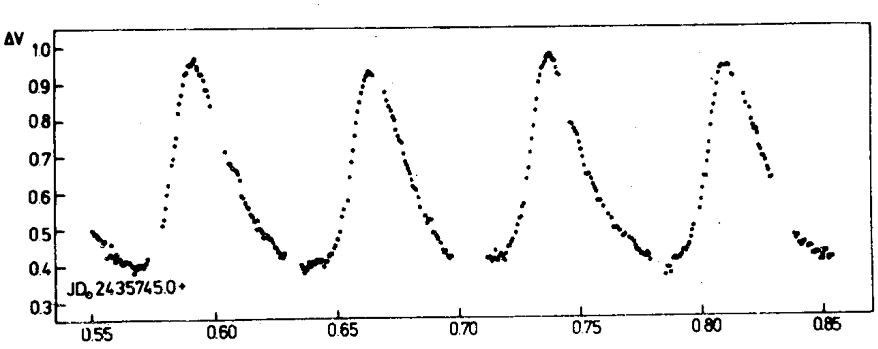

Fig. 1. A part (one night) of V magnitude observations of DY Peg plotted from the data contained in the Table 3 of Hardie and Geilker (1958).

We can see from this figure that the variation of the height of the maxima amounts to about $0^{m}.03$. The variation of the minima is not so clearly pronounced.

In an attempt to search for the nature of this non-repetitiveness we decided to carry out an analysis of photoelectric brightness observations of DY Peg. The method used was the periodogram method (Wehlau and Leung 1964). The photoelectric observations suitably distributed in time for a periodogram calculation are those of Masani and Broglia (1954), although their measurements are not so time-dense as those of Hardie and Geilker (1958).

Masani and Broglia observed the star DY Pegasi during 9 nights in October and November, 1953. They obtained a total of 573 measurements designated as "bleu" and 523 measurements designated as "giallo". We chose for our analysis 7 nights in the interval of JD 2434689-2434696 because these nights constitute compact block of observations (only the night JD 2434694 was missed by the authors). Such data set produces uncomplicated spectral window pattern (only the 1 cycle/day side lobes are present), and allow to use a relatively great frequency increment efficiently speeding up the computations. First, we analyses the "giallo" observations. As a check, we re-determined the principal period. The highest peak on the periodogram appeared for the frequency of $\omega_0=86.159\pm0.002$ radians/day. The corresponding period $P_0=0^{d}.072926\pm0^{d}.0000017$ agrees well with the more accurate previously known value, $P_0=0^{d}.072926355$ (Hardie and Geilker, 1958). The next step of our analysis was the fitting to the observations the trigonometric polynomial of the form:

$$m(t) = \langle m\rangle + \sum_{i=1}^{6} A_{0i}\cos(i\omega_0 t + \varphi_{0i}) \qquad (1),$$

where for ω_0 we used our value quoted above. Having the coefficients of Eq.1 determined we then subtracted from the analysed data the polynomial (1) and computed a periodogram of so prewhitened measurements. It was calculated in the range from 0.0 rad/d to 400.0 rad/d with the frequency increment of 0.2 rad/d. On this periodogram we can identify a spectral window structure with the highest peak placed at about 113 rad/d. This situation is shown in the upper part of Fig.2. A detailed computation gives the value $\omega_1=112.8\pm0.1$ rad/d, which corresponds to the new period $P_1=0^d.05570\pm0^d.000049$. Finally, we obtained the least squares solution for the expression

$$m(t)=\langle m\rangle + \sum_{i=1}^{6} A_{0i}\cos(i\omega_0 t + \varphi_{0i}) + A_1\cos(\omega_1 t+\varphi_1) \qquad (2),$$

fitted to the "giallo" magnitude observations. The results are listed in Table I. The arbitrary initial epoch we denoted by T, N is the number of observations, $\langle m_g\rangle$ - the mean "giallo" magnitude, and s.d. is the standard deviation as determined by residuals from the solution. The first column contains the identi-

Table I

Synthetic light curve of DY Peg

T = JD⊙2434689.0
N = 417
$\langle m_g\rangle=0^m.5322 \pm 0^m.0007$*
s.d.=0.0162

Interpretation	ω(rad/d)		A		φ(rad)	
ω_0	86.159	±0.002	0.286	±0.001	6.31	±0.01
$2\omega_0$	172.315	0.006	0.118	0.001	4.05	0.02
$3\omega_0$	258.48	0.02	0.045	0.001	1.91	0.07
$4\omega_0$	344.61	0.03	0.021	0.001	6.26	0.1
$5\omega_0$	430.75	0.08	0.008	0.001	4.7	0.3
$6\omega_0$	517.0	0.2	0.003	0.001	2.6	0.7
ω_1	112.8	±0.1	0.005	±0.001	5.2	±0.5

*This is the mean value as determined directly from the observations of Masani and Broglia (1954), Table III. It was substracted from the data before periodogram calculation. All the further analysis was performed on an intensity scale, assuming for $\langle m_g\rangle$I=1.0.

fication of the frequencies of all revealed sinusoidal components, second column - the frequencies expressed in radians/day, the third - the amplituds, and the fourth - the initial phases in radians.

It can be seen from this Table that the light variation of DY Peg is strongly non-sinusoidal. The harmonics up to $6\omega_0$ are present. The secondary variation ω_1 is very weakly excited. Its amplitude is placed between the amplitudes of $5\omega_0$ and $6\omega_0$ harmonics of the principal variation.

In order to check our results concerning the presence of ω_1 component we analysed in a similar manner the simultaneous "bleu" magnitude observations of Masani and Broglia (1954). It

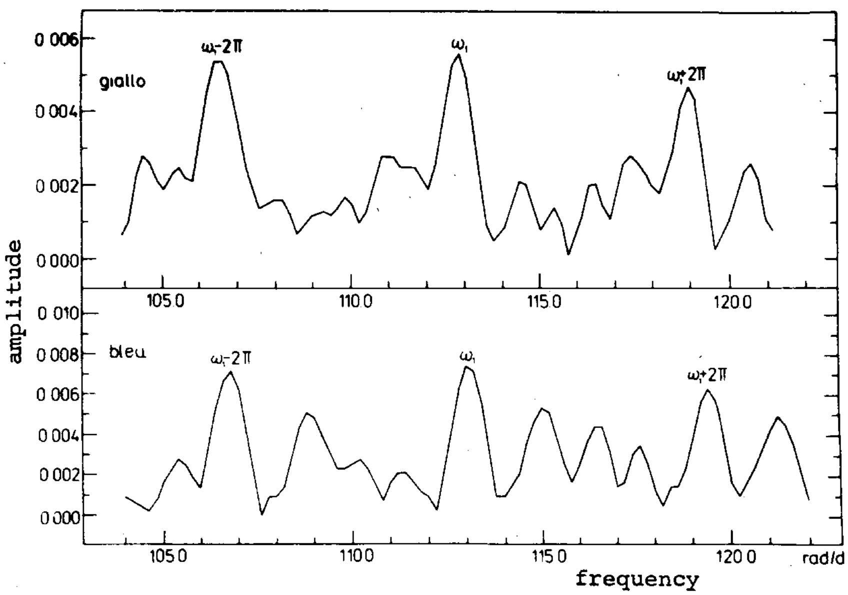

Figure 2. The secondary (ω_1) light variation component visible on the DY Peg periodograms.

has been found that the ω_1 component occurred on the relevant periodogram in the same place as previously (see bottom part of Fig.2). Finally, the same procedure adopted to the V magnitude observations od Hardie and Geilker (1958) presented in Fig.1, yielded two peaks on the periodogram. They are located at about 116 rad/d and 208 rad/d, respectively. Their amplitudes equal to about 0.01 in an intensity scale. Taking into account the fact, that the frequency error for these components as estimated from least squares solution amounts to about 4 rad/d, it can be concluded that the appearance of both the peaks is caused by the presence of ω_1, and even $2\omega_1$, components, respectively.

All the above results say us that the existence of the ω_1 component is not accidental, though the relevant amplitudes exceed the periodogram noise level not very much. The other fact strengthening our conclusion is that the ratio $\omega_0/\omega_1 = 0.764$ is quite similar to the period ratios for other double mode stars in the δ Scuti region. Thus, DY Peg is very likely a double mode (or dwarf cepheid) star with fundamental and first overtone radial modes of pulsation excited. The reason we have used the word "likely is that the synthetic light curve of the form of expression (2) does not reproduce satisfactorily the cycle amplitude variation of the observations analysed. Generally speaking, in order to improve this situation one should use more components in an expression like (2) with more accurately determined coefficients. This in turn requires more accurate, and possibly time denser, data points to be available. Thus, further photometric observations of DY Peg are badly needed.

In contrast to the other double mode δ Scuti stars with large amplitude light variations (of the order of $0\overset{m}{.}5$), the secondary pulsation in DY Peg seems to be very weakly excited (cf. Table 5 in Broglia and Conconi, 1975).

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SPECTROSCOPY OF THE NOVA-LIKE OBJECT KUWANO (NOVA VULPECULAE 1979) IN THE YEAR 1979

Kuwano (1979) discovered on April 5.8, 1979 sudden increase of brightness of the star in the position (see Ishida et al. 1979):

$\alpha_{1950.0}=20^h19^m01\overset{s}{.}08$; $\delta_{1950.0}=+21^\circ24'43\overset{''}{.}1$.

The photometric history of the object was reconstructed by Liller and Liller (1979). They showed that the star varied irregularly between B=14.5 and 16.6 prior to 1977 and some mini-eruptions were observed within the past 80 years. The present outburst began in late 1977 and within a year the star has reached B=10. After the discovery in April, 1979 the star fluctuated for several months on the level of B=9.5. According to Belyakina et al. (1980) the object dropped to B=13.0 at the end of June 1980.

The spectrum prior to the outburst was seen on some objective-prism photographs and it was classified as mid-M (Stephenson, 1979). Ishida et al. (1979) found the spectrum around the discovery time being of the type A4. According to Mochnacki (1979) the emissions were seen in H_α and H_β lines. P Cygni profile of H_α displayed the absorption component shifted for 50 km/s towards the blue. Sharp absorption Balmer lines up to H_{11} were detected by Schmidt and Green (1979). At the end of June 1980 the spectrum was a mid-M or advanced M-type with H_α and Na D emissions (Belyakina et al., 1980).

Our observational material consists of 7 spectrograms taken with the 350 mm camera of the coudé spectrograph of the 2 m telescope at the Ondřejov Observatory, with the reciprocal dispersion of 1.7 nm mm^{-1} in the blue region (380-497 nm). Kodak IIaO emulsions were used throughout. Depending on the photographic density of the plates (some spectrograms were rather underexposed) we have found on the plates strong sharp absorption lines H_β to H_8, CaII lines H and K (stellar), and furthermore fainter lines of Al I, Al II, Ca I, Ca II, Cr I, Cr II, Fe I, Fe II, Mg II, Mn I, Mn II, Ni II, Si II, Sr II, Ti I, Ti II, V II, Y II (?) and Zr II. Altogether up to 300 lines were detected.

From the relative intensities of the lines of Ca I (423 nm), Ti II (431 nm) and $H\gamma$ we have derived the spectral type of the star F 5 (±0.1). This is in agreement with the spectral type as determined from the UBV photometry. Neglecting the interstellar reddening the B-V index is close to 0.4 and this corresponds to the spectral class F 5 (see Allen, 1973).

Radial velocities of almost all identified lines were measured on the Abbê comparator. On four well-exposed spectrograms between JD. 2444118-2444157 (Nos. 3365,3368,3372 and 3420) the distribution of individually determined radial velocities was investigated. The distribution is clearly non-Gaussian, with pronounced asymmetry towards the negative velocities. We believe that we can distinguish two sources of the spectra of the object. Most lines belong to the spectrum of the stationary envelope connected with the M star. Assuming the Gaussian distribution, its average radial velocity is close to (+30±6)km s^{-1}. The rest of the lines is produced in an expanding envelope; their velocities are distributed in the interval from -40 to +25 km s^{-1}. The distribution of these velocities displays the maximum at +8 km s^{-1}. The existence of the expanding envelope is corroborated by the P-Cygni profile of the $H\alpha$ line.

It is apparent that there is much hesitation how to classify the star in the framework of stellar variability. The proposal that we observe the case of a slow nova is clearly inadequate. Thus the term nova-like was preferred by the discoverer. The existence of the late-type spectrum before the outburst suggests that the object is related to symbiotic stars. This was proposed by Bensammar et al. (1980). Future behaviour of the star should be followed up with vigilance.

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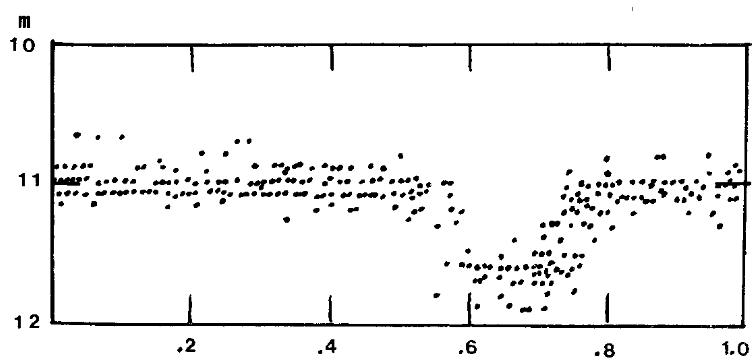
PROVISIONAL ELEMENTS FOR AN ECLIPSING VARIABLE IN SAGITTARIUS

Number 155 in a catalogue of Sagittarius variables discovered by Dorrit Hoffleit (1972) was investigated by means of eye estimates on approximately 500 plates at the Maria Mitchell Observatory. It is of Algol type, 11.0-11.8 pg. Most of the work of finding the period was done on a Radio Shack Level II computer programmed to read Julian Days from cassette tape, calculate phases for each test period, and display the resulting light curves. The star has a close companion and is too bright for most of the plates. This complicated the period search and the results should be regarded as provisional. The elements are

$$JD_{min}=2444025.73+2.145508\ n.$$



The light curve for full weight observations is shown in the Figure. The abscissa is phase defined as the fractional part of

$$(JD-2436000)/2.145508.$$

The possibility that the period is spurious was tested by trying related periods. No other period satisfied the observations as well.

This work was supported by the Dorrit Hoffleit Assistantship Fund of the Maria Mitchell Association, for which I am very grateful. I would also like to thank Dr. Emilia Belserene for her advice and for the opportunity to pursue this project, and Dr. Hoffleit for her valuable suggestions and guidance.

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Reference:

Hoffleit, D., 1972, I.B.V.S. No. 660

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PHOTOELECTRIC LIGHT CURVES OF RZ COLUMBAE

The eclipsing binary system RZ Col (CoD-36°2177) was discovered photographically by Hoffmeister (1949). With the exception of the photographic data obtained by Hoffmeister (1956), no further work has been done on this system. For this reason, RZ Col was selected for observation on eight nights during December 1979. The number two 41cm telescope at Cerro Tololo InterAmerican Observatory was used with standard B,V filters and an RCA 1P21. The comparison star was CoD-36°2174; CoD-36°2179 was the check star.

The β Lyrae-type light curve is well defined at each effective wavelength. From the observations defining two primary and three secondary eclipse curves, five epochs of minimum light were determined. These are listed in Table I.

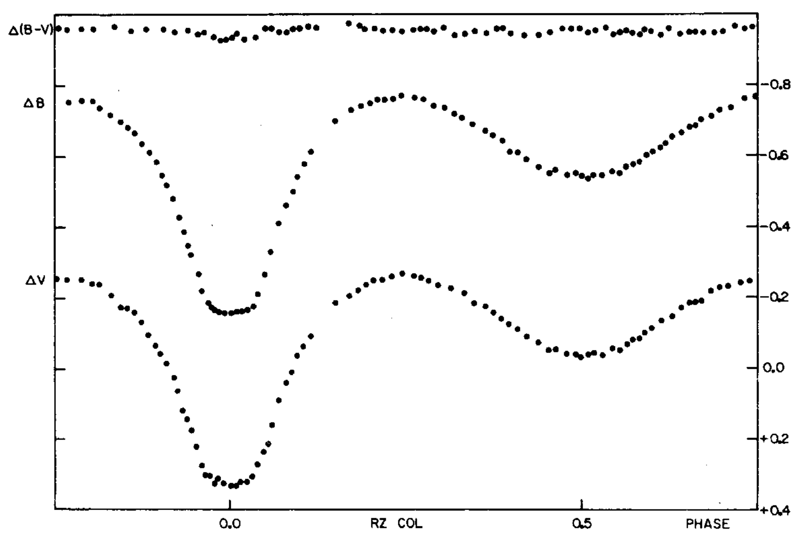
TABLE I

JD Hel. 2444200+	Min.	$(O-C)_1$	$(O-C)_2$
23.6959	II	$+0^d.0017$	$+0^d.0001$
27.6525	II	+0.0018	+0.0004
29.6291	I	0.0000	-0.0011
32.7396	II	+0.0018	+0.0010
33.5860	I	+0.0004	-0.0004

The times of primary minimum light in Table I and those observed by Hoffmeister (1956) were introduced into a least squares solution to obtain the ephemeris

$$\text{JD Hel. Min. I} = 2434326.2824 + 0^d.56522725\text{E}.$$
$$\pm 15 \quad \pm 29 \text{ p.e.}$$

This was used to calculate the $(O-C)_1$'s in Table I. The present observations



indicate a somewhat shorter period, and the following set of light elements,

$$\text{JD Hel. Min. I} = 2444229.6302 + 0^{d}.5651765E,$$

was used to calculate the (O-C)$_2$'s in Table 1.

The B and V light curves of RZ Col, defined by normal points, are shown in Figure 1 as Δm versus phase.

An analysis of the observations is underway. Preliminary work indicated the eclipses are complete. Spectroscopic observations are urgently needed.

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PHOTOELECTRIC OBSERVATIONS OF XY LEONIS

XY Leonis (BD +18°2307) is a W Ursae Majoris type star with a variable period. Because of the shortage of published data on XY Leonis, as pointed out by Mauder (1972), Binnendijk (1970), Ruciński (1974) and Koch and Shanus (1978), we present here UBV data, which we obtained as part of a senior undergraduate laboratory project in the Astrophysics program at the University of Calgary. Though incomplete, these data may be useful for comparison to Shanus' 1978 observations (Koch and Shanus, 1978), obtained about the same time as ours. In particular, our data substantiate those authors'decision to exclude from analysis Shanus'data of JD 2,443,573.

XY Leonis was observed using the 41 cm telescope at Rothney Astrophysical Observatory (University of Calgary) employing a dry-ice cooled EMI 6256 photometer at -1000 V (DC). Magnitudes were measured in the U, B and V, then transformed to the Johnson system. The comparison star chosen was BD +18°2309. Data was acquired on six nights during the period February 26 to April 7 of 1978. The ephemeris used is that due to Gehlich et al.(1972):

$$2,435,484.0222 \pm 0.0016 + (0.28410282 \pm 0.00000007)\cdot E \quad (1).$$

Our light curves, presented in Figures 1 to 3, show a phase shift of approximately $+0^{p}.04$, resulting in an O-C of $0^{d}.012 \pm 0.006$ at JD 2,443,587.783 ± 0.003,* which is not significantly different from

*This represents an average over all six nights,assuming the period remained approximately constant.

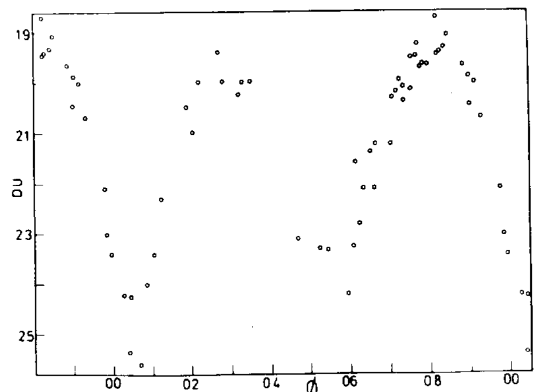

Fig.1.: Differential U magnitude (XY Leonis-BD+18°2309) versus phase for XY Leonis between JD 2,443,566 and JD 2,443,605.

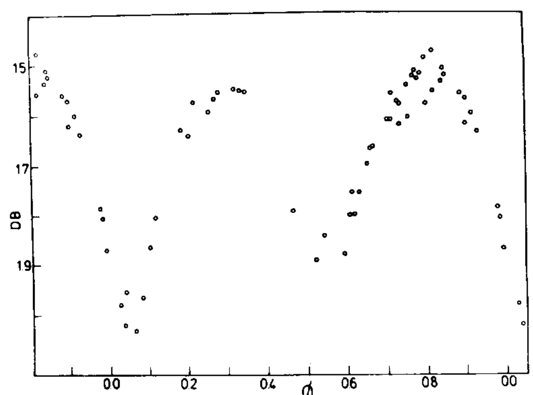

Fig.2.: Differential B magnitude (XY Leonis-BD+18°2309) versus phase for XY Leonis between JD 2,443,566 and JD 2,443,605.

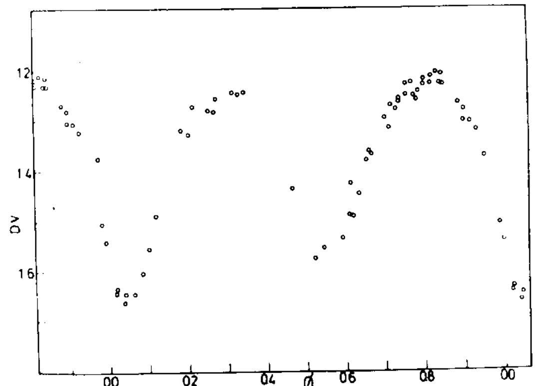

Fig.3.: Differential V magnitude (XY Leonis-BD+18°2309) versus phase for XY Leonis between JD 2,443,566 and JD 2,443,605.

that of Koch and Shanus (1978), and essentially confirms the departure from the O-C curve of Gehlich et al., first suggested by the data of Pohl and Kizilirmak (1977).

The present results support the conclusion of Koch and Shanus (1978) that XY Leonis is best considered a double, and not a triple, system.

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ERUPTIVE MASS-TRANSFER EVENTS IN RW TAURI

Many years of intermittent mass-transfer events in U Cephei have been observed and interpreted (for references, see Olson 1980a, 1980b). Most prominent among the photometric disturbances in U Cep was the ultraviolet light excess seen during primary eclipse, which sometimes changed the normal total eclipse to one of "partial" shape. This light has most recently been explained as an asymmetrical bulge that grows around the equator of the mass-accreting B star in response to the impact of the stream (Olson 1980b). Factors that determine the growth of the bulge include the mass-transfer rate and the contemporary (differential) rotational speed of the hot star. Such bulges were never observed in a steady-state, within the observational time resolution of a few days. We now report the occurrence of qualitatively similar photometric perturbations in the totally-eclipsing system RW Tau. Observations were obtained with the 1.0 M reflector of Prairie Observatory, using a single channel pulse-counting photometer with RCA 31034A-02 photomultiplier tube. Four-color u v b y and near infrared I_K data were obtained, and transformed to the Strömgren-Crawford and Kron standard systems; y-observations were transformed to Johnson V. Comparison star was BD +27°623 (checked and used by Bookmyer 1977), and observations of (variable minus comparison) were corrected for differential extinction.

Infrared and ultraviolet results are shown in Figure 1. Observations were obtained on five nights, and only on the first of these (UT Nov. 8 1978; squares in Fig.1) were the light curves free of contaminating light. Three times of primary minima were obtained (HJD-2440000.): 3820.7835±0.0001; 4180.7319±0.0001;

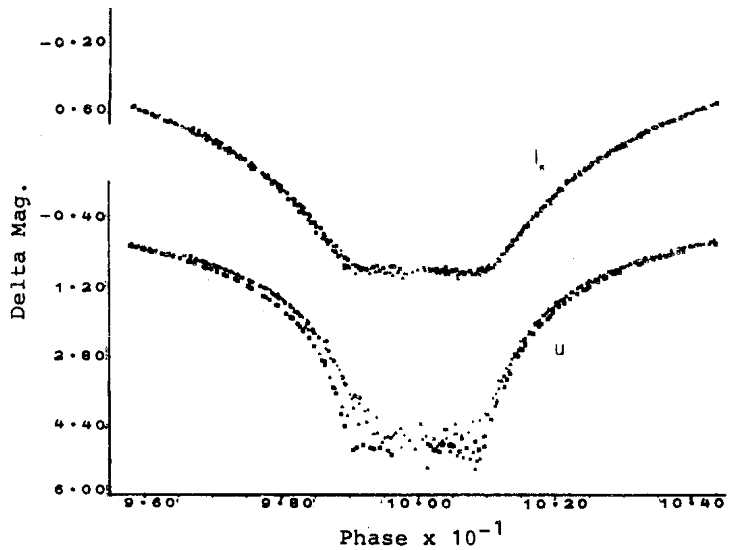

Fig. 1 - Infrared and ultraviolet light curves of primary eclipses of RW Tau. Symbols and UT dates are: square, Nov. 8, 1978; octagon, Dec. 28, 1978; triangle, Nov. 3, 1979; plus, Nov. 14, 1978; X, Nov. 17, 1979. Some of the ultraviolet scatter at minimum is due to moonlight.

4191.8074±0.0001. Infrared and ultraviolet times were omitted from the last minimum, as they were late by ~ 0.001 day. Light curves of Figure 1 were stacked with period 2.7688344 day.

During disturbed eclipses, excess light was present at all observed phases of primary eclipse, and can be detected even in the infrared. As with U Cep, the excess light at second contact exceeded the third contact excess; if an equatorial bulge is responsible in RW Tau, it too is asymmetrical. The maximum ultraviolet excess on the magnitude scale was ~ 1.2 mag on Dec. 28, 1978 (octagons in Fig.1), but the actual light excess peaked near phase 0.97 - again, similar to U Cep. These RW Tau observations differ from those of U Cep in showing no light loss during eclipse egress.

A quantitative discussion of these observations awaits the accurate measurement of comparison star colors. RW Tau may be entering an active phase, and may repay observations in the coming season. We particularly urge interested observers to use intermediate band, rather than broad-band filters, if possible.

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TIMES OF MINIMA OF SIX ALGOL-LIKE ECLIPSING BINARIES

As a part of a two- to three-year program of monitoring primary eclipses of Algol-like binaries for evidence of mass-transfer events, we give 20 times of minima for six systems observed from 1978 to 1980. When observations are complete, times will follow for about eight more systems. Observations were made with the 1.0 M Prairie Observatory, the Nos. 3 and 4 0.4 M and the No. 2 0.9 M Kitt Peak National Observatory reflectors. Single channel pulse-counting photometers with RCA 31034A-02 photomultiplier tubes were used for all observations, and data were obtained in Strömgren-Crawford u v b y and Kron I_k standard photometric systems. Times of minima for each color were determined by the method of Kwee and Van Woerden (1956), as programmed by R.C. Crawford.

Times of minima and mean errors are listed in Table I. Except in three cases noted in footnotes, times in all colors agreed to within observational errors, The first eclipse listed for RZ Cas was slightly abnormal in shape, showing small-amplitude "waves" during ingress and egress, and a flat tilted 19-minute interval around minimum light in all colors. Other observers have seen similar features (Archer 1958; Szafraniec 1960; Burke and Rolland 1966; Margrave et al. 1975). Evidently, the time of minimum is unaffected, as the ephemeris Min I=3740.5582+ $1^{d}.1952492$ E represents all minima satisfactorily. We cannot explain the time quoted by Margrave (1979), 3796.7303, which is nearly 7 min earlier than our time.

Table I

Times of primary minima

Binary	HJD-2440000
K O Aql	4487.7954 ± 0.0001
RZ Cas	3741.7533 ± 0.0001
	3759.6822 ± 0.0001
	3766.8536 ± 0.0000
	3796.7349 ± 0.0000
	4121.8432 ± 0.0002
	4127.8190 ± 0.0001
	4151.7241 ± 0.0001
	4181.6054 ± 0.0001
	4273.6387 ± 0.0000
U Cr B	3671.6922[a]
	4313.8051 ± 0.0002[b]
	4351.7817 ± 0.0001[b]
	4382.8505 ± 0.0001
AI Dra	3659.6606 ± 0.0002
	4009.7139 ± 0.0001
	4015.7079 ± 0.0001
TT Lyr	4383.8555 ± 0.0001[c]
RW Mon	3864.7101 ± 0.0001
	3883.7710 ± 0.0001

[a]Determined graphically.

[b]Omitted u; in the first eclipse, u was early by 0.0017 day; in the second, u was late by 0.0020 day.

[c]Omitted u, which as late by 0.0010 day.

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IS THERE A MAGNETIC FIELD - PERIOD RELATION FOR THE HOTTER Ap - STARS ?

In two recent papers by P. North (1980) and Cramer and Maeder (1980) a new technique is discussed for a photometric way to detect surface magnetic fields. The Z parameter is a linear combination of the Geneva colours U, B1, B2, V1 and G (Cramer and Maeder, 1979) and is nearly independent of T_{eff} and log g for main sequence stars from about B2 to A5. A linear relation between Z and the surface field Hs is presented. Although no astrophysical argument can be given for the existence of such a relation, there is no doubt that any - even heuristic - photometric technique which allows to pick out candidates for a detailed spectroscopic analysis is highly valuable.

S.C. Wolff (1975) brought up some evidence for a correlation between the radius and period for non-Si stars in the sense that larger radii are correlated with larger periods. Her interpretation of this effect was a deceleration due to magnetic braking, with the increasing radius being a consequence of stellar evolution. If this idea is correct, stars with stronger magnetic fields should rotate slower than equally old but weak magnetic field stars. With more data now available for Hs it was interesting to look again into this problem, which is an aspect of the nature of magnetic fields in Ap stars (Weiss et al., 1976).

Havnes and Conti (1971) and Strittmatter and Norris (1971) derive a rate of loss of angular momentum to:

$$dI/dt = \rho^{1/2}\, v_f\, R^3\, B_c$$

where ρ is the density of matter which is lost from or accreted by the star, v_f is the relative velocity of the star and interstellar medium or the velocity for mass loss, R is the stellar radius and B_o is the magnetic field strength at the stellar surface. The radius R varies even for our subgroup of hot Ap stars, but the observed range in B_o still exceeds the effect of R on dI/dt.

Table I

Hot magnetic Ap stars

HD	Hs	C	BP	UF	ST	pec.	P^d
9996	.20	B	3	50	B9p	CrEu	36.5
10221	.14			39	A0p	SiSr	3.1848
10783	.24		24		A2p	CrSr	4.14
11502	.18	D	55	51	B9V+Ap		2.6095
12447	.18	DB	92	87	AOP	SiSr	0.7383
18296	.18		22	5	B9p	Si	2.88422
21699	.15			59	B8IIIp	Mn	2.4761
22470	.15			190	A2V	Si	1.9
22920	.16			121	B8IIIp	Si	
25267	.20	B		34	Ap	Si	2.42 (5.74,7.4)
25354	.12		17		A0p	SrCrEu	3.9001
25823	.20	B	21	21	B9p	Si	7.227
27309	.46			46	A0p	Si	1.5691-2.7098
32633	.51		23		B9p	SiCr	6.43
34452	.48	D	62	44	A0p	Si	2.466
34797	.12		80	80	Ap	Si	
35479	.22		82		B9p	Si	
43819	.18			55	B9IIIp	Si(Cr)	1.0785
54118	.18			0	A0p	Si	
74521	.35		19		A1p	EuCr	4.2359
77653	.12	D		0	Ap	Si	3.2
79158	.17			29	B8IIIp	Mn	
90569	.14			90	A0p	CrSr	1.4-7.9
103498	.25		13	≤ 25	A1p	CrEu(Sr)	
112413	.18	D	24	33	A0p	SiEuHg	5.46939
120198	.18			20	B9p	EuCr	1.3799
125248	.20	B	9	59	A0p	CrEu	9.2954
126515	.27		3		A2p	CrSr	~130
133029	.35		20		B9p	SiSrCr	2.8881
134759	.10	D		72	A0p	Si	
136933	.25	D		0	A0p		
140728	.15		75	100	B9p	SiCr	1.30488
142884	.15		200	200	B9p	(Si)	
144661	.13			100:	B7IIIp	HgMn	
145501	.29	D	70	70:	B9p		
147010	.56		25	≤ 50	B9p	SiCr	
147890	.19	D	25	≤ 50	B9p	Si	
148199	.28		25	≤ 50	Ap	SiCr	
153882	.25		26		B9p	CrEu	6.0087
164429	.27			200:	B9p	SiSr	0.51747
168733	.13			0	B8p		6.3
173650	.14		16		B9p	Si(Cr)	9.9748
174933	.15	B	20	20	B9p	Hg	6.36247
175362	.18			0	B8IV	Si	3.682

Table I (cont.)

HD	Hs	C	BP	UF	ST	pec.	P^d
187474	.23	B	4	0	A0p	CrEu	
192678	.50		5		A4p	Cr	18.20, 360?
193722	.13		250		B9p	Si	1.13254
196502	.20		8	0	A0p	SrCrEu	20.2754
203006	.24			48	A2p	CrEuSr	2.1219
204411	.10			32	A6p	Cr(Eu)	~ 360 ?
215038	.39		31		A3p	Si	2.03763
215441	.51		3		A0p	Si	9.4877
220825	.14		35	42	A0p	CrSr	0.5805
223640	.22			64	B9p	SiSrCr	3.73
224801	.18		38	70:	Ap	SiEu	3.73975

HD...HD number, Hs...surface magnetic field in Tesla (1 T = 10000 Gauss), C... Comments (D photometrically unresolved double star, B spectroscopic binary)
BP...v.sin i from Bernacca and Perinotto (1971),
UF...v.sin i from Usuegi and Fukuda (1970) in km/s,
ST, pec...spectral type and peculiarity from North (1980),
P...period in days.

Table I gives a subset of stars from Cramer and Maeder (1980, op.cit.) for which v. sin i and/or a rotational period is determined. F. Catalano (Catania) kindly contributed 5 periods from his catalog.

Double stars not separated during the measurements and spectroscopic binaries (circles in Figure 1) obviously do not differ systematically from single Ap stars. Therefore all objects from Table I are used for the following discussion.

A comparison of the integral probability distribution for all Ap stars with known rotational period (adapted from Catalano and Strazzulla, 1976) with those for which Hs is measured by the Geneva group give no evidence for a different parent distribution for both samples (Figure 2). We can therefore hope that the objects from Table I are characteristic at least for the group of hot Ap stars. The median rotational period is 2.56 days.

Large Hs values are found in Figure 1 for all periods almost equally frequent. This result does not change even if all pure Si stars from Table I are excluded, as did S. Wolff for her investigation (Figure 3). Hs obviously does not correlate with the period.

On the basis of the still rather limited material it can be concluded:

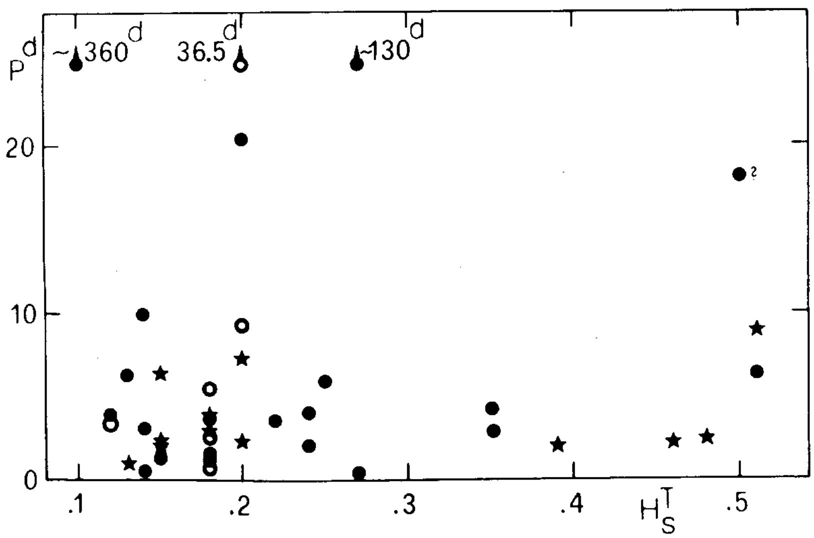

Figure 1: Hot Ap stars with known period P (in days) and photometrically determined surface magnetic field (H_S^T) in Tesla (1 T = 10000 Gauss). Asterisks: Si stars, one Hg and one Mn star. Circles: double stars not separated during Hs measurement and spectroscopic binaries. Points: hot single Ap stars.

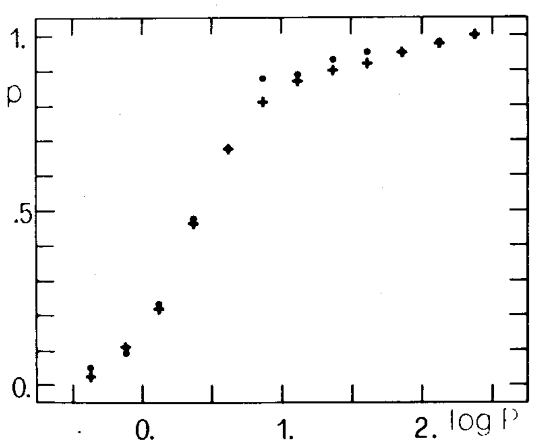

Figure 2: Probability function p for all Ap stars (crosses) with known period (P in days), adapted from Catalano and Strazzulla (1976) and for Ap stars with photometrically determined surface magnetic fields (dots).

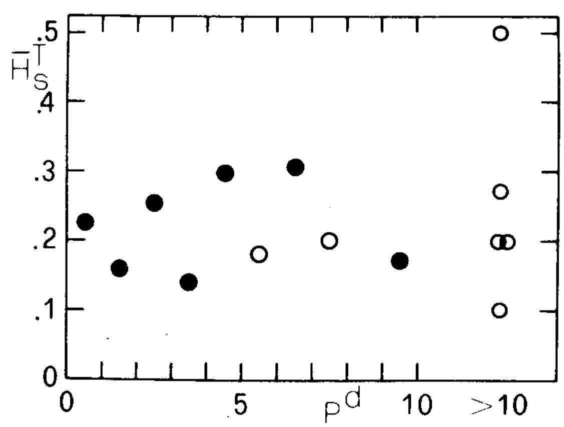

Figure 3: Mean photometrically determined surface magnetic fields ($\bar{H}_S^T$ in Tesla, 1 T = 10000 Gauss) for Ap stars within a given period interval (P in days). Filled symbols: arithmetic mean, open symbols: individual stars.

i) The quantity Hs, as determined by Cramer and Maeder photometrically, shows the same distribution for P (and v.sin i) as is known to be typical for Ap stars.
ii) No evidence can be found for a correlation of Hs with the rotational period. Thus, at least for the hotter Ap stars, magnetic braking needs further investigation.
iii) Only 34 more or less reliable periods are known for more than 140 bright magnetic Ap stars from the list of Cramer and Maeder. Much more telescope time should be devoted to the determination of basic Ap star parameters, such as is the rotational period.

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PHOTOELECTRIC MINIMA OBSERVATIONS OF THE ECLIPSING BINARY SV CENTAURI

SV Cen is an early type contact binary (B1 III + B4) which has shown the largest known period decreases of (dP/dT)/P = $-2x10^{-5}y^{-1}$ (cf. e.g. Drechsel et al. 1977 and literature quoted therein). Photoelectric UBV observations of this close eclipsing binary were carried out in 1978, 1979 and 1980 to determine further times of minima. For the observations we used the ESO 50 cm telescope and the double channel photometer, the Bochum 61 cm telescope with its standard photometric equipment, and the ESO 50 cm telescope with the single channel photometer, respectively. For a description of the photometric facilities cf. the ESO Users Manual.

We used CoD-59°3946 as a nearby comparison star. The times of minima T_{min} were reduced to the Sun and are given in the Table below.

Table

Times of primary minima of SV Cen

	T_{min}	S.D.
JD_O	244 3601.6566	±0.0018
	244 4024.5668	±0.0003
	244 4299.8849	±0.0020
	244 4304.8624	±0.0002

The first entry in the table denotes a graphically determined minimum derived from a complete lightcurve (Drechsel et al., 1980b). The other minima were obtained using the method described by Kwee and van Woerden (1956). The standard deviation was calculated from the individual minima determined from the UBV measurements.

The first two minima given in the table show the continuing decrease of the orbital period as expected from previous observations. The last two minima however were observed delayed by more than 20 minutes (compared to the expected times of minima), which implies that the period has increased between our observations in 1979 and 1980. It is suggested that this change of sign of (dP/dT)/P is caused by a variation in the mass loss from the binary system. In fact SV Cen has been proved recently to be a mass loosing star by Drechsel et al. (1980a).

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PERIOD CHANGE OF AW URSAE MAJORIS

From a discussion of O-C for AW UMa, A-type contact binary, Woodward et al. (1980) found that the times of minimum light obtained in 1978 indicated a significant period shortening. To examine this change of period all published photoelectric times of minima were collected and used in calculations of elements (References 1-4, 8-10).

Two times of minima were determined recently in Cracow and analysed by the procedure developed by Kwee and van Woerden (1956) and listed in Table I. For this purpose, photoelectric observations in V colour were made using a 50 cm Cassegrain reflector equipped with an EMI 9789QB and standard Schott filters.

Table I

Times of minimum light for AW UMa

J.D. hel	E_I	Observer
24 44292.5358$\pm$0^d.0002	6744.5	Kurpinska
44294.5093 0.0002	6749	Kurpinska

In the behaviour of O-C diagram two linear parts were observed: one from the years 1963 to 1975 and second one from the period 1978-1980. For these two parts linear elements of light were determined by least-squares solutions:

I 1963-1975 JD_{hel}= 24 41333.51870+0.43873231·E 20phe obs.
± 20 ± 5

II 1978-1980 JD_{hel}= 24 43948.79280+0.43872687·E 7phe obs.
± 13 ± 19

Figure 1 presents the O-C diagram calculated according to the elements I. It can be seen in Fig.1 that the secondary minima show a larger dispersion than the primary ones which results from the asymmetry of the light curve, occasionally appearing near the secondary minimum (Dworak and Kurpinska 1975, Woodward 1980).

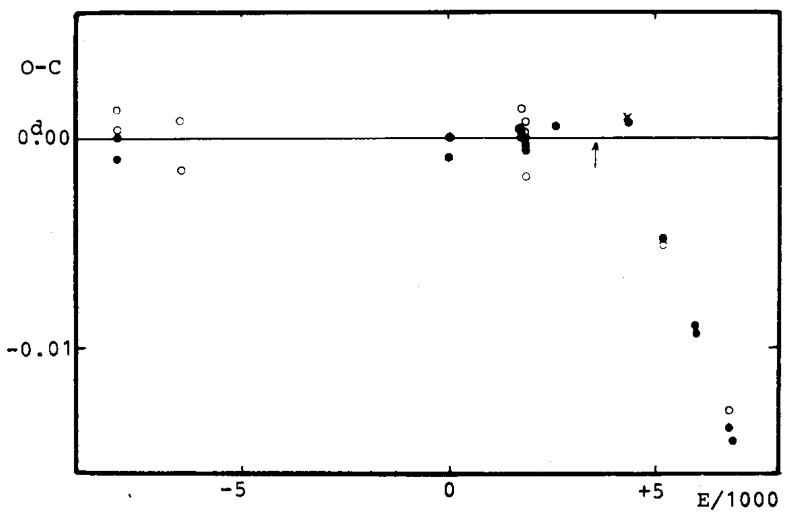

Figure 1. O-C diagram for AW UMa. Filled and open circles refer to primary and secondary minima, respectively. Cross and cross in circle denote mean visual primary and secondary minima. The arrow marks the visual observations of Locher with O-C ≈ +0ᵈ04.

The decrease of period $\Delta P = 5^d.4 \times 10^{-6}$ and the extremely low mass ratio value q = 0.08, accepted by many authors, may be regarded as a possible proof for the relation ΔP - q presented by Kreiner (1977) for W UMa type stars. This relation seems to indicate that absolute period changes are increasing with the q values.

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A LIGHT CURVE AND TIME OF MIMIMUM FOR W UMa OBTAINED WITH THE IUE SATELLITE

The eponymous late spectral type contact binary system W Ursae Majoris BD + 56° 1400, HD 83950; period ~8 hours) has been the subject of many theoretical and observational studies. During a programme to obtain ultraviolet spectra of W UMa we obtained an optical light curve and time of minimum using the Fine Error Sensor (FES) detector onboard the International Ultraviolet Explorer Satellite (IUE).

The IUE satellite and its instrumentation are described by Boggess et al. (1978). The FES is usually used either as a star tracker to assist satellite pointing or as a field camera which scans a region of sky to enable a target star to be selected for observation. In this Bulletin we describe the use of the FES as a photometer.

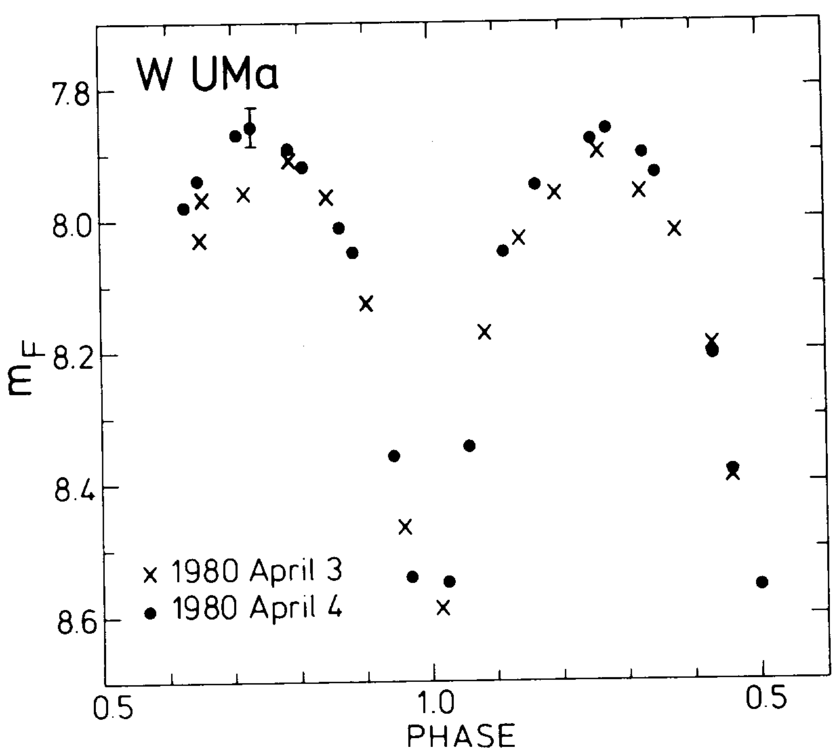
The telescope has a 45 cm diameter mirror and an f/15 Cassegrain beam. The FES is an image dissector tube with an S-20 response. Roughly the wavelength range 4000 Å to 7000 Å is covered with a broad peak near 5000 Å and effective bandwidth of order 2000 Å. Thus an FES magnitude, m_F, is a broad band measurement at effective wavelength 5000 Å and is roughly similar to a J magnitude from a IIIaJ plate.

The effective integration time of a measurement was 2.5s composed of many shorter samples of the image dissector to avoid saturation. The count value detected is nearly equivalent to a photon count. However, the "object plus sky" is detected; no separate sky count is made. The sky count is composed of astronomical skylight and zero point detector counts (dark current). It is not important for W UMa. The FES countrate(N) has been calibrated into FES magnitudes (m_F) and to B and V of the UBV system, using 129 stars, by Stickland (1979):

$$m_F = 16.71 - 2.58 \log N \quad (1)$$
$$m_V = m_F - 0.28\ (B-V) \quad (2)$$

The relative error in calibration (1) over the range of magnitudes relevant to W UMa < 0.01 mag. The error due to countrate is of order $\lesssim$ 0.02 mag giving a combined error better than 0.03 mag.

The lightcurve for W UMa obtained on 1980 April 3 and 4 (U.T) is shown in Fig. 1. A period P = 0.3336381 days was used, and ephemeris 2



below. Different symbols are used for the different days. From the data we conclude: (i) the light curve in the F band is similar to those observed at B and V (e.g. Breinhorst 1971); the amplitude $\Delta F \sim 0.71 \pm 0.02$ mag compares with $\Delta V \simeq 0.71$ mag and $\Delta B = 0.74$ mag. (ii) apart from two points on 3 April the light curves from the two days are in very good agreement with each other; the difference of order 0.03 mag near maxima may be due to the errors or to a small change in W UMa itself; (iii) combining the two light curves in phase enables the time of deeper minimum to be measured:

$$\text{min I at 1980 April 3 } 6^h 24^m \pm 2^m \qquad (3)$$

$$\text{HJD } 2444332.768 \pm 0.001$$

(iv) using equation (2) and a mean maximum value $m_F^{(max)} \sim 7.88 \pm 0.02$ and (B-V) = 0.66 gives V(max) ≃ 7.71 ± 0.04 where the extra error is due to errors in calibration (2). V ∿ 7.71 from the IUE FES agrees well with the ground-based telescope, atmospheric extinction corrected value V(max) ∿ 7.7 (Eggen, 1965).

The time of minimum given in (3) above enables us to discuss the currently available ephemerides for W UMa presented in the following table:

Code	J.D. Hel	P	(O-C) (d)	reference
	2400,000.0+			
1	42829.3939	0.3336370	0.006	Eaton (1976)
2	35918.4154	0.3336381	0.000	Baldinelli, Ghedini (1978)
3	41738.3989	0.3336370	0.008	Piirola (1976)
4	41004.3977	0.3336370	0.008	Kukarkin et al. (1976)
5	37986.9742	0.33363808	-0.003	Tümer (1980)

The current observed time of minimum is consistent with ephemeris 2 above. Our time of minimum is further confirmed by recent times of minimum for W UMa obtained by Tümer et al. (1980).

We conclude that ephemerides 2 and 5 above currently best describe the times of minima of W UMa. We also note that the IUE Fine Error Sensor detector gives photometric magnitudes in detailed agreement with ground based data and that it can prove a useful tool in the study of variable stars.

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A PHOTOGRAPHIC LIGHT CURVE OF NOVA V1668 CYGNI AND SOME OBSERVATIONS OF SS CYGNI

V1668 Cyg (Nova Cygni 1978) is a relatively faint, but well investigated nova. It was discovered on 1978 September 10.0 (UT) by Morrison (1978) and Collins (1978). Reginaldo (1978) published two pre-discovery magnitudes. At Hoher List Observatory, spectroscopic, photoelectric and photographic observations were carried out. In this note, we present a light curve based on the photographic observations of the field of V1668 Cyg between 1978 September 12.87 and 1979 October 24. As a by-product of this study, several outbursts of the nearby dwarf nova SS Cyg were also observed.

The series of photographic plates was obtained with the 30 cm f/5 four-lens astrograph. 70 plates are available, 12 of them were taken a few weeks before the brightening of the nova. All plates were measured with a Becker iris diaphragm photometer. Photographic magnitudes of the comparison stars and the sources from which they were taken are given in Table I. A critical review of m_{pg} of those stars which form the comparison sequence of SS Cyg was recently given by Lukas (1979). The magnitudes of the fainter stars were derived through comparison with a sequence in the open cluster IC 5146 (Walker 1959). An identification chart of the fainter stars is given in Fig. 1a,b, which is the reproduction of a POSS chart.

The photographic magnitudes of V1668 Cyg and SS Cyg are given in Table II. The plates were taken by the following observers: D = Duerbeck, H = Hopp, Hä = Hänel, K = Kiehl, Ka = Karimie, L = Lukas, Le = Lentes, S = Schumann, W = Witzigmann. On the plates taken before 1978 September 10, V1668 Cyg is not visible. One of the deepest plates is A3171, taken 18 days before outburst, which has a limiting magnitude m_{pg} of about 17^m, and does not show the image of the nova.

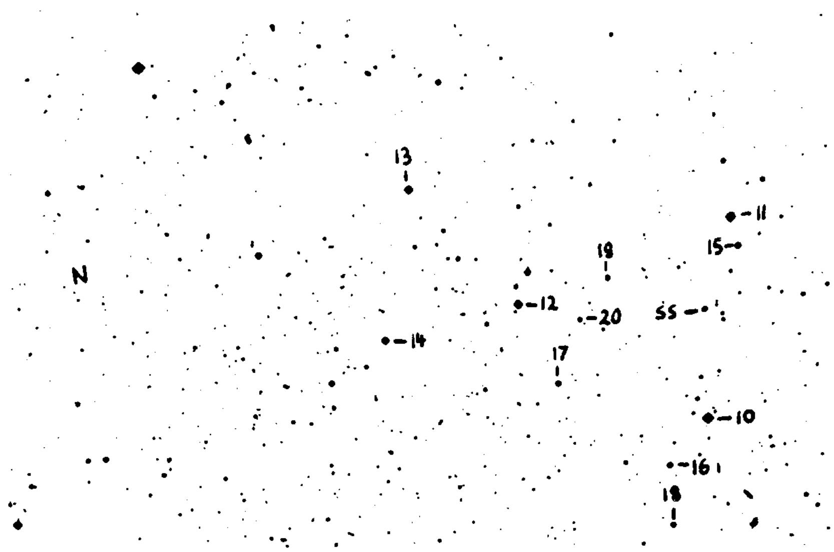

Fig. 1a. Field of Nova V1668 Cyg (=N) and SS Cyg (=SS); some of the fainter comparison stars are identified. North is to the left

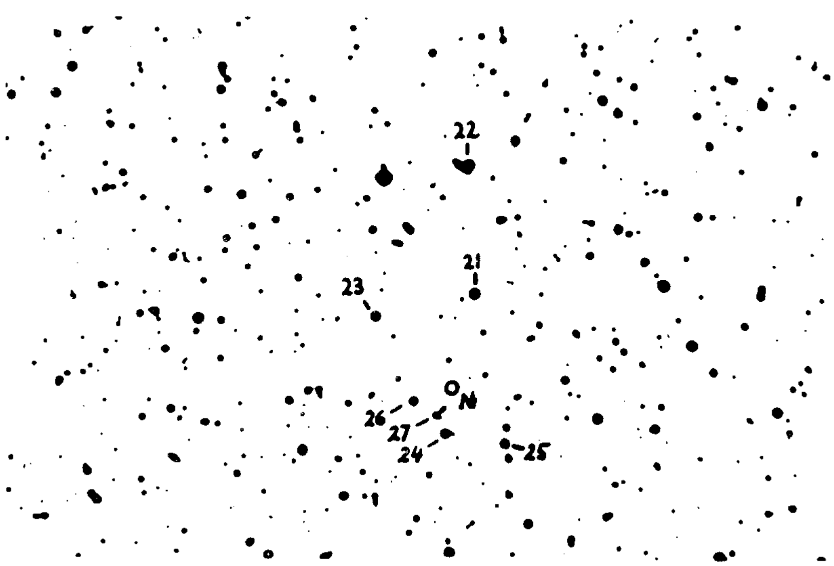

Fig. 1b. The field of Nova V1668 Cyg. The position of the nova (=N) is marked by a circle; some comparison stars are identified. North is to the left

Table I

List of comparison stars

No.	BD No.	m_{pg}	ref.	No.	BD No.	m_{pg}	ref.
1	+44° 3865	4.91	3,5	15	-	11.35	1,2,4,6,8
2	+44° 3889	6.39	4	16	-	12.04	6
3	+43° 4002	6.66	4	17	-	12.07	1,6,7
4	+42° 4204	6.86	2	18	-	12.28	1
5	+43° 4048	7.94	1,7	19	-	12.48	1,6,7
6	+42° 4197	8.74	1	20	-	12.91	1,6,7
7	+43° 4037	9.12	1	21	-	13.78	9
8	+43° 4030	9.18	1	22	-	13.93	9
9	+43° 4017	9.36	4	23	-	14.02	9
10	+42° 4190	9.76	1,4,6,7,8	24	-	14.58	9
11	+43° 4020	10.19	1,2,4,6,7,8	25	-	14.69	9
12	-	10.55	1,4,6,8	26	-	14.88	9
13	-	10.62	1,6,7	27	-	16.34	9
14	-	11.05	1,6,7,8				

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Table II

Photographic observations of V1668 Cyg and SS Cyg

Plate No. A	Date JD 2440000+	Exposure (min)	Emulsion	Observer	V1668 Cyg	SS Cyg
3135	3718.414	10	ZU-2	H,K,W		8.91
3141	19.385	10	"	"		9.12
3145	19.531	10	"	"		9.47
3146	20.486	9	"	"		9.85
3147	23.483	10	"	"		11.11
3150	24.442	6	"	"		11.50
3151	25.451	10	"	"		11.67
3158	38.452	5	IIa-O	L		12.15
3161	40.450	9	"	"		12.57
3165	41.477	5	"	"		12.75
3169	42.478	7	"	"		12.30
3171	47.459	15	ZU-2	Ka		12.27
3172	64.373	5	"	D	6.82	12.45
3173	64.380	5	"	"	6.80	12.43
3174	64.399	5	"	"	6.53	12.37
3175	64.446	5	"	"	6.44	12.55
3176	64.536	13	"	"	6.48	12.47
3177	65.310	5	"	"	6.03	12.12
3178	65.332	6	"	"	6.06	12.04
3179	66.476	5	"	"	6.71	11.69
3180	66.483	5	"	"	6.85	11.86
3181	67.479	5	"	"	6.88	9.06
3182	67.483	5	"	"	7.04	8.82
3183	68.289	5	"	"	6.68	8.19
3184	68.293	5	"	"	6.51	8.07
3185	69.307	5	"	"	6.38	-
3186	69.342	8	"	"	6.37	8.16
3187	70.331	6	"	"	7.12	8.23
3188	70.337	8	"	"	7.03	8.40
3189	71.391	6	"	"	7.22	7.95
3190	71.397	8	"	"	7.46	8.15
3191	72.327	10	"	"	7.63	8.22
3192	72.336	13	"	"	7.39	7.94
3193	73.337	9	"	"	7.50	8.30
3194	73.351	10	"	"	7.67	8.51

Table II (cont.)

Plate No. A	Date JD 244000+	Exposure (min)	Emulsion	Observer	V1668 Cyg	SS Cyg
3195	3775.465	8	ZU-2	D	7.74	8.37
3196	75.471	10	"	Hä	7.56	8.14
3198	78.347	6	"	"	8.04	8.86
3199	83.434	10	"	D	8.30	11.07
3200	83.441	10	IIa-O	"	8.23	11.26
3201	85.333	15	"	Hä	8.17	11.67
3202	85.353	8	"	"	8.82	11.48
3204	88.430	23	"	S	9.17	12.22
3212	91.350	10	"	Hä	9.07	12.16
3213	92.343	10	"	"	9.77	12.32
3214	93.489	10	"	D	9.81	12.44
3215	94.382	10	"	"	9.65	12.49
3216	96.404	8	"	"	9.70	12.08
3217	3801.365	10	"	"	9.82	12.31
3218	03.382	10	"	"	10.02	12.33
3219	22.333	10	"	"	10.75	12.51
3220	25.396	10	"	"	10.68	12.40
3221	28.435	10	"	"	10.73	11.79
3222	49.237	10	"	"	11.26	12.42
3257	4040.463	20	"	"	14.64	12.57
3263	90.523	15	"	"	15.80	8.35
3272	4100.469	20	"	"	15.84	8.88
3285	28.394	20	"	"	15.55	12.38
3289	33.338	30	"	Le	15.80	12.38
3293	39.488	15	"	H	15.81	12.15
3297	40.343	30	103a-O	"	15.50	12.37
3305	42.411	30	"	"	15.86	12.11
3311	43.344	30	"	"	16.02	12.26
3320	46.481	30	"	"	15.96	12.46
3322	47.463	10	"	"	15.86	12.60
3330	70.381	20	IIa-O	D	16.29	8.98
3331	70.364	20	"	"	16.01	8.99
3332	71.301	10	"	"	16.20	8.99
3333	71.309	5	"	"	16.40	9.10
3334	71.318	13	"	"	16.07	9.39

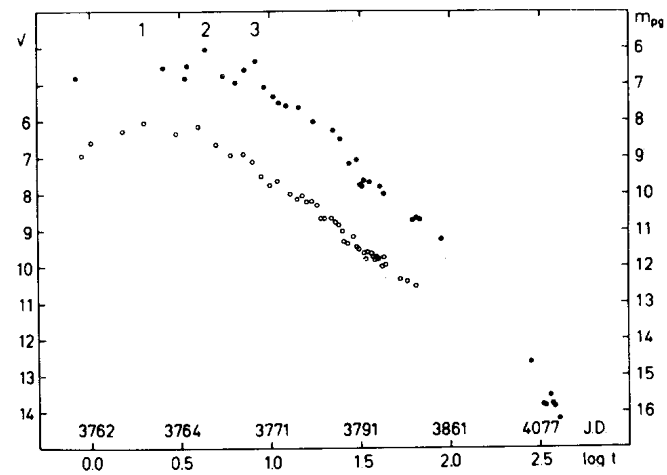

Fig.2. Photographic (upper) and photoelectric V (lower) light curves of V1668 Cyg. On the log t axis (number of days elapsed since JD 2 443 761.0), several Julian days are indicated. Three brightness maxima are labeled by numbers 1,2,3 (see text).

In Fig. 2, the photographic light curve and the photoelectric V light curve compiled by Duerbeck et al. (1980) are compared. The construction of a nova light curve from photoelectric data of different observers is somewhat problematic: UBV observations obtained with various instruments of different sensitivity functions exhibit systematic differences because of the influence of emission lines in the spectrum of the nova after maximum. Therefore, a series of photographic observations obtained with a single telescope is important to check the reality of some fluctuations in the light curve of V1668 Cyg which were reported in the paper by Duerbeck et al. (1980).

A logarithmic time scale is used in Fig. 2 in order to display the fluctuations in the early stages as well as the brightness decline in the late stages of the outburst. The time t = 0 was set to JD 2 443 761.0, as proposed by Gallagher et al. (1980). The maximum of the nova has a complicated structure, three brightness maxima occurred on JD 2 443 763, 765 and 769. They are present in the V light curve, yet more pronounced in the photographic light curve.

The photographic light curve supports the fact that the light curve of V1668 Cyg deviates markedly from those of the fast, intrinsically bright novae, like V1500 Cyg, Q Cyg, CP Lac etc. It is more like that of the somewhat slower, intrinsically fainter nova LV Vul. The finding of Duerbeck et al. (1980) that V1668 Cyg is subluminous for its fast evolution is thus confirmed and leads to the conclusion that the t_3 - time is not as good a luminosity indicator as hitherto assumed. A thorough discussion of the problem of nova luminosities is the subject of a forthcoming paper (Duerbeck 1980).

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RAPID VARIABILITY OF SYMBIOTIC STARS: CH CYGNI AND EG ANDROMEDAE

Previous investigations of 12 symbiotic stars have shown that they do not exhibit flickering activity (Walker, 1977). Only for one star CH Cyg the presence of flickering similar in nature to that seen in the cataclysmic variables has been confirmed during the course of its outburst in 1977 (Slovak, Africano, 1978).

Two of the symbiotic stars were observed by us in September 1980 by using the 1 m telescope of the Konkoly Observatory of the Hungarian Academy of Sciences, equipped with an automatic one-channel photometer with an unrefrigerated photomultiplier EMI 9058. All the observations were made in standard U filter. Because all the observations were made near to the zenith so the differential atmospherical extinction could be neglected.

CH Cyg: BD +49°2994 was used as comparison star. The integration time of one measure was 3s. After every 15 measurements the comparison star and the background were observed with the same integration time. The mean standard error determined from measures for the comparison star was $0^m.005$. The results are shown in Fig.1. It seems that CH Cyg shows rapid variability with an amplitude above $0^m.1$ on time scales about $15\text{-}20^m$ similar to that described by Slovak and Africano (1978). Additional rapid flickering activity (about some hundredths of magnitude and on the time scales of some minutes) may also be present but it is not clearly discernable because of the method of observation.

EG And: BD +40°158 was used as comparison star. The method of observations was the same as in the case of CH Cyg. The in-

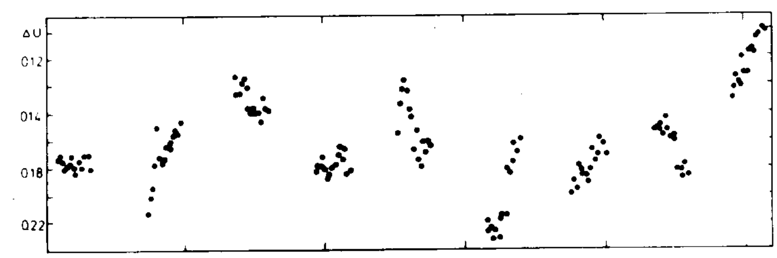

Fig.1. Rapid light variation of CH Cyg in the standard U filter. The observation was made on 4 September 1980. Time marks are 500s apart.

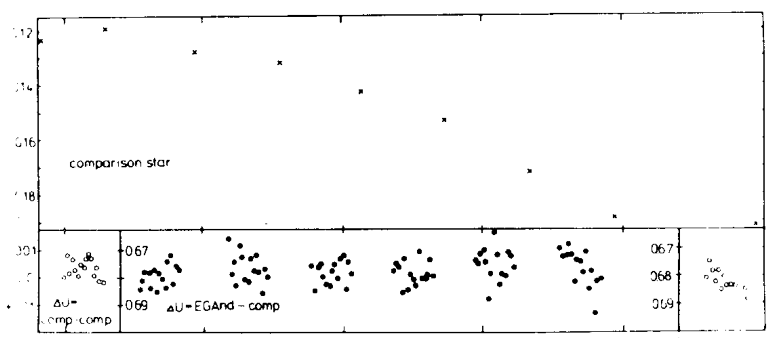

Fig.2. U observations of EG And. Crosses correspond to the comparison star; dark points to differences in magnitudes of EG And and comparison star; open circles to control series of measures of comparison star. The observation was made on 5 September 1980. Time marks are 500s apart.

tegration time was 5s. The mean standard error was about $0^m_.005$. It seems that the quiescent symbiotic star EG And does not show any rapid variability with the amplitude above the noise (Fig.2). Small differences in brightness are caused rather by interpolation errors.

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PHOTOELECTRIC BEHAVIOUR OF V 818 Sco AND X-Per

The variable star V 818 Sco identified as the optical counterpart of Scorpius X-1 (Sandage et al.,1966) has been extensively studied by many photometric observers. Despite these extensive observations including those with high time resolutions, the nature of Sco X-1 is still uncertain. This star was observed with the 104 cm reflector, having a thermoelectrically cooled EMI 6094 S photomultiplier at the Uttar Pradesh State Observatory. Usual d.c. techniques were used to record the observations on four nights during April 1977 - May 1978. Star C (Lyutyi, 1972) was used as the comparison star.

Behaviour of the star through the U, B and V filters is shown in Figures 1-3 while Figure 4 shows observations of 16 May,1978 in B filter when the star could not be observed through other filters. In these figures the differential instrumental magnitudes against the universal time have been plotted. The standard deviations in the U, B and V filters for a single observation of the comparison star are $0^m.065$, $0^m.035$ and $0^m.032$, respectively. The light curves show that the active and the quiescent states can last for hours at a time. It can also be seen that the magnitude of the star and shape of the light curve change from night to night. Durations of the anomalous behaviour (Figs.1-4) are too long in our observations as compared to the short duration dips reported by Sharma et al. (1979), while the magnitude changes are comparable.

X-Per was also observed during 1974-1977 for 6 nights and no variability in UBV was recorded. Even a continuous monitoring on 28 February 1977 for three hours did not show any variability in B filter.

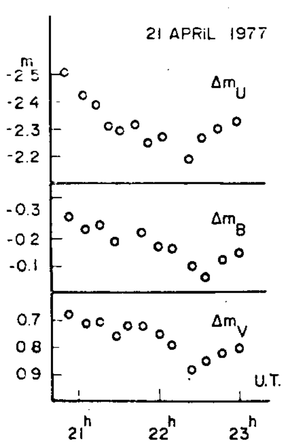

Fig.1

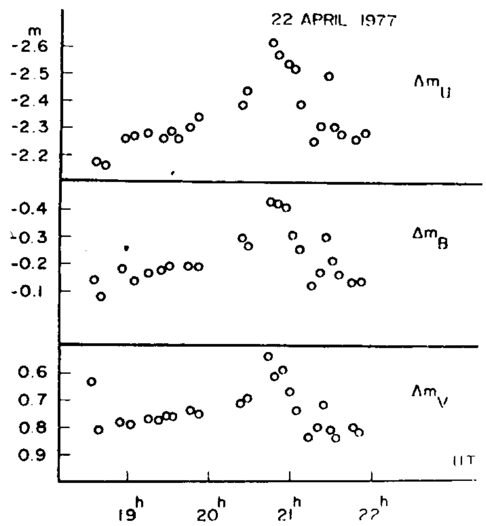

Fig.2

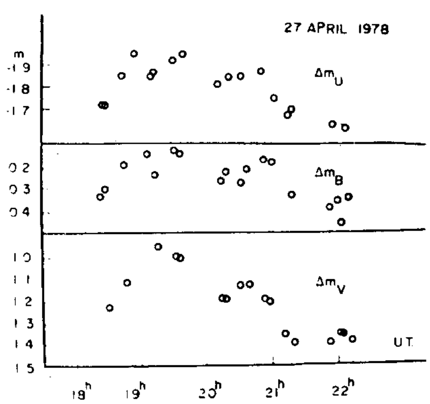

Fig.3

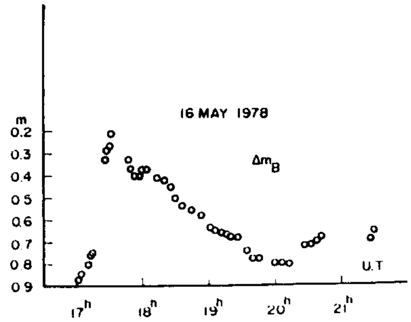

Fig.4

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ON THE VARIABILITY OF CENTRAL STARS OF TWO PLANETARY NEBULAE

There are several indications on the existence of rapid small-scale oscillations of the central stars of planetary nebulae (see Kohoutek, 1966; Lawrence et al., 1967; Stothers, 1977). Amplitudes of oscillations lie in the range of thousandths and hundredths of stellar magnitude on time scale extending from minutes to several weeks. Photoelectric observations of two planetary nebulae (NGC 7009, m_{pg}=8.5 and NGC 7662 m_{pg}= 9.0) were carried out during three nights in September, 1979 in order to detect and study their microvariability. The nebula diameters are less than one minute of arc. Observations were made at the Abastumani Astrophysical Observatory on the 48-cm telescope with 50" diaphragm by the photon counting method. Integrations of 10sec in B filter were used. In order to control the atmospheric properties of the night the normal star HD 21479 (A2V,m_v=7.28) was observed after the nebulae. The data are given in Table I.

Table I

Object	Date	Number of observations	Mean-square amplitude (mag.)
NGC 7009	14 - 15.9.1979	740	0.0048
NGC 7662	20 - 21.9.1979	916	0.0046
	21 - 22.9.1979	896	0.0036
HD 21479	21 - 22.9.1979	95	0.0024

Figs. 1 and 2 show the autocorrelation functions (ACF) and the power-spectra of brightness variations. The results are the following:

1) Both nebulae display the microvariability with amplitudes of 0.002-0.003 mag and periods 82 min (NGC 7009) and

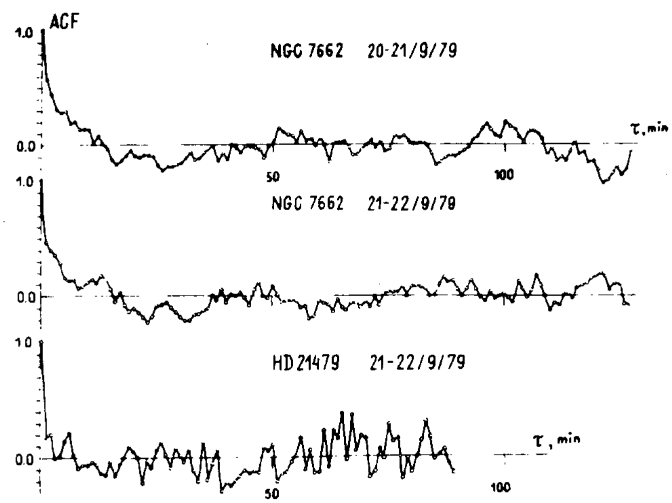
ACF
1.0
NGC 7662 20-21/9/79
τ, min
0.0
50
100
NGC 7662 21-22/9/79
HD 21479 21-22/9/79

Fig. 1.

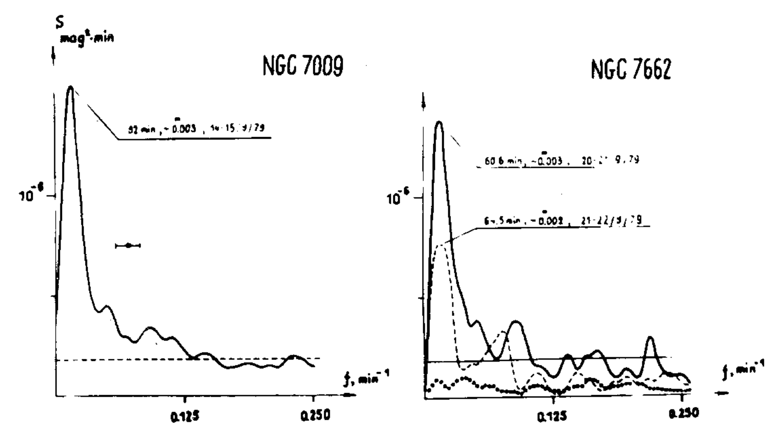
S
mag²·min
NGC 7009
NGC 7662
10⁻⁶
f, min⁻¹
0.125
0.250

Fig. 2.

60-64 min (NGC 7662);

2) The frequency spectrum shows no significant variations from night to night, amplitudes in this case may change noticeably (Fig. 2, NGC 7662).

3) Comparison of ACF and power-spectra of NGC 7662 with those of the control star in the same night (in Fig.2 depicted by circles) testifies to the physical variability of the nebulae in brightness rather than variability due to fluctuations in atmospheric transmission.

The authors suppose that the microvariability of the planetary nebulae indicate on the activity of their hot central stars, concentrated in the UV region.

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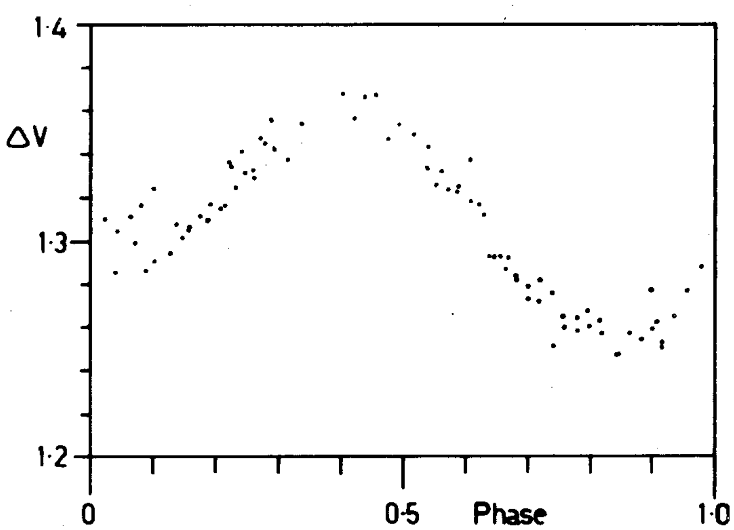
OPTICAL VARIABILITY OF THE RS CVn CANDIDATE HD 174429

The star HD 174429 is included in the southern RS CVn systems candidate list of Weiler and Stencel (1979), and radial velocity measurements on it are given by Stacy et al. (1980).

Using a photoelectric photometer with Monash University's 40-cm Newtonian telescope we have measured 85 values of V for this star on 9 nights in the interval 1980, July 23 to September 16. We find that the star is a variable having an approximately sinusoidal light curve with a period 0.942 ± 0.002 day, and a magnitude range of 0.10 ± 0.02.



Light curve of HD 174429. ΔV is relative to SAO 245894, and the phase is of the estimated period 0.942 day.

The graph below shows magnitude difference from the comparison star SAO 245894 versus phase of the estimated period, using primary epoch J.D. 2444443.0000. Check stars used were HD 172223 and SAO 245899. Incidentally our measurements indicate that HD 172223 was constant in V within the accuracy of our measurements (0.005 magnitude) during the period concerned, which does not support the suspicion of Cousins et al.(1966) that it is a variable with a range of about 0.05 magnitude in V.

We are preparing a fuller account of this work for publication elsewhere.

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PHOTOELECTRIC y AND λ6585 OBSERVATIONS OF VW CEPHEI

The W UMa-type eclipsing binary, VW Cep (HD 197433), was observed for about 5 hours on 29 July 1977 U.T.using a photoelectric photometer mounted on the 51 cm Cassegrain reflector of Biruni Observatory. The photoelectric photometer is equipped with an unrefrigerated RCA 4509 multiplier photocell (similar to the commercially available RCA 8645 photocell), and a Leeds and Northrup Speedomax was used to record the amplified signal from the photomultiplier. The observations were made using a Strömgren y filter and an intermediate bandpass interference filter with a maximum transmission of λ_{max} = 6585Å and a full width at half maximum transmission of FWHM = 280Å. A 40 arc second diaphragm was used and the observing sequence was the usual pattern of sky-comparison-variable-comparison-sky, with each observation lasting about 30 seconds.

BD + 76°809 (SAO 9836; m_v = 7.1) was used as the comparison star and the effects of differential atmosphere extinction were removed using the extinction coefficients derived from the comparison star observations. The extinction corrections were, however, very small because of the angular proximity of the comparison star to the variable star. The differential magnitudes in the sense (variable minus comparison) are plotted in Figure 1 where the phases were computed according to the ephemeris of Cristescu (1978):

$$\text{MinI} = \text{HJD } 2443448.2663 + 0.2783176 \cdot E$$

A determination of the time of secondary minimum was obtained from the data yielding: MinII = HJD 2443354.3410 ± $0\overset{d}{.}0008$. This minimum occurs at 0.475 phase according to Cristescu's ephemeris and represents an O-C = $-0\overset{d}{.}007$ when the secondary minimum is assumed to occur at the half period point. This timing is in good agreement with other minimum determinations made during the same observing season (Hopp et al. 1979).

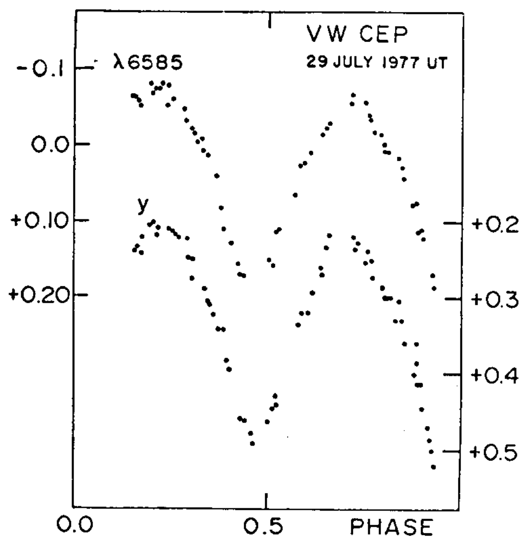

Figure 1. The λ6585 nand Δy light curves ot VW Cep as a function of orbital phase. The phases were computed according to the ephemeris of Cristescu(1978).

Although the light curve is only partially covered, the maxima are both defined by the observations and appear to have slightly different heights where the maxima near 0.25 phase are brighter than the corresponding maxima near 0.75 phase by about 0.015 mag in each bandpass. The light curve of VW Cep is intrinsically variable, at times showing asymmetries between adjacent maxima of 0.07 mag (Kwee, 1966).

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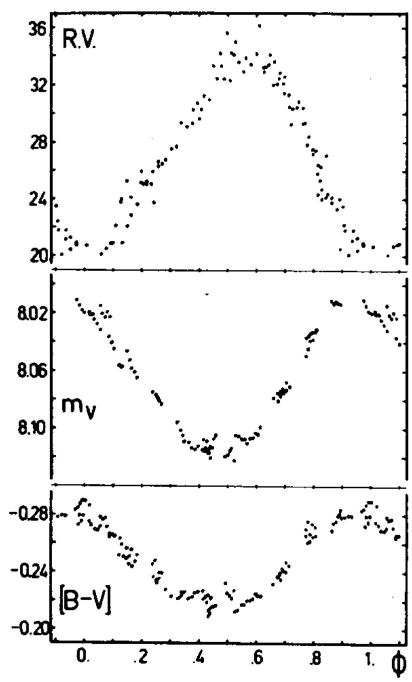
HD 37819, A NEW δ SCUTI STAR

Because of its erroneous spectral classification (F5Ib), HD 37819, a 8th magnitude star, has been included in the observational program of study of the supergiant variability carried on at the Geneva Observatory. A variation of short period (P ≅ 4.5 h) was detected in radial velocity the 5th of March 1980 by means of the spectrophotometer CORAVEL (see Baranne et al., 1979) from the Geneva station at the Haute-Provence Observatory (France). The same period was found for the light and colour variability the 15th of March 1980 from the Jungfraujoch Observatory (Switzerland). Spectra at 65Å/mm were taken at the Haute-Provence Observatory with the 120 cm telescope the 21 of March 1980 (Goy, 1980). The revised spectral classification for HD 37819 is F4 III p - δ Delphini - (Jaschek, 1980). Consequently, HD 37819 is a new δ Scuti-type star.

The radial velocity of HD 37819 was measured 105 times, during the nights of March 5, 7, 9, 12, 16 and 17, 1980. In addition, 110 photometric measurements in the U,B,V filters of the Geneva system were obtained during the nights of March 15, 16 and 17, 1980.

Fourier analysis reveals a single frequency of $5.28653 d^{-1}$, thus the period is

$$P_o = 0.18916 \text{ d} \simeq 4.5398 \text{ h}$$



The curves of variation in radial velocity, apparent magnitude and Geneva colour index [B-V] are shown in the Figure. The peak-to-peak amplitudes are respectively 13.5 km/sec, $0^{m}.103$ and $0^{m}.064$.

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ON THE VARIABILITY OF V1068 CYGNI

In 1977 D. Hoffleit (I.B.V.S. No. 1282, 1977) published a new value of the period of the eclipsing binary star V 1068 Cyg.

$$\text{Min} = \text{JD } 2437876.1 + 42^{d}.68 \cdot E \qquad (1)$$

The star was estimated from the Moscow plates by S.Shugarov (A.Ts., No. 949, 1977; No. 1094, 1979), who confirmed this period. It was shown that the light elements derived by R. Weber (I.B.V.S. No. 39, 1963) and given in the GCVS (Moscow, 1969) were not correct. However, about half of the minima published by Weber was not consistent with the new period of $42^{d}.68$.

We have estimated this star on the Odessa plates, spanning 1957-1977. Among 711 plates the star was found at minimum on 51, some observations were obtained on two plates taken at the same time in photographic and photovisual systems, respectively. In the photographic system the star's light varied from $10^{m}.98$ to $12^{m}.06$. 34 moments were found when the star was at minimum, 17 of these from two plates. Besides deep minima the decrease of light by $0^{m}.3$-$0^{m}.5$ was observed, but the number of such estimations is little.

The dates of the observed minima and close maxima (M), deviations (O-C) and epochs relative to elements (1), the system of plates (pg, pgvis) and the observer's name (D-V.G.Derevyagin, Ch-R.I.Chuprina) are given in Table I.

There were 9 cases when the star had minimum light on several plates taken on neighbouring nights (from 2 to 4). The longest minimum was observed in October 1962 (JD 2437960, 961, 962, 963), and the decrease was seen on the plates of two cameras.

Using Odessa observations and those published by other authors as well as original observations by S.Shugarov kindly presented to us, we tried to make a search for the period. No other value of the period has been found. It seems to be necessary to carry out systematic observations of this system.

Table I

	JD	O–C	E	System of plates		Observer
M	2436080.403					
	82.397	$-1^{d}.2$	−42	pg	pgvis	Ch
	83.400	−0.2		pg		Ch
	84.437	+0.9		pg		Ch
	381.499	−0.8	−35	pg		Ch
	425.449	+0.4	−34		pgvis	Ch
	426.438	+1.4		pg	pgvis	Ch
M	428.445					
M	465.365					
	466.354	−1.4	−33	pg		Ch
	809.436	+0.3	−25	pg		D
	894.194	−0.3	−23		pgvis	Ch
	37193.397	+0.2	−16	pg	pgvis	Ch, D
M	195.380					
	492.511	+0.5	− 9		pgvis	Ch
	493.477	+1.5			pgvis	Ch
	.501			pg		D
M	494.478					
	578.277	+1.0	− 7	pg	pgvis	Ch, D
	.304			pg		D
	960.265	−1.3	+ 2	pg	pgvis	Ch, D
	961.271	−0.2		pg		D
	962.277	+0.8		pg	pgvis	Ch, D
	.304			pg		D
	963.296	+1.8		pg	pgvis	D, Ch
M	964.276					
	39027.314	−1.2	+27	pg		D
	.346			pg		D
	28.345	−0.2		pg		D
	29.328	+0.8		pg		D
	412.297	−0.3	+36	pg	pgvis	Ch
	414.428	+1.8		pg		Ch
M	415.249					
M	709.484					
	711.470	+0.4	+43	pg	pgvis	Ch
M	713.468					
	40478.360	−1.3	+61	pg	pgvis	Ch
	479.355	−0.2		pg	pgvis	Ch
	480.356	+0.8		pg	pgvis	Ch
	41162.483	0.0	+77	pg	pgvis	Ch
	163.472	+1.0		pg	pgvis	Ch
M	544.404					
	545.442	−1.2	+86	pg	pgvis	Ch
M	42355.222					
	357.229	−0.3	+105	pg	pgvis	Ch

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A CEPHEID VARIABLE IN NGC 6067

HD 144972 (CPD -54°7159) has been classified as of type F6 I by Drilling (1968). The star is in the region of the cluster NGC 6067 discussed by Thackeray, Wesselink and Harding (1962, Plate 5) but not observed by them. It is included in a current program of intermediate band, Hβ and RI observations of southern supergiants during which a variation of 0.3 mag was found in visual light. The observations are shown in Figure 1, where filled circles represent means of two observations in different cycles. The observations were obtained in the interval between 1 May and 7 September, 1980 with the 0.9 m reflector on Cerro Tololo. The preliminary light elements are Max. = JD 2444361.875 + $3^{d}.770$. The path of the variable in the (V, b-y) plane is shown in Figure 2 where the top of the main sequence is shown schematically and two, known supergiants in the cluster (-53°7400p and -53°7400f) are labeled with the types assigned by Thackeray et al. Both the median magnitude and the spectral type are intermediate between the two cluster supergiants, supporting cluster membership. The cluster velocity is -43.4 km/sec from four stars observed by Thackeray et al. and cluster membership for HD 144972 could be tested in this way.

The cluster modulus, from the discussion by Thackeray et al., and a not entirely independent derivation by Engver (1966), is

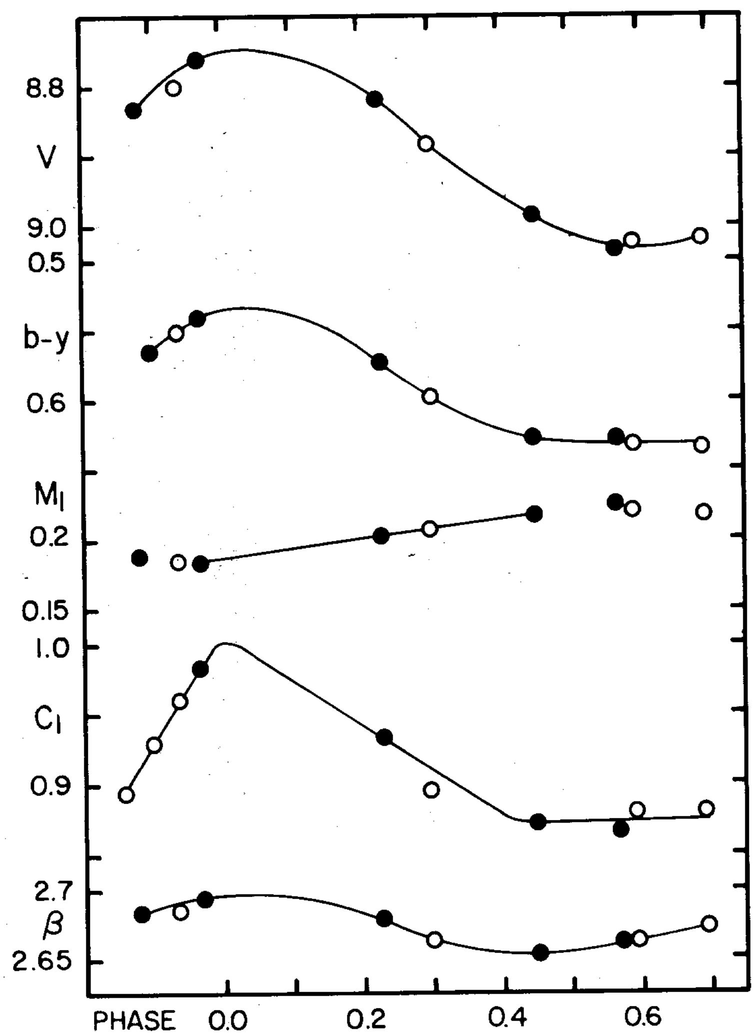

Figure 1

near 11.5 mag. Adopting the mean reddening determined by Thackeray et al., E(B-V) = 0.33 mag, (E(b-y) = 0.25 mag) the intrinsic values of the median magnitude and color (read at phase 0.25) of HD 144972 are $V_o = 7.8$ mag and $(b-y)_o + 0.33$ mag. The modulus of 11.5 gives $M_V = -3.7$ for the variable, which is about one magnitude brighter than predicted by current period-luminosity relations.

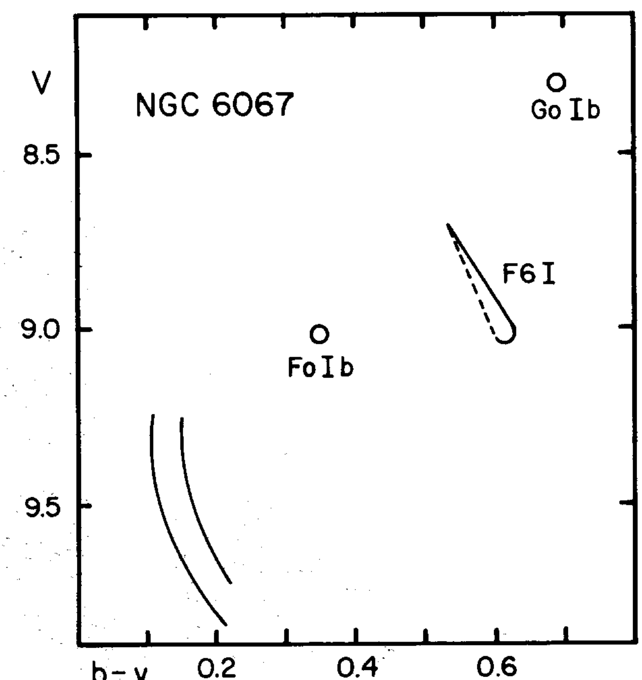

Figure 2

The situation is reminiscent of that for Polaris, also a short period (4 days) and small amplitude (0.1 mag) variable, for which McNamara (1969) finds $M_V = -3.7$ mag from intermediate band and Hβ observations of the common proper motion companion. It should be noted that if both these cepheids are first overtone pulsators, the fundamental periods would indicate luminosities near $M_V = -3.7$ mag from the P-L relations.

An alternate possibility is that the cluster modulus is about one magnitude too large, a not unprecedented situation for very young clusters fitted to a universal main sequence (see e.g. Eggen 1976). There is some preliminary indication that this may be the case, in that single intermediate band and Hβ observations of three early type cluster stars, with visual magnitude between 9.0 and 11.2, give a mean modulus of 10.6 ± 0.05 (σ) mag and a mean reddening of E(b-y) = 0.29 ± 0.02(σ) mag. These values, if confirmed, will lead to M_V = -3.0 mag for the median luminosity of the variable.

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UBV PHOTOMETRY OF SZ Lyn

Between December 1979 and March 1980 about 350 photoelectric observations of the short-periodic variable SZ Lyn were carried out with the aid of 64 cm reflector of the Crimean Astrophysical Observatory.

The observations were made in the UBV system with a photometer employing uncooled EMI 6256B tube. The standard techniques of differential photometry were employed both in the observations and reduction procedures.

The comparison star was BD +45°1544 ($V=9^{m}.43$; $B-V=+0^{m}.46$; $U-B=+0^{m}.03$).

The light and colour variations are shown in Figure 1.

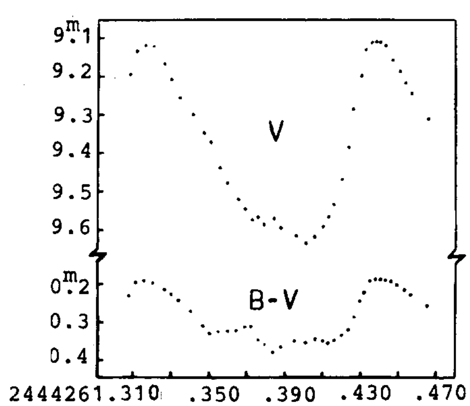

Figure 1

From the observed light curves 6 heliocentric moments of maxima and corresponding magnitudes were determined (see Table 1).

Differences O-C refer to the following linear elements:

$$\text{Max.hel.JD} = 2438124.3977 + 0^{d}.12053481 \cdot E$$

given by Barnes and Moffet (1975).

Table I

JD_{hel}	O-C	B_{max}	V_{max}	$(B-V)_{max}$
2444222.3817	$+0^d.0074$	$9^m.330$	$9^m.105$	$+0^m.225$
257.4574	.0075	9.316	9.095	0.221
261.3156	.0086	9.325	9.126	0.199
261.4359	.0083	9.312	9.115	0.197
262.2787	.0074	9.315	9.100	0.215
269.2711	.0088	9.323	9.121	0.202

As it follows from this Table there are small variations of maximum brightness. However, we do not confirm radical changes in the shape of maximum claimed by van Genderen (1967) and Wisse and Wisse (1969).

The maximum brightness changes with the phase ψ of 1146 days period. Our observations are shown by open circles in Figure 2 taken from the paper by Barnes and Moffet (1975).

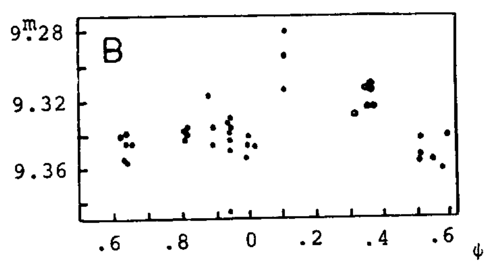

Figure 2

The scattering in values of B_{max}, V_{max} and O-C shows the existence of more rapid changes.

All individual B and V light curves at the $0^P.4$-$0^P.6$ of the pulsation period phases show the wave, whose amplitude varies in appreciable limits. The wave is also observed on the (B-V) curve.

On the basis of radial velocity determinations McNamara et al. (1976) consider that stellar radius reaches maximum at phase $0^P.4$. Consequently the wave is the result of the processes taking place at the initial stage of the stellar compression.

We wish to thank the authorities of the Crimean Astrophysical Observatory for giving us the chance to get the observations.

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THE MAXIMUM TIMES AND NEW LIGHT ELEMENTS OF 28 AQUILAE

The Delta Scuti type variable 28 Aql has been observed at Ege University Observatory from June 13, to July 15, 1980. The observations were carried out with the 48 cm Cassegrain reflector equipped with an unrefrigerated EMI 9781A photomultiplier. The intermediate band filters were used at the observations.

The maximum times obtained during the observations are given in the following table.

Table I

The maximum times of 28 Aql

JD Hel.	O-C (I)	O-C (II)	E	Filter
2444404.5209	$-0\overset{d}{.}0112$	$-0\overset{d}{.}0125$	-13	b
.5271	-0.0050	-0.0063	-13	y
405.4417	+0.0096	+0.0103	- 7	b
.4404	+0.0083	+0.0090	- 7	y
406.4821	0.0000	+0.0031	0	b
.4807	-0.0014	+0.0017	0	y
416.5018	-0.0303	-0.0046	67	b
.5015	-0.0306	-0.0049	67	y
421.4527	-0.0294	+0.0074	100	b
.4436	-0.0385	-0.0017	100	y
426.5305	-0.0516	-0.0034	134	b
.5278	-0.0543	-0.0061	134	y
427.4305	-0.0516	-0.0014	140	b
.4285	-0.0536	-0.0034	140	y
428.4778	-0.0543	-0.0017	147	b
.4799	-0.0522	+0.0004	147	y
429.3799	-0.0522	+0.0024	153	b
.3847	-0.0474	+0.0072	153	y
436.4139	-0.0682	+0.0022	200	b
.4146	-0.0675	+0.0019	200	y

For the preliminary elements JD Hel. 2444406.4821 and a period of $0\overset{d}{.}150$ were taken. The O-C(I) residuals were computed with these elements. The least square solution has been applied and the new light elements were derived as follows:

$$\text{Max.} = \text{JD Hel. } \underset{\pm 21}{2444406.4790} + \underset{\pm 17}{0\overset{d}{.}149663} \cdot E.$$

The O-C(II) residuals were computed using these new light elements.

The light curves and the variations of their amplitudes will soon be published elsewhere.

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NARROW- AND INTERMEDIATE-BAND Hα PHOTOELECTRIC PHOTOMETRY OF VW CEPHEI

The W Ursae Majoris-type eclipsing binary VW Cep (BD+75°752) was observed through a complete orbit on 30 October 1979 U.T. The observations were made with a photoelectric photometer mounted on the 38-cm reflector of Villanova University Observatory. The detector is a thermoelectrically cooled (to -10°C) EMI 9558 photomultiplier tube and a microprocessor-controlled integrating system was used to record the signal. A pair of intermediate- and narrow-band interference filters centered near the rest wavelength of the Balmer Hα line (λ6563) was used. The Hα filter pair is similar to that used by Baliunas et al. (1975) in the definition of the Villanova α-system. The Hα narrow-band filter is centered at 6568Å and has a bandwidth of FWHM = 35Å. The intermediate bandpass filter is broad enough to be little affected by the presence of the Hα feature within the bandpass. The α index is defined as follows:

$$\alpha = -2.5 \log F_N/F_I + \text{constant}$$

where F_N and F_I are the fluxes measured through the narrow- and intermediate-bandpass, respectively, and yields a measure of the net Hα line strength.

The comparison star was BD +76°809 (SAO 9836; m_V=7.1; F2) and was the same star used in a previous study of VW Cep by Guinan et al. (1980). The observing sequence was the usual pattern of sky-comparison-variable-comparison-sky, with each observation lasting 20 seconds. The effects of differential atmospheric extinction were removed by using an extinction coefficient of k(λ6585)=0.185, found from the observations of the comparison star. The differential extinction corrections were, however, small because of the angular proximity of the comparison star to the variable star.

The differential magnitudes in the λ6585 intermediate bandpass are plotted against orbital phase in Figure 1. The standardized α indices are also shown in the figure where a numerical de-

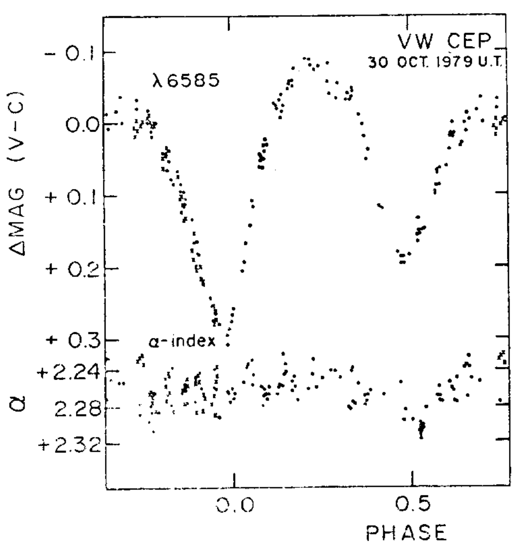

Figure 1. The λ6585 intermediate-band light curve and α index for VW Cep, as a function of orbital phase where a numerical decrease in the α index corresponds to an increase in net Hα emission. The filled circles represent observations obtained during the coverage of the first orbit while the "χ" symbols represent data obtained during the second orbit. The phases were computed using the ephemeris of Cristescu (eq.1).

crease in the α-index indicates an increase in the total energy flux through the narrow-band filter relative to the intermediate-band filter. This can be due either to increasing emission or decreasing absorption in the Hα line relative to the continuum. The phases were computed according to the ephemeris of Cristescu (1978):

$$\mathrm{MIN} = \mathrm{JD\ Hel}\ 2443448.2663 + 0.2783176 \cdot E \qquad (1)$$

where 0.0 phase corresponds to the time of mid-primary eclipse.

Using the method of Szafraniec (1948), the times of primary and secondary minimum were determined as Min I = HJD 2444176.6161 ± $0^{d}.0006$ and Min II = HJD 2444176.7584 ±0.0011, respectively. Only data within ± 0.10 phase of mid-eclipse were used in obtaining each timing. The O-C for the above timing of primary minimum using the light elements of Cristescu is $-0\overset{d}{.}0074$ while the O-C for the secondary minimum is $-0\overset{d}{.}0039$ when secondary eclipse is assumed to occur at the half period point.

As shown in Figure 1 the present light curve is very asymmetrical, the maximum near 0.25 phase being about 0.060 mag brighter than the corresponding one near 0.75 phase. The depths of primary and secondary minimum, relative to maximum light near 0.25 phase, are 0.377 mag and 0.275 mag, respectively. Intermediate band $\lambda 6585$ light curves of VW Cep obtained in July 1977 by Guinan et al. (1980) and in November 1978 by Guinan and McCook (unpublished) also display outside eclipse asymmetries, but not to the extent seen in the 1979 data. The differences in the mean height of the maximum at 0.25 phase relative to the maximum at 0.75 phase in the sense Max I- Max II are -0.015 mag and -0.030 mag for the 1977 and 1978 data. Investigations of the outside eclipse changes in the light curve of VW Cep have been made by Kwee (1966), Leung and Jurkevich (1969) and by Pustylnik and Sorgsepp (1976). Leung and Jurkevich interpret the light curve variations as arising from a circumstellar cloud of absorbing material which revolves with a period about 9.3 seconds longer than the orbital period of the stellar components, resulting in a 780 day beat period. Pustylnik and Sorgsepp, however, interpret the light curve asymmetries as arising from the effect of a hot spot produced by a gas stream impacting on a circumstellar shell (or disk) around the hotter star. More recently, W UMa systems have been linked with RS CVn-type stars (Hall 1976) in which the photometric disturbances often present are attributed to the presence of large subluminous regions (starspots) over their surfaces. The recent identification of VW Cep as an X-ray source (Carroll et al. 1980) and the detection of strong emission lines of CIV, HeII, NV and SiIV in the far UV spectrum of VW Cep by the I.U.E. satellite (Dupree et al. 1980), further appear to relate W UMa-systems to RS CVn binaries.

Despite the relatively large scatter in the α-indices (introduced chiefly by the observational noise in the narrow-band data), a phase dependent variation in α is clearly present. As shown in Figure 1, the α-index has its largest numerical value of α=2.30 during mid-secondary eclipse. No significant variation in the α-index appears to be present during primary minimum or during the outside eclipse phases. Outside secondary minimum, the mean value of α lies between 2.24 and 2.27. A value of $\alpha \simeq 2.29 \pm 0.01$ is expected from the G5 ± K1(3) spectral types assigned to the components of VW Cep (e.g. Koch et al. 1970). Thus, at mid-secondary minimum the observed α-index appears appropriate for the assumed spectral types of the component stars, while outside the eclipse the α-index is too small. The smaller than expected value of α outside secondary eclipse can be explained by weak residual Hα emission observed at these phases. At secondary minimum (when the K component is partially eclipsed) the Hα emission appears to be absent, thus suggesting that the Hα emitting region is on, or closely associated with, the eclipsed star. Hα emission has also been observed in several RS CVn systems where it may arise from active regions on the stellar surfaces. A similar origin may be possible for VW Cep in which the asymmetries in the light curve as well as the behaviour of the α-index may be explained in terms of active regions on the surface of the cooler star.

Further Hα narrow- and intermediate-band photometry of VW Cep is planned. An extensive analysis of the observations is underway and will be published in the near future.

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THE PERIOD OF V154 IN NGC 5272 (M3)

The variability of the star was discovered visually by Barnard (1906). Greenstein (1935), Arp (1955) and Kholopov (1972) published photographic observations of the star. A radial velocity curve was published by Joy (1940). These authors concluded that V 154 is a W Vir star, changing its light between $12^{m}.1$ - $13^{m}.7$ in B and $12^{m}.0$ - $13^{m}.25$ in V. The spectral type varies between F5 and G3.

Between spring 1976 and spring 1979 we took 25 Kodak 103a-D plates of NGC 5272 with the 314/5000 mm two lens refractor of the Wilhelm Foerster Observatory, Berlin. The plates were exposured 10 to 30 minutes behind a Schott GG495 filter. As the variable is located near the center of the cluster, it was not possible to measure the star with an iris photometer. Therefore,the star was estimated by the Argelander step method using seven comparison stars. The resulting magnitudes have an accuracy of about $0^{m}.05$.

With the period value $P=15^{d}.2854$ we reduce the observations to one period and determined from the resulting light curve an actual time of maximum by the Pogson method. This value is listed in Table I together with the values derived by the above cited authors. The epochs and O-C values were calculated with Arp's elements

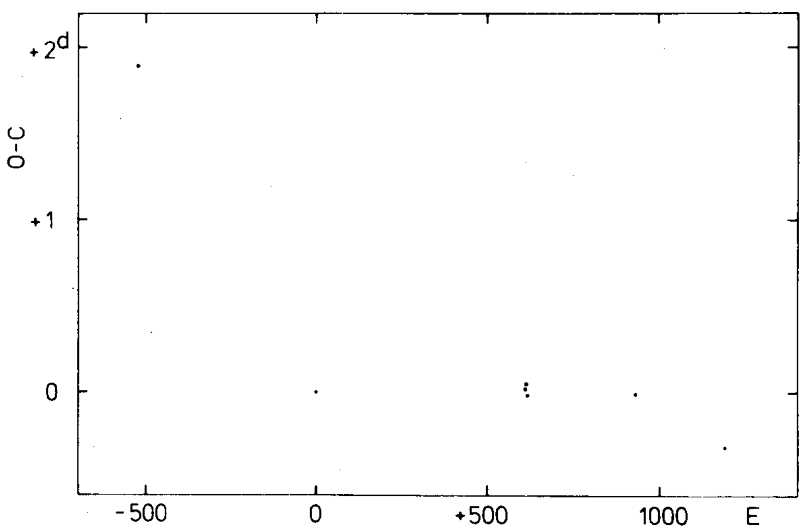
$$\text{Max.} = 2424627^{d}.55 + 15^{d}.2854 \cdot E \qquad (1)$$

and are shown in the Figure. Formula (1) represents the values of Greenstein, Arp and Kholopov. Our new observations indicate a period change because the O-C is significantly greater than the error of our maximum timing. If one makes a linear fit between the value of Kholopov, one can derive a first approach to the new period value. We find an actual value of $P_a=15^{d}.2842$ which means that the period has shortened by approximately $1^{m}45^{s}$. The value $\Delta P/P$ is $-7.8 \cdot 10^{-5}$. Another period change is indicated by the large O-C value of Barnard's observations.

Table I

Observed times of maxima of V 154 in NGC 5272

Maximum (J.D.)	E	O-C	Reference
24 16604.6 d	-525	+1.89 d	Barnard (1905)
24627.55	0	0.00	Greenstein (1935)
34119.8 ±0.15 d	+621	+0.02	Arp (1955)
34150.4	623	+0.05	"
34180.9	625	-0.02	"
38873.53	932	-0.01	Kholopov (1972)
42862.71±0.08	1193	-0.32	this paper.



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THE SPECTRUM OF R SEXTANTIS

R Sex (HD 84127=BD $-7^{\circ}2873$) was noted as variable between 9.7 and 10.6 pg at Harvard some 85 years ago, but in recent years its variability has been questioned and it is considered as "constant?" in the GCVS. The Henry Draper Catalogue classifies it as Mb, but apparently no other spectroscopic observations exist. On two blue objective-prism plates taken for the Michigan Southern Hemisphere Spectral Survey made available to the writer through the kindness of Dr. N.Houk, R Sex appears as an M5 star with hydrogen emission:

Date	Spectrum
March 13, 1970	Hγ rather weak, Hδ considerably stronger than Hγ
March 1, 1971	Hγ and Hδ equal and moderately weak

In view of its spectral type, the presence of emission, and its evident spectral variability, it seems very likely that R Sex does indeed deserve its variable star designation.

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SURPRISINGLY HIGH OPTICAL POLARIZATION OF μ CEPHEI

During August and September 1980 at Belgrade Astronomical Observatory a high degree of linear polarization of μ Cephei in V spectral region was observed. The preliminary mean values of polarization parameters, observed on August 7 and 15 as well as on September 5 and 9, are: P = 3.8% and $\theta = 35^{o}$. Deviations of the individual measurements from the mean values are insignificant. As far as we know this is the highest long lasted value of the μ Cephei polarization percentage, although some highly scattered individual measurements reaching 4% (Grigoryan, 1959) have been published.

μ Cephei is a star having long series with a great number of photoelectric observations - photometric and polarimetric (e.g. Polyakova, 1975 and 1974). There were also several inconclusive attempts to explain the origin of the observed polarization. It is clear, however, that the additional observations of various kinds, especially during forthcoming decrease of polarization percentage we can expect, seem necessary. Therefore, besides Belgrade polarimetric observations that will be carried on, similar observations, as well as photometric ones, in various spectral regions, including infrared, are desirable. Spectral observations, especially radial velocities, would be useful, too. Even a series of speckle interferometric measurements can be of interest.

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H AND K EMISSIONS IN V 471 TAURI (BD + 16° 516)

The white dwarf eclipsing variable V 471 Tauri was discovered as a spectroscopic variable by Wilson in 1953. In the intervening years the star has been observed by many investigators mainly photoelectrically and also spectroscopically. The photoelectric observations of the star indicate that the light curve of the star exhibits only primary minima and an advancing migration wave through the light curve. It was also reported that the migrating wave appears to indicate a periodicity of about 1/2 years (Ibanoglu, 1978). Although the star has been continuously observed at the observatory of Ege University, from 1973 until the present time, the data concerning photoelectric observations already published goes until 1978. In the mean time for the source of the migrating wave and its travel through the light curve many suggestions were put forward. One of these suggestions is a spot model where a spot or spots occur on the surface of the star with changing their positions similar to the Sun, resulting in the changing appearance of the light curve. It was also suggested that probable correlation may exist between simultaneous spectroscopic and photoelectric observations such as; Intensity of the Ca II (H and K) lines in emission may vary according to the position of the migrating wave, or occurrence of H and K emissions may be correlated with the maxima or minima position of the wave. Bearing these facts in mind, the star was spectroscopically observed at the Observatory of Asiago in March 1980, with 122 cm Cassegrain telescope, prism spectrograph and image intensifier with 42 and 40 A/mm dispersions at 3968 and 3933 A, respectively. When the light curves sofar obtained and published examined and compared with the spectroscopic observations recently obtained, some interesting results came out seem to be worthwhile particular attention. In the Figures 1 and 2, the intensity of H and K lines

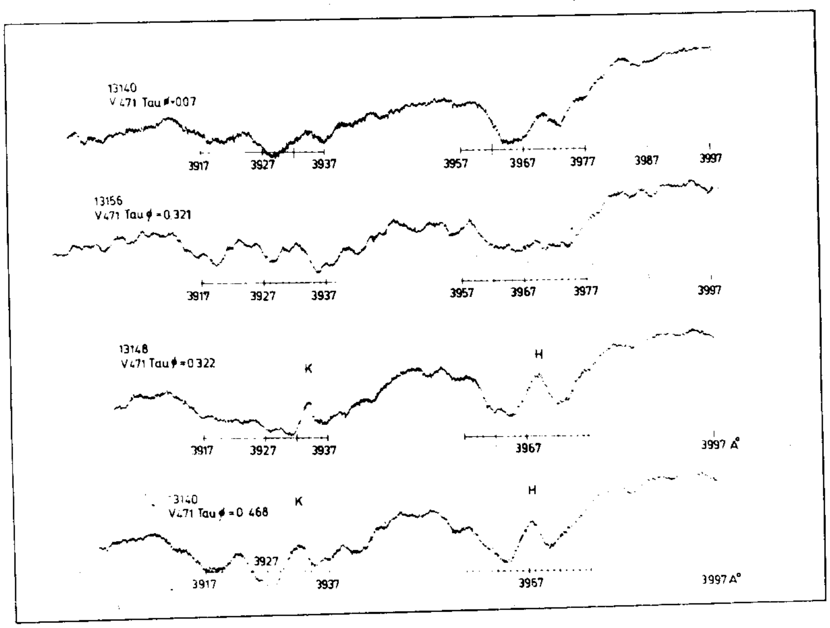

Figure 1

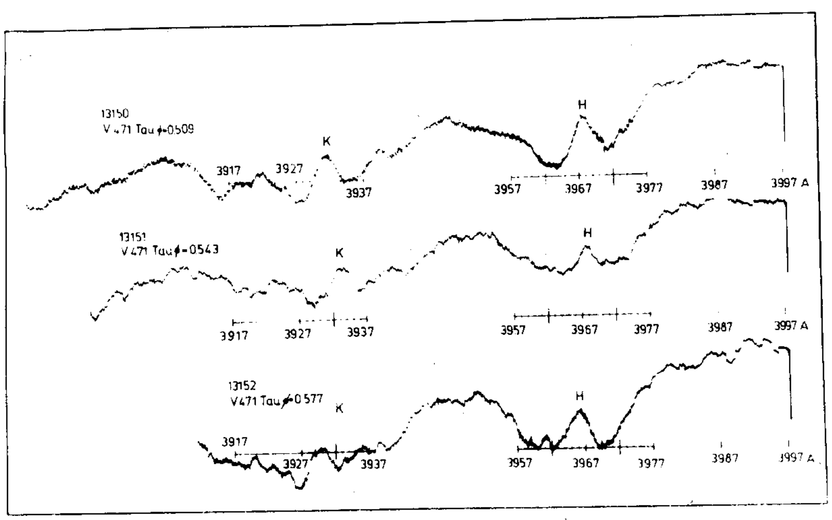

Figure 2

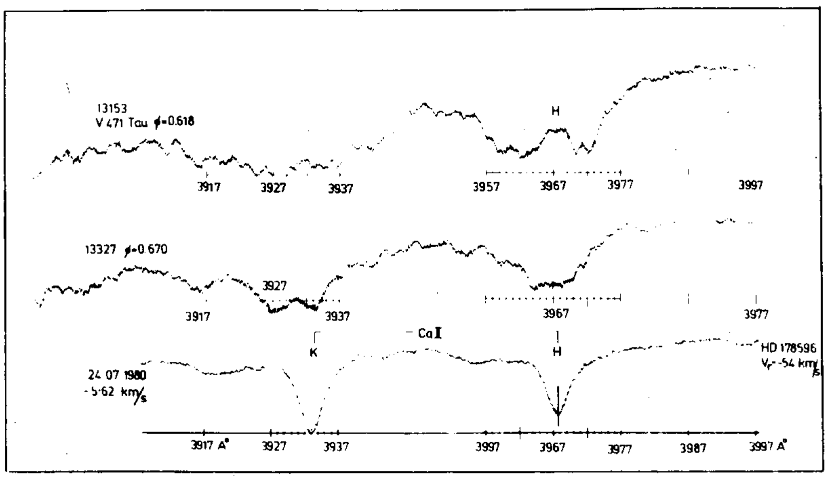

Figure 3

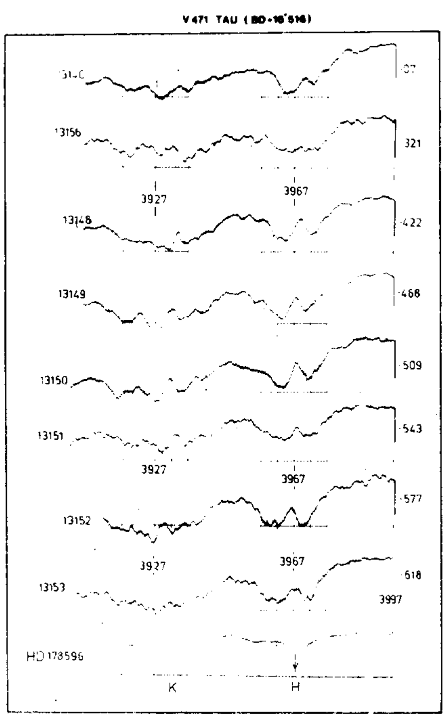

Figure 4

versus orbital phases of the star are presented along with the absolute wavelength scale, derived from the comparison spectra and also checked by observing one of the variable stars (HD 178596) from Wilson (1953). At the orbital phase 0.32 H and K emission does not exist or it is nearly minimum, where as in all other orbital phases the Ca II emission exists. If we examine the light curves and particularly the last one, (Tunca et al.,1979) at 0.32 phase where Ca II emission does not exist or its intensity is in minimum, the light curve exhibits a maximum. Although spectroscopic observations presented here were obtained at the beginning of March 1980 and time duration difference with the last light curve is about 1 year, if we consider that the migrating wave shows periodicity with 180 - 192 days interval (Ibanoglu, 1978) we may anticipate to see the maximum position again in the vicinity of the previous position. Where the maximum peak position within the light curve corresponds to the observation of the star surface with no spots and this also corresponds to the non existence of the Ca II emission. In Figures 1,2 and 3, the microdensitometer scans of rotationally broadened H and K emissions within the absorption lines for different orbital phases are presented. In Figure 4 the same scans together with the scan of the comparison star are presented.

Acknowledgements
I am grateful to Prof.L.Rosino, Director of the observatory of Asiago for the excellent facilities provided, to Prof.A.Mammano for constant comments and guidance of the subject and Dr.C.Ibanoglu and his colleagues for constructive discussions.

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PRESENT ACTIVITY OF CH CYGNI

The last activity phase of the semiregular variable star CH Cyg began in May 1977. High resolution spectra (12.4 Å/mm) have been obtained regularly at the Haute Provence Observatory since September 1977. The evolution of the present outburst is remarkably slower and quite different from the previous one of 1967-1970. In the blue region the normal absorption line spectrum has been continuously weakening because of the presence of a hot continuum filling up the lines; almost no M6 lines have been detectable since 1979. The spectrum is dominated by strong emission features mainly due to Fe II and [Fe II] and by a very well-developed Balmer series. A report on the results obtained from these spectra during the first two years of activity has been published by Faraggiana (1980).

Since then the main variations observed up to September 1980 are:

1) The Balmer series shows a much sharper absorption component and lines are visible on the last spectra up to H_{38}.
2) The He I emission lines are steadily weakening.
3) The Ti II lines which had a P Cyg profile until 1979 are now present as red-winged emission lines.
4) The Fe II emission lines which had a violet-winged profile until 1978 now show a red-winged profile.
5) The [Fe II] emission lines are developing a much sharper profile in comparison with the permitted Fe II lines.
6) New emissions are developing, e.g. Na I and Sr II resonance lines.
7) The [O III] 5007 and 4363 present during the 1967-70 outburst

are not present during the present burst, but [O I] 6300 and 6363 and [O II] 3727 have been present with increasing intensity since 1978.

Low resolution observations of the far ultraviolet spectrum have been obtained with IUE on April 22, 1978, July 31, 1978, March 11, 1979, September 22, 1979 and September 1, 1980 by Hack, Morossi and Selvelli. In the first two epochs the observations were made with the small aperture, which transmits an unknown fraction, varying between one half to one tenth of the incident radiation, according to the accuracy by which the stellar image is centred on the 3" hole. Hence the absolute flux at these two epochs is larger than the observed value by a factor which at the most is about 10. All the other observations were made with the large aperture. The fluxes at four wavelengths are given in Table I. The energy distribution has remained practically the same, except in September 1980, when the relative intensity at $\lambda < 1300$ is smaller than at the previous epochs. The flux, however,

Table I

Date	λ	Flux at the Earth ($erg\ cm^{-2}s^{-1}A^{-1}$)
Apr. 22, 1978 (small aperture)	1200	$3.2\ 10^{-14} < F \leq 3.2\ 10^{-13}$
	1380	$1.2\ 10^{-13}$ $1.2\ 10^{-12}$
	1500	$1.8\ 10^{-13}$ $1.8\ 10^{-12}$
	1800	$2.8\ 10^{-13}$ $2.8\ 10^{-12}$
July 31, 1978 (small aperture)	1200	$2.0\ 10^{-13}$ $2.0\ 10^{-12}$
	1380	$4.0\ 10^{-13}$ $4.0\ 10^{-12}$
	1500	$6.3\ 10^{-13}$ $6.3\ 10^{-12}$
	1800	$1.1\ 10^{-12}$ $1.1\ 10^{-11}$
March 11, 1979 (large aperture)	1200	$4.6\ 10^{-13}$
	1380	$7.9\ 10^{-13}$
	1500	$1.1\ 10^{-12}$
	1800	$2.7\ 10^{-12}$: (overexposed)
Sept. 22, 1979 (large aperture)	1200	$1.5\ 10^{-10}$
	1380	$4.3\ 10^{-10}$
	1500	$6.9\ 10^{-10}$
	1800	$1.2\ 10^{-9}$
Sept. 1, 1980 (large aperture)	1200	$2.4\ 10^{-10}$
	1380	$1.3\ 10^{-9}$
	1500	$2.1\ 10^{-9}$
	1800	$3.8\ 10^{-9}$

increased from March 1979 to September 1979 by 6.5 magnitudes, while visual observations (Henshaw, 1979, 1980) for the period December 1977 to December 1979 indicate that V oscillates between 6.4 and 7.4. In September 1980 the ultraviolet flux has further increased relatively to the flux observed one year before by a factor of 3 in the range 1300 -2000 Å and by a factor of 1.6 in the range 1200 -1300 Å. No photometric observations of the visual magnitude have been published for this date but the spectroscopic observations made by Faraggiana at the Haute Provence Observatory at the end of September suggest that also the visual and photographic magnitudes are much brighter than the average magnitude of CH Cyg, because of the much shorter exposure time needed for obtaining well-exposed spectrograms at 12.4 Å/mm and the possibility of obtaining for the first time a spectrogram at 7 Å/mm.

The complexity of the observed phenomena (e.g. the striking presence simultaneously of P Cyg (Ca II lines) and inverse P Cyg (Balmer series) profiles) and the evidence that the observed peculiarities are not reproduced during subsequent outbursts imply the necessity to combine spectroscopic and photometric observations extended over the largest wavelength region attainable.

The two different classes of models for the symbiotic stars (single or double star) have been applied to CH Cyg by several authors but the observed peculiarities do not make it possible to discriminate between the two models.

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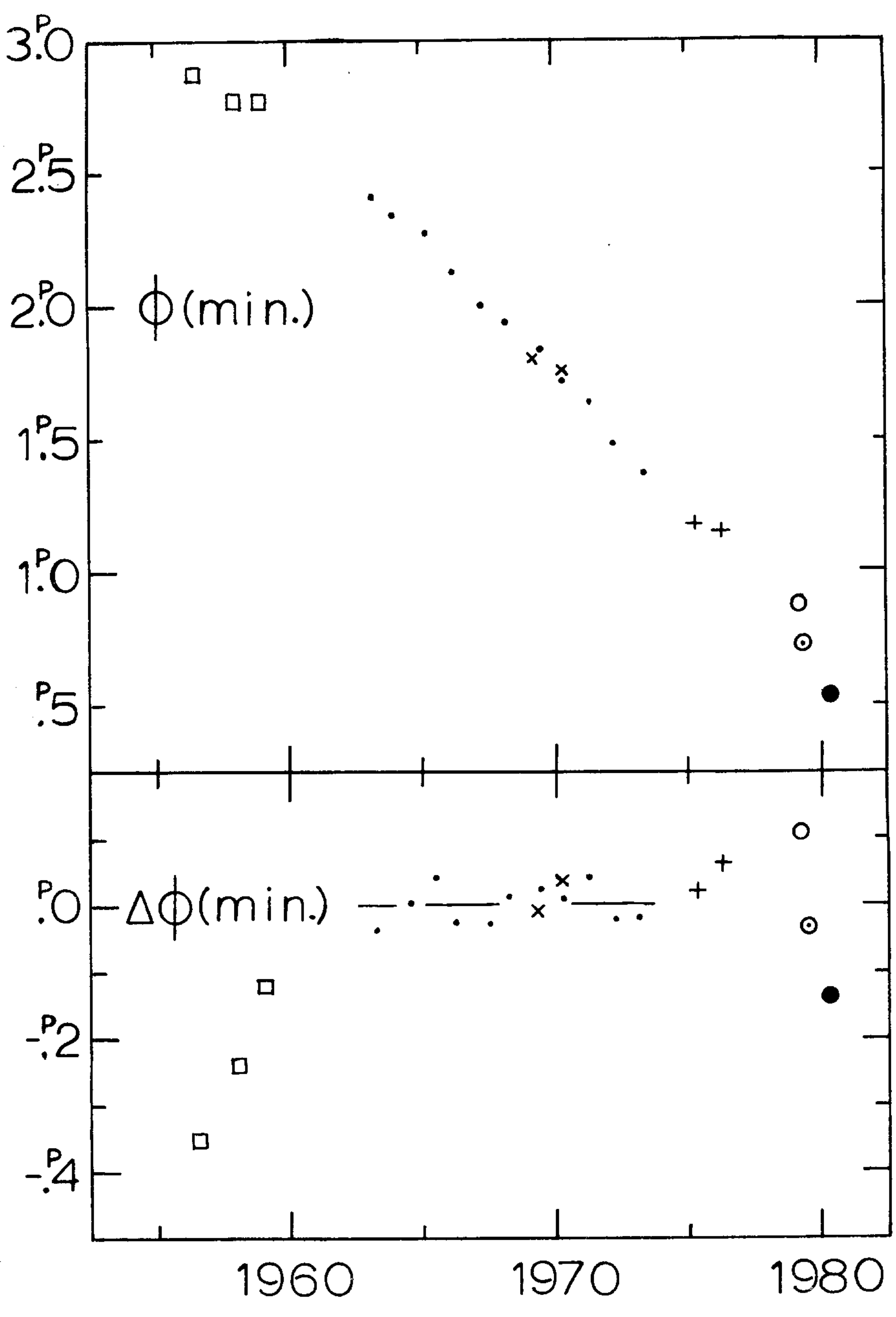
A SUDDEN ACCELERATION IN THE MIGRATION RATE OF RS CVn

The purpose of this note is to show that our recent photometry of the wave in RS CVn, along with previously published values of the phase of wave minimum, seems to indicate a recent sharp acceleration in the migration rate and a simultaneous decrease in the amplitude of the wave.

Eaton obtained observations in V only with the 24-inch reflector at the Pennsylvania State University Observatory between JD 2443945.74 and 2444001.66. Fourier analysis of his light curve outside eclipse yielded $\Delta V = 0^m.189 \pm 0^m.020$ for the wave amplitude and $\phi(\text{min.}) = 0^P.871 \pm 0^P.017$ for the phase of its minimum. Henry obtained observations in V and B with the No. 4 16-inch at Kitt Peak National Observatory and the 24-inch at Dyer Observatory between JD 2444316.86 and 2444425.64. Fourier analysis of his light curves outside eclipse yielded $\Delta V = 0^m.116 \pm 0^m.009$ and $\Delta B = 0^m.097 \pm 0^m.007$ for the wave amplitude and $0^P.510 \pm 0^P.009$ and $0^P.511 \pm 0^P.008$ for the phase of the wave minimum in V and B, respectively. In this Fourier analysis, phases were computed with the ephemeris of Evren et al. (1980) The equipment and observing technique used by Eaton and Henry have been described already by Burke et al. (1980).

In the Figure below, the top part is the migration curve between 1956 and 1980, with the ordinate $\phi(\text{min.})$ being the phase of wave minimum. The three squares are from Popper (Hall 1972); the eleven points are from Catania (Catalano et al. 1980); the two crosses are from Oliver (1975); the two plusses are from Ludington (1978); the one open circle is from Eaton (this paper); the


3.0
2.5
2.0
φ(min.)
1.5
1.0
.5
.0
Δφ(min.)
-.2
-.4
1960
1970
1980

one circled point is from Evren et al. (1980); and the one filled circle is from Henry (this paper). In the bottom part, each symbol is the corresponding residual

$$\Delta\phi(\text{min.}) = \phi(\text{min.}) - \phi'(\text{min.}),$$

where ϕ'(min.) is the phase of wave minimum computed with the 9.48-year migration period determined by Catalano et al. from the Catanian observations between 1963 and 1973. Specifically

$$\phi'(\text{min.}) = 0\overset{p}{.}45 - (T - 1963.32)/9.48,$$

where T is the mean epoch of each light curve.

In the $\Delta\phi$(min.) plot we see that a migration period of 9.48 years does indeed fit the observations very well between 1963 and 1973, the horizontal straight line segment. On the other hand, the migration rate was much slower in the late 1950's and now, as of 1980, is apparently much faster. A fit to the earliest three symbols would indicate P(migr.) $\sim$ 20 years whereas a fit to the latest three symbols would indicate P(migr.) $\sim$ 3 years.

Because another point or two in the figure is needed to define the recent trend better, it would be premature to speculate now on physical interpretations. We should, however, issue the following warning immediately. If the migration rate really has accelerated recently, then we are in danger of losing continuity in the migration curve, which has been maintained now for the 24 years since 1956. Anytime the wave migrates an appreciable fraction of one cycle between one light curve and the next, $\gtrsim 0\overset{p}{.}4$ for example, we cannot know with confidence whether it moved towards increasing or towards decreasing phase. Therefore we urge observers of RS CVn binaries (and observers of RS CVn itself in particular) to begin observing RS CVn as soon as it becomes available in the eastern sky and continue photometry throughout the observing season, thereby obtaining not just one but rather two or perhaps three light curves for the year 1981.

It is of additional interest to note that, whereas the wave amplitude (max. to min.) has remained around $0^m.2$ in V throughout the 1960's and 1970's, the most recent three light curves show it decreasing to about half that during the course of only one year. Eaton found $\Delta V = 0^m.19 \pm 0^m.02$ in 1979.27, Evren et al. found $\Delta V = 0^m.14$ in 1979.41, and Henry found $\Delta V = 0^m.12 \pm 0^m.01$ in 1980.36. It would be very interesting if we are seeing the beginning of a decline from a spot cycle maximum to spot cycle minimum.

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PHOTOELECTRIC MINIMA OF DO CASSIOPEIAE

The times of minima of eclipsing variable DO Cas were photoelectrically determined with a 48 cm Cassegrain telescope at the Ege University Observatory. The photometer is equipped with an EMI 9781 A photomultiplier tube and the standard Johnson B, V filters.

The heliocentric minima are listed in Table I, where (O-C) values of DO Cas were computed with the help of the light elements given by Cester et al. (1977).

Min I = JD Hel. 2433926.4573 + $0^{d}.6846661 \cdot E$.

Table I

JD Hel.	E	(O-C)	Filter
2444485.37800	15422	0.00011	B
.37855	15422	0.00066	V
498.38564	15441	-0.00091	B
.38584	15441	-0.00071	V

The photoelectric times of the minima which have been obtained so far by other observers are also shown in Figure 1.The (O-C) values were computed again from the above given equation and plotted against cycles.

If the observations obtained in the recent years are examined one can easily assume that DO Cas exhibits decreasing period, since some (O-C) values obtained by other researchers do not fit to the above given equation. But the latest observations of this star, presented in this paper clearly indicate that (O-C) values fit very well to the equation given by Cester et al.(1977).

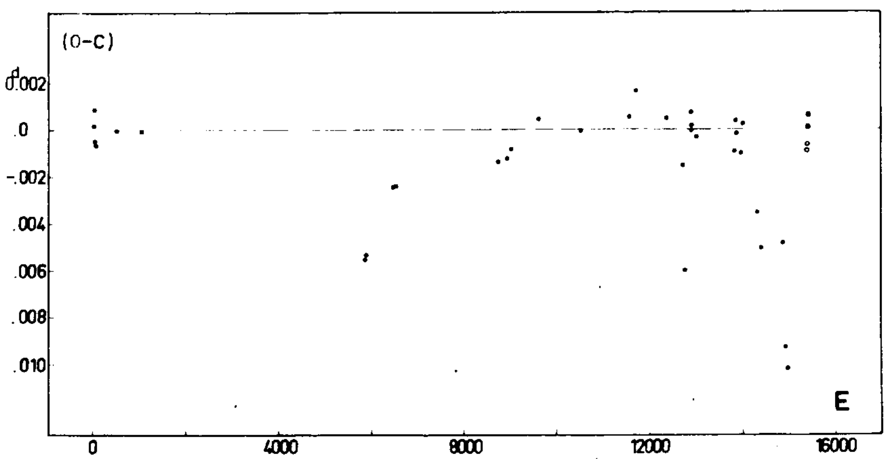

Figure 1. Dots and circles indicate the observations taken from other researchers and observations obtained at Ege University Observatory, respectively.

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Reference:

Cester, B., Giuricin, G., Mardirossian, F., and Pucillo, M., 1977, Astron. Astrophys. Suppl. 30, 223

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PERIOD OF SV CENTAURI STOPPED DECREASING

Up to 1978 the period of SV Cen was decreasing very rapidly, representing the highest rate of change of the period so far known. Our recent observations between Jan. 1978 and July 1979 show that the period became constant giving new ephemeris

$$T_{min} = HJD\ 2444061.0600 + 1.658500 \cdot E.$$

The pattern of period changes shows a cycle of about 32 years but there is no strict periodicity and light-time interpretation is not feasible. Changes of both minima are simultaneous and apsidal motion is also excluded.

Observers using photoelectric photometers in the Southern hemisphere are urged to pay attention to this very interesting star. All photoelectric timing of minima has been done so far in the UBV system and thus filters close to B and V should be preferred for new measurements of minima.

Modern photoelectric photometers allow the accuracy of the determination of the time of minima up to 0.0001 day and a detailed study of period changes of SV Cen would require at least 3 observations of both minima per observing season (January to August). Observers are reminded that the depth of minima shows changes, too, and some observation during both maxima or a careful tie-in to the system of standard stars would greatly increase the information content of the measurements during minima.

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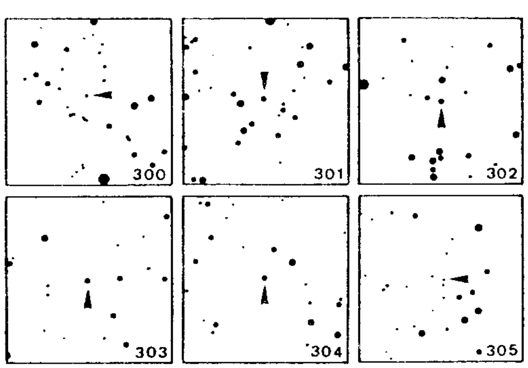
NEW VARIABLE STARS IN THE FIELD OF 9 URSAE MAJORIS

A survey for the search of new variable stars at high galactic latitude have been made on the plates taken with the Schmidt telescope (67/90/210 cm) of Asiago in the field around 9i U Ma.

Six new variables have been discovered on ten pairs of plates examined with the blink. The position (1950) and the characteristics of these stars are listed in Table I.

Table I

var.	R.A. 1950	D	max.	min.	type
GR 300	$8^h49^m00^s$	+50°15′	15.3	16.8	RR :
GR 301	8 50 13	+49 29.7	14.3	15.8	RR
GR 302	8 55 25	+49 04.2	14.0	15.2	?
GR 303	8 56 30	+49 30.3	14.4	15.0	RR
GR 304	8 58 40	+49 58.6	13.2	14.4	E :
GR 305	9 03 32	+48 28.5	17.7	18.6	L



The B magnitudes of the comparison stars have been determined by SA 45.It is not possible to derive on the basis of our material the elements of these stars. Fig 1 shows the finding charts;north is on the top; 15' of side.

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AN INTERESTING PHENOMENON OF THE FLARE STAR BD+22°3406

Continuous photoelectric monitoring of the flare star BD+22°3406 has been carried out at Kottamia Observatory-Egypt (λ=31°49'30", φ=+29°55'54", H=476m) as a continuation of flare stars' programme started at Stephanion Observatory-Greece. The observations were made in the B-colour. The description of the telescope and the connected equipments will be described elsewhere.

During the photoelectric patrol observations of this flare star, a sudden decrease of its brightness followed by increase of its brightness have been registered. We can call this decrease of brightness anti-flare. The star, after the decrease and increase in brightness has become again stable. Here we give the parameters of the flare and anti-flare phenomenon. Table I gives the date of observations, monitoring intervals in U.T., total monitoring time and the standard deviation of random noise fluctuation σ(mag) = 2.5 log $(I_o+\sigma)/I_o$ for different times (U.T.) of the corresponding monitoring intervals.

Table I

Monitoring intervals in 1980

Date 1980 May	Monitoring intervals (U.T.)	Total monitoring time	σ(mag)
25	$00^h42^m - 01^h46^m$	01^h04^m	0.03
25–26	22^h47^m–23^h22^m, 23^h24^m–00^h08^m,		0.04, 0.08,
	00 11 -00 35.	01 43	0.04
27–28	22 53 -23 14, 23 43 -00 24,		0.00, 0.20,
	00 29 -01 08, 01 12 -01 48.	02 17	0.11, 0.06
29–30	22 22 -23 16, 23 18 -23 37,		0.04, 0.00,
	23 40 -23 51, 23 53 -00 51,		0.02, 0.05,
	00 54 -00 57, 00 59 -01 20.	02 46	0.04, 0.06
	Total	07^h50^m	

Table II

Characteristics of the flares and anti-flares observed

No.	Flare Date 1980 May	U.T. max	T_b min.	T_a min.	D min.	$\frac{I_f - I_o}{I_o}$ max.	P min.	Δm mag	σ mag	air mass
1.A	25	$01^h07^m.20$	0.20	0.10	0.30	−0.46	↑	−0.67	↑	1.03
1.B	25	01 11.72	3.20	2.10	5.30	+0.41	+2.48	+0.37	0.03	1.04
1.C	25	01 38.04	0.20	3.30	3.50	+0.55	↓	+0.48	↓	1.07
2.A	28	00 04.41	1.40	0.10	1.50	−0.54	↑	−0.84	↑	1.01
2.B	28	00 05.69	0.20	0.50	0.70	−0.42	−0.40↓	−0.59	0.02↓	1.04
3.	29	22 22.48	0.40	1.30	1.70	+0.76	+0.35	+0.61	0.04	1.01

Table II gives the characteristics of each flare and anti-flare (Andrews et al.,1969) : the date and U.T. of flare maximum and anti-flare minimum, the duration before and after the maximum or minimum (t_b t_a, respectively), as well as the total duration of the flare and anti-flare (D), the value of the ratio $(I_f - I_o)/I_o$ corresponding to flare and anti-flare extremum, where I_o is the intensity deflection less sky background of the quiet star and I_f is the total intensity deflection less sky background of the star plus flare or anti-flare, the integrated intensity of the flare and anti-flare over its total duration, $p = \int [(I_f - I_o)/I_o] dt$, the increase or decrease of the apparent magnitude of the star at flare maximum or anti-flare minimum $\Delta m(b) = 2.5 \log(I_f/I_o)$, where **b** is the blue magnitude of the star in the instrumental system, the standard deviation of random noise fluctuation $\sigma(mag) = 2.5 \log (I_o + \sigma)/I_o$ during the quiet-state phase immediately preceding the beginning of the flare or anti-flare, and the air mass at flare or anti-flare.

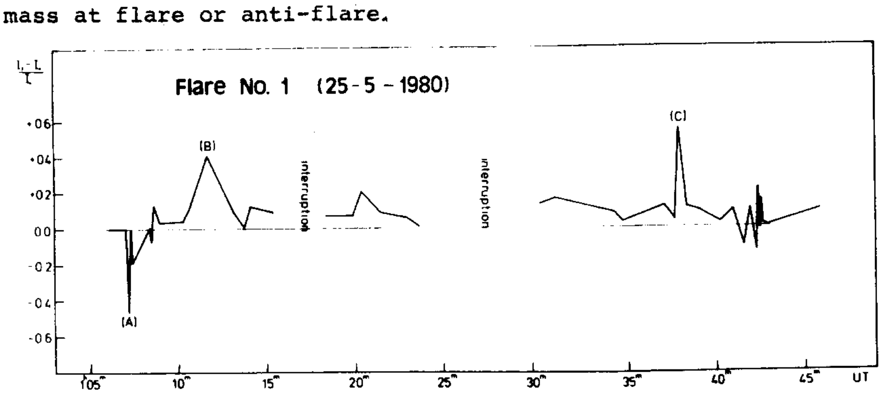

Figure 1

The light curves of the observed flares and anti-flares in the b colour are shown in Figs. 1-3.

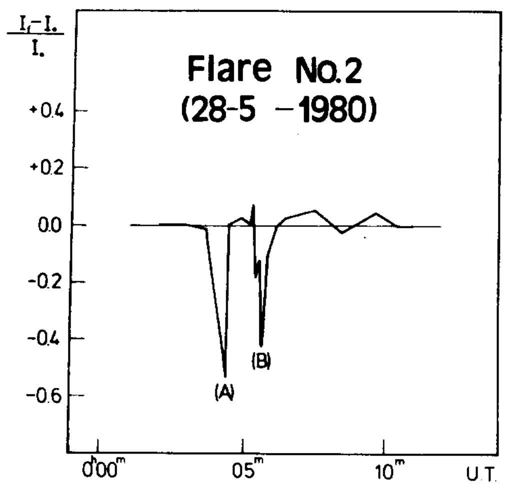

Figure 2

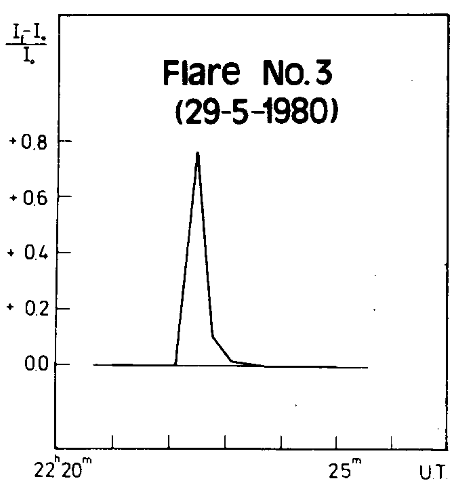

Figure 3

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Reference:

Andrews, A.D., Chugainov, P.F., Gershberg, R.I., and Oskanian, V.S., 1969, I.B.V.S. No. 326

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LIGHT CURVE OF RS SCUTI

Four-colour (BVRI) photoelectric photometry was carried out over three nights (1980 June 16.37 - 16.61 UT, July 16.34 - 16.71 UT, July 17.34 - 17.67 UT) on the short period eclipsing binary RS Scuti (BD - $10^{\circ}4814$). The photometry was carried out using the 61cm Boller and Chivens reflector at Mt John University Observatory. Comparison and check stars were respectively SAO 161865 and SAO 161906.

The anomalous point at phase .04 in the differential colour curves is as yet unexplained.

The following is a revised ephemeris for the star :

T_{min} = 2444437.1658 + 0.6642384 E

These graph symbols were used :

June 16 = △

July 16 = □

July 17 = ◇

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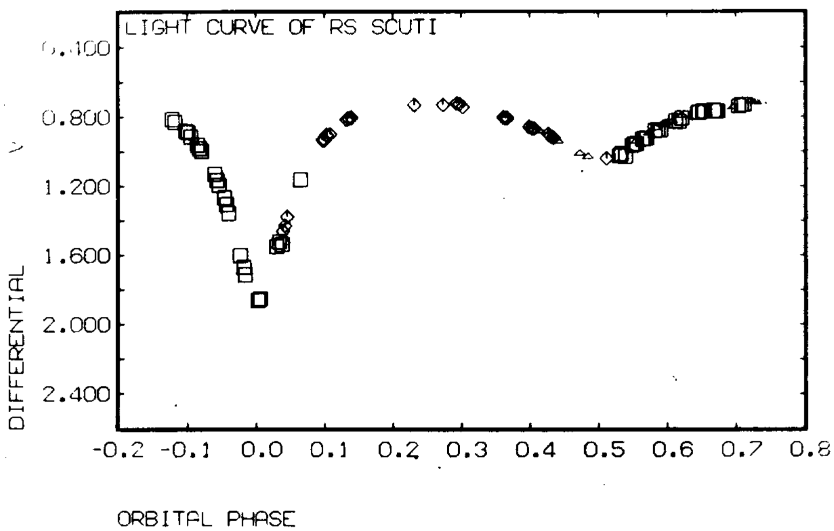
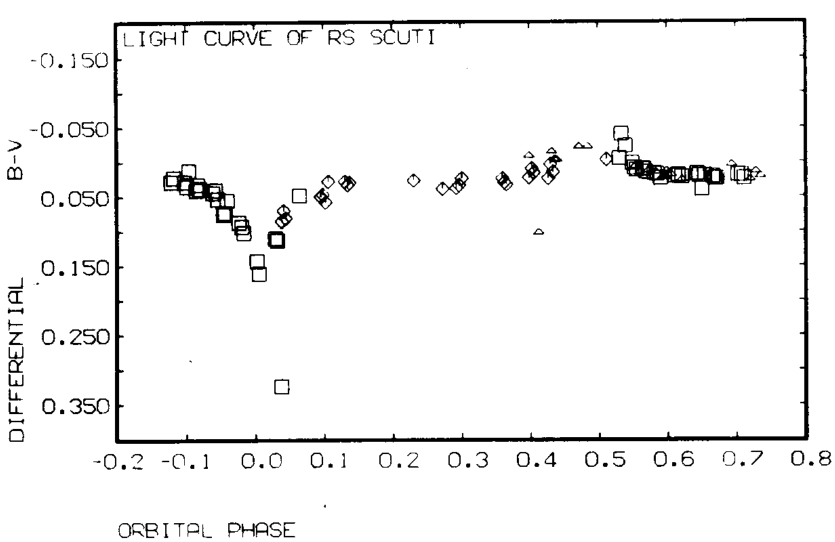
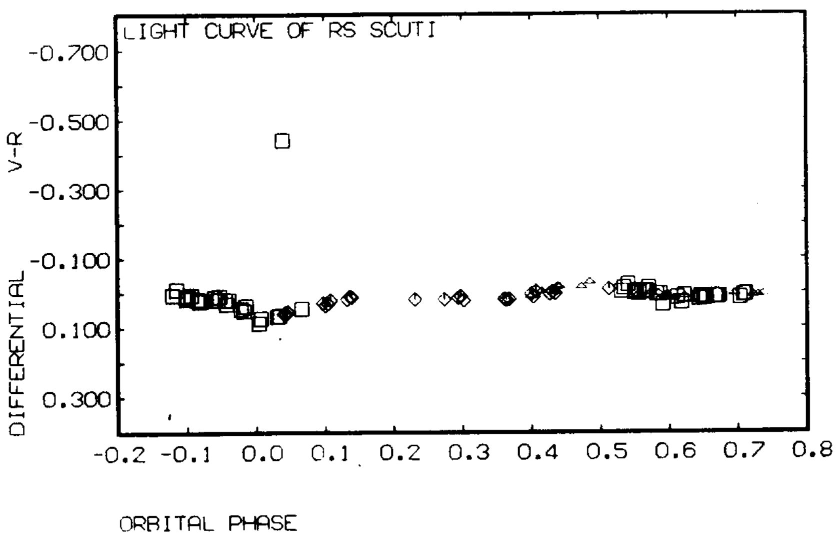


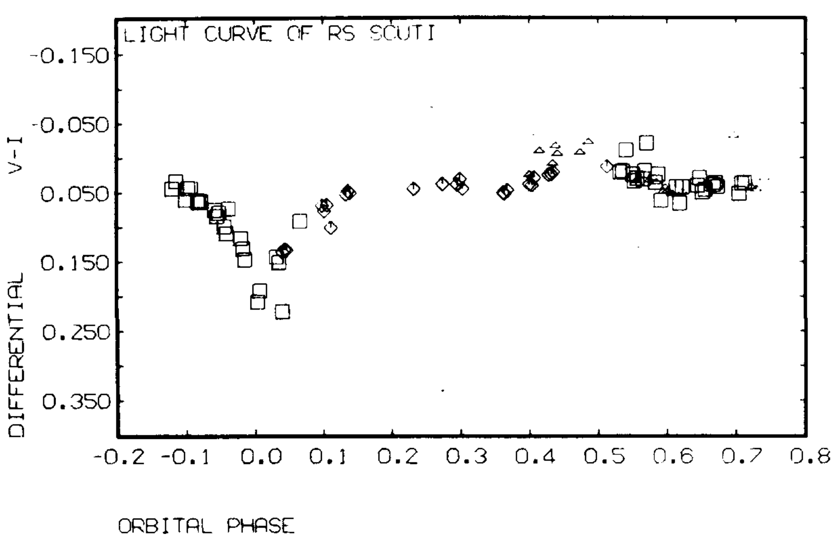
LIGHT CURVE OF RS SCUTI
0.400
0.800
1.200
1.600
2.000
2.400
DIFFERENTIAL V
-0.2 -0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
ORBITAL PHASE



LIGHT CURVE OF RS SCUTI
-0.150
-0.050
0.050
0.150
0.250
0.350
DIFFERENTIAL B-V
-0.2 -0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
ORBITAL PHASE



LIGHT CURVE OF RS SCUTI
-0.700
-0.500
-0.300
-0.100
0.100
0.300
DIFFERENTIAL V-R
-0.2 -0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
ORBITAL PHASE



LIGHT CURVE OF RS SCUTI
-0.150
-0.050
0.050
0.150
0.250
0.350
DIFFERENTIAL V-I
-0.2 -0.1 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8
ORBITAL PHASE

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RESULTS OF THE PHOTOELECTRIC OBSERVATIONS OF 88 Her

In 1974 Harmanec, Koubsky and Krpata (1974) confirmed both the spectral duplicity and the 87-days period for the Be shell star 88 Her, discovered by the above authors earlier. Having used the radial velocity curve obtained by Harmanec et al., with allowance for that eclipses can be expected at the phase of 0.29 and 0.80, Haupt (1974) estimated and published the moments of possible eclipse of 88 Her for the nearest future (1974,1975).

Based on the photometry in UBV system performed at five observatories in 1968-1977, Harmanec et al.,(1978) found a long-term variation of light and colour for 88 Her. In 1978 Hirata (1978) pointed to the similarity of photometric and spectral behaviour of 88 Her and Pleione. Unlike 88 Her, which represents a spectroscopic double system, the properties indicating the double nature of Pleione have not been discovered.

Our attention was drawn by P. Koubsky to 88 Her in 1975. We observed 88 Her in the UBV system from June 1977 through August 1980 with the electrophotometer attached to the 48-cm reflector AZT-14 A. The recording was performed using the photon counting method. HD 162132 = BD $+47^{o}2537$ served as the comparison star.

Our observations of 1977-78 show the light variation near the phase of 0.8 with an amplitude of $0^{m}.14$, $0^{m}.10$ and $0^{m}.07$ in UBV, respectively. The phases were calculated by the formula:

$$T_{maxRV} = \text{HJD } 2419429^{d}.251 + 86^{d}.7207 \cdot E.$$

Further observations of 88 Her in 1979-80 show that the star has constant maximum brightness (Figures 1,2) both near 0.8 and at other phases, which proofs that the light decrease of 88 Her observed in 1977-78 is not of eclipsing pattern, but it has the character similar to the light variation of Pleione.

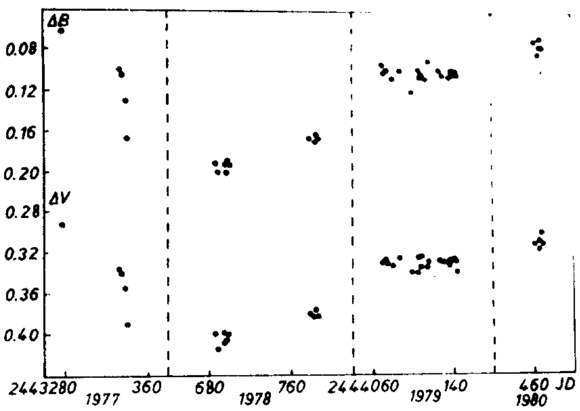

Fig. 1

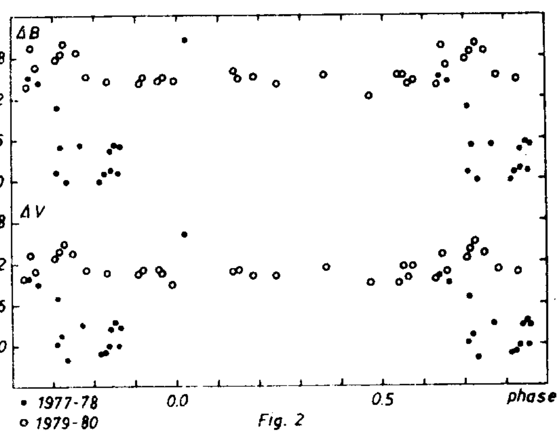

Fig. 2

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REVISED BLUE MOUNTAIN OBSERVATORY TIMINGS

Recent reports (Chambliss et al. 1979; Olson 1980) have shown that published eclipse timings of RZ Cassiopeiae from the Blue Mountain Observatory (Margrave et al. 1975; Margrave 1978) are systematically earlier than those of most other observers. The search for the cause of these discrepancies has resulted in the elimination from the computer program used to reduce the photometry data of two problems which gave rise to systematic errors in the calculated Heliocentric Julian Dates of the observations. It was the nature of the two problems that they generated errors sometimes of the same sign and sometimes of opposite sign. The net effect varied from star to star and from week to week.

Consequently, all published eclipse timings (Margrave et al. 1975; Margrave 1978; Margrave 1979a; Margrave 1979b) and times of maxima of BW Vulpeculae (Margrave and Mefford 1975; Margrave 1979c) have been recalculated and are given in Table I. The ephemerides used to calculate the residuals for the eclipsing binaries are the same as those used originally, while that used for BW Vulpeculae is from Tunca (1978).

The revised minima of RZ Cas are in complete accord with the trend illustrated by Chambliss (1979). A period decrease between September 1975 and September 1976 is exhibited by the Blue Mountain photoelectric times of minimum light. There are three RZ Cas minima in common with those of Olson (1980), namely, 3796.7352, 4121.8434, and 4127.8197, for which the differences in the sense (Olson - Margrave) are $-0\overset{d}{.}0003$, $-0\overset{d}{.}0002$, and $-0\overset{d}{.}0007$, respectively. The revised minimum of AT Peg at 2661.8136 is also now in accord with the other

Table I. Revised Heliocentric Julian Dates

Star	Hel. JD - 2,440,000	O-C
KO Aql	2637.8563	$+0^{d}.0090$
	4135.7552	+0.0202
44 i Boo	2619.8309	-0.0011
RZ Cas	1954.8616	+0.0022
	2339.7312	+0.0022
	2633.7617	+0.0018
	2664.8386	+0.0023
	2670.8163	+0.0038
	3049.7055	-0.0004
	3723.8240	-0.0014
	3729.8012	-0.0004
	3760.8786	+0.0005
	3772.8299	-0.0007
	3790.7582	-0.0011
	3796.7352	-0.0003
	3803.9071	+0.0001
	4096.7436	+0.0010
	4121.8434	+0.0006
	4127.8197	+0.0007
TV Cas	3786.7841	-0.0111
	3795.8481	-0.0101
	4094.9264	-0.0119
	4114.8657	-0.0113
TW Cas	2666.8447	+0.0005
	3096.7675	-0.0034
	3103.9179	+0.0053
	3803.7959	+0.0026
	4110.8769	-0.0069
	4123.7345	-0.0043
	4130.8748	-0.0056
DO Cas	2636.7816	+0.0041
	2664.8505	+0.0017
	3728.8203	+0.0006
	3795.9199	+0.0029
	4095.8017	+0.0010
XX Cep	2663.7526	+0.0112
	4133.9311	+0.0218
AT Peg	2661.8136	-0.0131
	3728.8093	-0.0412
	4089.8270	-0.0465
	4128.7925	-0.0486
	4136.8149	-0.0489

Table I, (cont.)

BW Vul	2350.7826	+0.0016
	2356.8079	-0.0044
	2678.8813	+0.0018
	3002.9597	+0.0026
	3012.8135	+0.0054
	3060.6542	-0.0016
	3724.8889	-0.0054
	3729.9214	+0.0011
	3755.8520	-0.0026

times cited in SAC 51 (1979).

The provisional ephemerides suggested by Margrave (1979b) for KO Aql, TV Cas, TW Cas, and AT Peg have been redetermined using the revised times with the following results.

KO Aql: Hel. JD (Min) $= 2,441,887.4724 + 2^{d}.864055 \cdot E$

TV Cas: " $= 2,441,595.3582 + 1^{d}.8125944 \cdot E$

TW Cas: " $= 2,442,008.3873 + 1^{d}.4283240 \cdot E$

AT Peg: " $= 2,440,407.4365 + 1^{d}.14611064 \cdot E - 6.2110 \times 10^{-9} \cdot E^2$

The mean residuals for these ephemerides are $0^{d}.0010$, $0^{d}.0008$, $0^{d}.0028$, and $0^{d}.0017$, respectively. The quadratic ephemeris for AT Peg implies a continuous period decrease since 1969 of 17.1 seconds per century.

The author deeply regrets any confusion or inconvenience that the erroneous timings have caused. He also expresses his sincere gratitude to C. R. Chambliss and E. C. Olson for pointing out the systematic deviation of the RZ Cas eclipse timings from this observatory.

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HD 200925, A PULSATING VARIABLE

The star HD 200925 (BD +50°3259) was observed by Bedolla and Pena (1979) on four nights during 25th to 28th September 1978 in V filter. They reported this star as a variable with a tentative period of $0^{d}.238$, and no definite type of its variability is given.

To determine its accurate period and establishing its type of variability, the star was observed by us photoelectrically on the 38 cm reflector of the Uttar Pradesh State Observatory on a total of seven nights during October-December 1979, using a cooled (-20° C) 1P21 photomultiplier tube, the conventional U, B and V filters of the Johnson and Morgan system, and standard d.c. techniques. The data were reduced to the standard system. BD +50°3256 was used as a comparison star. The average standard deviations of the comparison star are $0^{m}.015$, $0^{m}.010$ and $0^{m}.010$ in U, B and V filters, respectively.

On the basis of the maximum of the individual light curves observed by us and those reported by Bedolla and Pena, we determined a period of $0^{d}.267396 \pm 3$. In our U, B and V light curves magnitude variations of $0^{m}.54$, $0^{m}.45$ and $0^{m}.32$, respectively have been noticed. The variation in B-V colour during a pulsation cycle is $0^{m}.14$. The V light curve of our individual observations and normal B-V colour curve covering the whole cycle, are given in Figure 1.

From the shapes of the light and colour curves, the star appears to be a short period cepheid variable. The mean values of B-V and U-B colours have been determined to be $0^{m}.30$ and $0^{m}.07$ respectively which indicate that it belongs to spectral type

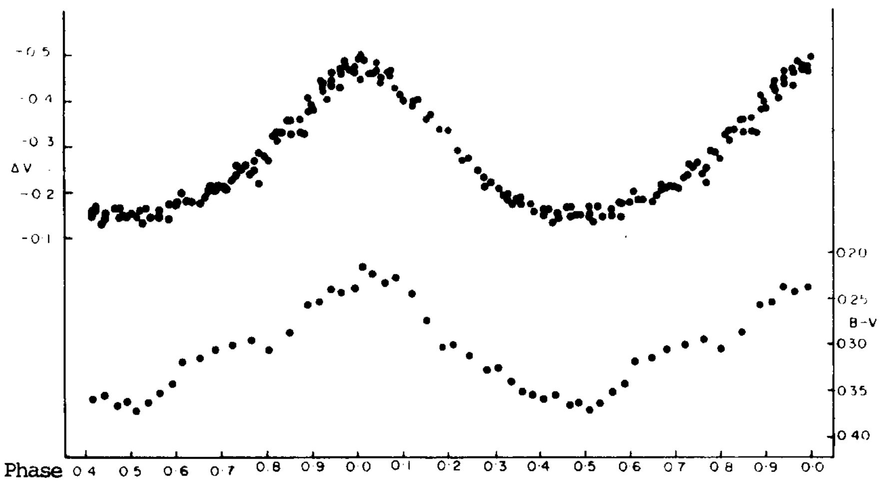

Fig. 1. Observed V light curve and B-V colour curve of HD 200925

F2 III. Using the period and B-V colour (assuming there is no reddening), determined by us, in the P-L-C relation (Gupta, 1977), the absolute magnitude (M_V) is derived to be $0^m.37 \pm 0^m.16$. Plotting these values of M_V and B-V in the colour magnitude diagram the star lies within the cepheid instability strip, which further supports that the star HD 200925 is a cepheid variable.

A detailed analysis of the UBV light curves and further observations are in progress.

The authors are thankful to Dr. S.D. Sinvhal for fruitful discussions.

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HU ISSN 0374-0676

THE ECLIPSE OF CI Cyg IN 1980

The symbiotic star CI Cyg is known for recurrent deep fadings of the visual luminosity going up to 2-3 magnitudes, which take place with a period of about 855^d (Pucinskas, 1972).

In 1975 a deep minimum with the duration of about 100^d was observed and was interpreted as a regular eclipse of the hot component by the cold one (Belyakina, 1976 and 1979a).

Another minimum was detected in 1977-78, but few photoelectric observations were secured (Belyakina, 1979b).

Photoelectric UBV observations of CI Cyg were planned using the 50 cm reflector at the Collurania Astronomical Observatory in the occurrence of the eclipse of 1980.

Bad sky conditions during the period corresponding to the beginning of the minimum phase (at the end of April) have prevented us to observe. The observations were carried out during the period June-October.

BD +35^{o}3824 and an anonymous star in the field of CI Cyg were respectively used as comparison and check stars; BD+35^{o}3821 was also observed to obtain a comparison with the observations by Belyakina. The results of these observations are plotted in Fig.1.

The mean variations in U, B and V colours are $1^m.30$, $0^m.90$ and $0^m.50$, respectively.

It is interesting to note that the U, B and V lightcurves are not synchronous, in particular the eclipse in the U colour seems to last more than in B and V colours.

Small fluctuations are seen over the curves of Fig. 1; their amplitudes are close to $0^m.2$-$0^m.3$ with a duration of some days.

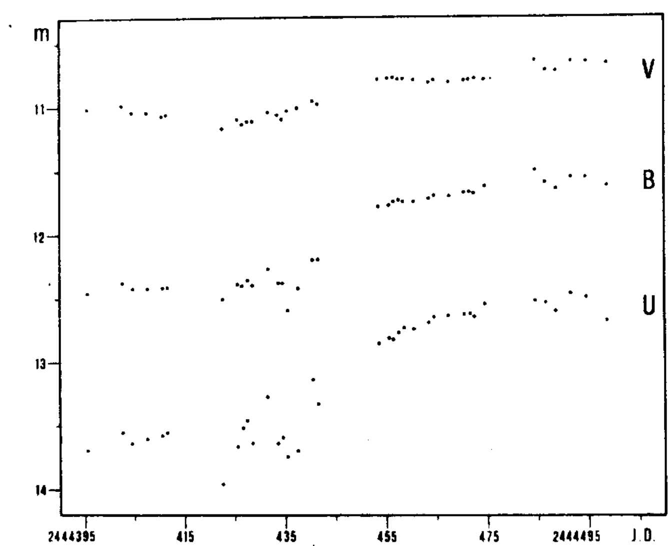

Figure 1

A detailed analysis of the lightcurves of CI Cyg will be presented in a forthcoming paper.

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ON THE PHOTOMETRIC ELEMENTS OF RX Her

In Popper's (1980) excellent review on the stellar masses proper emphasis has been placed on the importance of considering the spectroscopic estimates of the ratio of the light of binary components in order to avoid giving misleading solutions of eclipsing binary lightcurves. In particular, Popper (1980) considered the double-lined spectrum eclipsing binary RX Her (=HD170757; for the history of this star see, e.g., Popper (1980) and references cited therein) as an illustrative example of these kinds of problems connected with binary lightcurve analyses. He stated that Cester et al.'s (1978) reanalysis of Wood's (1948) lightcurve of RX Her is very questionable, since it leads to a too large light ratio (L_h/L_c=2.44) as compared with Petrie's (1950) spectroscopic estimate (L_h/L_c= =1.44). But this conclusion is due to an unfortunate misunderstanding concerning the meaning of the entries L_h and L_c given in Table 2 of the paper by Cester et al. (we recognize that this point is somewat unclear in the text); in fact, these entries are the normalized fractional luminosities integrated over 4π steradians and not the monochromatic (i.e. blue) fractional luminosities. For RX Her, the light ratio (in blue) computed by Cester et al. is indeed 2.12, whereas the surface flux ratio is J_h/J_c=1.18 (the ratio of the observed depths of minima is equal to 1.22). As a consequence, in view of the large uncertainties affecting Petrie's estimate for the light ratio, Cester et al.'s photometric solution appears to be consistent with the available spectroscopic results.

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HU ISSN 0374 - 0676

CW UMa – A NEW FLARE STAR?

By chance the writer recently noted that the coordinates of the object No. 1710 in the Catalogue of Stars Suspected of Variability, which is designated CW Ursae Majoris in the 62nd Name-list of Variable Stars (I.B.V.S. No. 1248), agree very closely with those of the faint proper-motion star G 119-62 discovered at the Lowell Observatory (Lowell Obs. Bull. 6, 1, 1963). Luyten includes the latter object in his New Two-Tenths Catalogue, assigning to it a motion of 0".203/yr and a photographic magnitude of 12.8 . Positions for both objects are accurately known.

CW UMa was discovered to be a rapid, presumably RR Lyrae, variable by Neujmin (Var. Stars 4, 41, 1932 and Poulk. Circ. 4, 22, 1932) and confirmed as an RR Lyrae star of range 12.8 - 14.4 pg by Parenago (Var. Stars 4, 134, 1933), who however did not determine a period. To the writer's knowledge no further work has been done on the star.

Reference to a visual-region Warner and Swasey Observatory objective-prism plate reveals that the proper-motion star has, as expected, a spectral type of about M3; in view of its motion it is undoubtedly a dwarf. It appears very likely that this is in fact the variable CW UMa, though no chart exists for the latter object. It is probably significant that the photographic magnitude assigned at Lowell (14.6) is substantially fainter than that given by Luyten. In view of the object's photometric behavior and spectral type it seems probable that CW UMa will prove to be a flare star and it is thus recommended to observers.

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VARIABLE STAR IN THE GALACTIC CLUSTER NGC 7654

During the course of photographic photometry in the vicinity of the galactic cluster NGC 7654 = M 52 one of the standard stars was detected to be variable. It is NGC 7654-26 in the list of Hoag et al. (1961). The photographic plates (UBV system) were taken in the years of 1971 to 1980 with the 60/90-cm Schmidt telescope of Jena University Observatory (Großschwabhausen outstation). Results of iris-photometry of all the plates are collected in Table I and extracts drawn in Fig. 1. In the Figure the arrows at the ordinate scale indicate the magnitudes published by Hoag et al. (1961). The variation in brightness amounts to at least 0.5 mag in the B and V colours, it remains uncertain in U. The

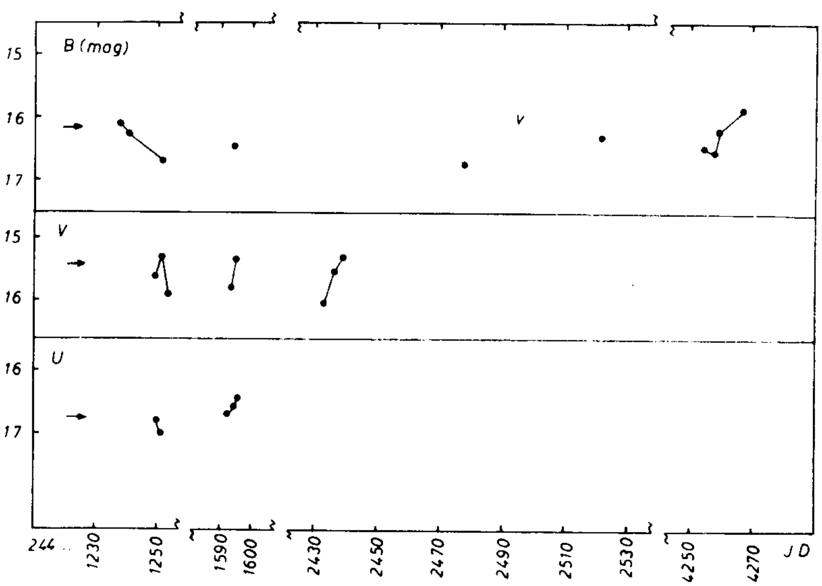

Figure 1

light changes observed are inconclusive as to the type of variability. The ranges of types under consideration is restricted, however, by the spectral type (early A-type) of the star. Further photometric observations are desirable.

Table I

Photographic observations of NGC 7654-26

(Results of photoelectric observations by Hoag et al. (1961):

V = 15.44 mag. (B - V) = 0.72 mag. (U - B) = 0.60 mag.)

J.D. 244...	B (mag)	J.D. 244...	V (mag)	J.D. 244...	U (mag)
1237.49	16.11	1249.39	15.61	1249.45	16.79
1240.58	16.25	1251.36	15.29	1251.44	17.00
1251.48	16.70	1253.39	15.89	1592.45	16.68
1594.40	16.44	1276.34	>15.5	1594.37	16.58
1594.41	16.53	1593.40	15.81	1595.46	16.47
2477.36	16.70	1593.47	15.79	1982.40	16.65:
2494.37	>16.0	1595.40	15.34	1989.36	16.50
2521.60	16.32	2433.34	16.02		
3075.40	16.52	2436.35	15.51		
3157.36	16.62	2439.31	15.29		
3336.51	16.38	2652.51	15.72		
3745.43	16.44	2654.58	15.45		
3745.59	16.45	2765.42	15.16		
4254.39	16.47	3075.43	15.76		
4257.31	16.56	3336.49	16.00		
4259.31	16.19	3336.56	15.65		
4266.30	15.89				

From the colour indices given at the head of Table I a reddening E(B-V) = 0.7 mag and spectral type A2 follow. If we assume A2V (M_V =1.6 mag) then the star is at a distance of 2.3 kpc. This is in accordance with r = 2.1 kpc and E(B-V) = 0.51 ... 0.81 mag as quoted by Schmidt (1962) for the cluster. Upon photometric quantities Mermilliod (1976) also classifies the star as a cluster member. For the importance of this statement an independent proof of cluster membership was attempted.

From the luminosity function and the total number of cluster stars both given by Taff (1974) the number of cluster members within an 1-mag interval about M_B = 1.6 mag can be derived as N_{cl} (M_B = 1.6) = 68. For the field stars application of the Schwarzschild integral equation of the space density law gives N_f(B=16) = 20 as the number of stars per magnitude within the 18 min of arc diameter cluster area. The star densities used in the computations are from Allen (1973), interstellar extinction was taken into account, and the cluster diameter is from Wallenquist (1933). If the areal densities of stars derived this way are adjusted to the star counts made by Wallenquist (1933) at brighter magnitudes the higher and probably more reliable number $N_f(B=16)=44$ results. So the probability that a certain star at B = 16 mag is a cluster member turns out to be between 0.61 and 0.77 with the lower value being of higher weight. From this statement together with the photometric result and the position of the star 5.2 min of arc from the cluster centre it seems to be quite sure that NGC 7654-26 is really a cluster member.

I am indebted to Mr. D. Uhlig, former member of the technical staff of our observatory. He directed my attention to the star and made the first photometric measurements.

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PHOTOELECTRIC TIMES OF MINIMA OF TT Her

On years 1978 and 1979, about 4500 U-B-V photoelectric observations of the eclipsing binary TT Her (BD +17°3117)were performed at the Teramo Observatory. The observations will be published elsewhere.

The photometric equipment is a single-channel pseudo-multiband photon-counting photometer which is controlled by a DEC PDP 11-minicomputer.

The photometer is attached to the Nasmith focus of the 50 cm Askania reflector of the Capodimonte Astronomical Observatory in Naples stationed at Teramo. An EMI 6506 photomultiplier has been used with Schott filters GG14+GG13 (2mm) for V, BG12 for B and UG2 for U.

Six times of minima have been calculated by means of the Kwee and Van Woerden method (1956) from the data at our disposal. By a differential correction procedure it was computed a linear ephemeris, taking also into account other data from the literature (van Genderen, 1969; Pohl and Kizilirmak, 1972). The linear ephemeris we obtained is:

$$\text{Hel. J.D. Min.I} = \underset{\pm 7}{2444025.4596} + \underset{\pm 11}{0.91207838} \cdot E \qquad (1)$$

In the Table below are listed the times of minima, their (O-C)'s from (1) and the standard deviation σ of each time of minimum:

J.D. 2 400 000+	E	O-C	σ
44015.4245	-11	-0.0023	±0.0013
44015.4262	-11	-0.0005	0.0004
44015.4254	-11	-0.0013	0.0007
44025.4547	0	-0.0049	0.0025
44025.4599	0	+0.0004	0.0010
44025.4574	0	-0.0022	0.0011

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SPECTROSCOPIC MEASUREMENTS OF THE YELLOW SUPERGIANT CO Aur

CO Aur is a moderately bright ($7^m.5-8^m$) SRd or RV Tau star with a spectral type of F5Ib, as classified by Preston (Smak, 1964). Photometry has been published by Kurochkin (1950), Smak (1964), and Dawson (1979).

Since radial velocity observations of this kind of objects are rare, this brighter object has been selected and observed spectroscopically in March and April, 1976. Eight spectra have been taken with the Cassegrain spectrograph at the 106 cm telescope of Hoher List Observatory. The dispersion was 47A/mm with a spectral range from 3800 to 4800A. The results of the spectra are summarized in Table I.

Table I

JD	RV (km/s)	weight	Ca II emissions
2442867.35	-25.2	7	weak
2442869.35	-25.3	11	weak or absent
2442874.35	-28.3	12	weak or absent
2442877.35	-30.2	10	strong
2442879.40	-24.5	7	?
2442886.40	-27.0	5	?
2442890.40	-25.4	5	?
2442891.40	-27.8	7	weak or absent

The mean error of the radial velocity determinations is 1.5 to 2.0 km/s. They are based exclusively on Fe lines. The radial velocity zero point has not been calibrated during the observations, but earlier and later measurements showed systematical displacements of the zero point of less than 1 km/s.

The amplitude of the variations is not improbable for stars of this type (cf. DuPuy, 1973). The photometric measurements by Smak show eight maxima within 120 days, so there was on the average one maximum in 15 days. Within the 25 days of these spectroscopic observations also two cycles are indicated. CaII emission is present in the spectra of CO Aur, but it is usually weak. Only at the time of the most negative radial velocity measurement, an enhanced CaII emission has been observed.

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TZ BOOTIS' 1980 LIGHT CURVE

The W UMa system TZ Bootis is one of the most observed eclipsing binaries during the last decade. It could be shown that this star has an extraordinary variable light curve even for W type W UMa systems. Observations up to the middle of 1979 show repetitive interchanges of the minima depths with a period of about 3.5 years (Hoffmann, 1978, 1980). Just because of the frequent measurements of the last years a dense patrol of the subsequent light curve behaviour is of importance. Only then the development and nature of the 3.5y period can be revealed. For that reason further measurements of TZ Boo have been made on November 22, 1979, and May 12 and 13, 1980. They have been carried out in B and V with the 106cm Cassegrain telescope of Hoher List Observatory and a two channel photometer. Period, phase and geographic position permitted the measurement of the two different minima depths in November, although TZ Boo is then in conjunction with the sun at a separation of only 60°. The occultation minimum was then $0\overset{m}{.}06$ fainter (B) than the transit minimum. In May, a complete light curve could be obtained (Figures 1 and 2). This light curve has a quite regular appearance with only a small O'Connell-effect. Smaller "complications" are visible at several phases, for instance the sloped transit minimum. The amplitude of the light curve is moderately small ($0\overset{m}{.}38$; 1978: $0\overset{m}{.}51$, 1979: $0\overset{m}{.}34$ (B)). The regularity of the light curve is also demonstrated by the coefficients of the Fourier series of the outside eclipse measurements:

$$B \quad \ell = 0.897 - 0.012 \cos\varphi - 0.097 \cos 2\varphi + 0.006 \sin\varphi - 0.007 \sin 2\varphi$$

$$V \quad \ell = 0.913 + 0.006 \cos\varphi - 0.093 \cos 2\varphi - 0.002 \sin\varphi - 0.005 \sin 2\varphi$$

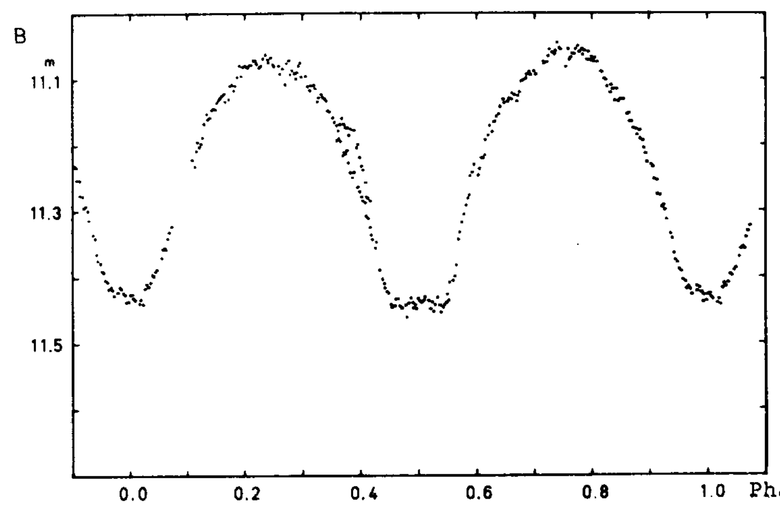

Figure 1. May 1980 light curve of TZ Boo. Colour B.

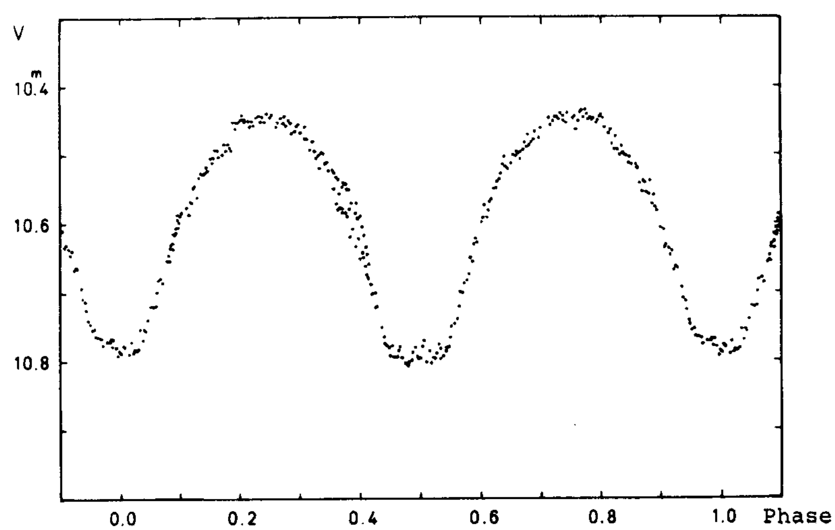

Figure 2. May 1980 light curve of TZ Boo. Colour V.

The sine coefficients are obviously small as well as the first cosine term, the latter indicating a small reflection effect.

Minima times of TZ Bootis have been determined:

Transit	JD 2444372.5710
Occultation	JD 2444372.4211

With the mean period of the last decade, $P=0^{d}.2971620$, these minima are $0\overset{d}{.}005$ early. If this means a spurious period fluctuation can only be decided by subsequent observations. The difference of the minima depths in May 1980 is only $0\overset{m}{.}01$, the occultation being fainter. This means that TZ Boo is already on the way again to deeper transit minima. There is no difference in B-V at the minima, but the maximum following occultation is markedly bluer than the other one. A temperature difference of the "side" hemispheres can be claimed therefore. The reductions have partly been carried out with a calculator granted by the Deutsche Forschungsgemeinschaft (Schm 167/12). This shall be gratefully acknowledged.

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OBSERVATIONS OF THE SPOT STARS EQ Vir AND UZ Lib IN 1977

There is a rapidly increasing amount of observations substituting the existence of magnetic active stars on or in the vicinity of the lower main sequence. Ca II and even hydrogen emission lines are often combined with the so called BY Dra syndrome, a sinusoidal light change referred to star spots. EQ Vir is one of the better known stars of this type. Broad band photometry is known from the years 1971 (Ferraz Mello and Torres, 1971) and 1975 (Hartmann, 1976). The amplitude has changed during that time from $0\overset{m}{.}10$ to $0\overset{m}{.}06$.
In a 24^d interval in March and April, 1977 this star has been observed photoelectrically in B with the 61 cm Bochum telescope at the European Southern Observatory (La Silla/Chile). The measurements are plotted in Fig. 1. The underlying ephemeris (period

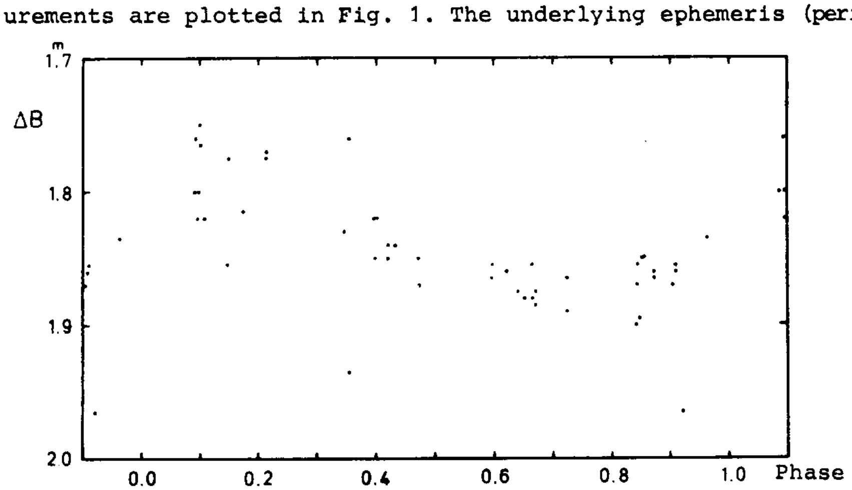

Figure 1: 1977 observations of EQ Vir.

by Torres and Ferraz Mello, 1973) was

$$2443219.30 + 3\overset{d}{.}96 \cdot E.$$

Apparently the amplitude of the light variation has recovered to $0\overset{m}{.}08$. Also the shape of the light curve has changed, showing the complete rise in only a quarter of the period. It is not clear, if the observed minima of different years belong to the same spot groups. In such a case the change of the light curve shape could be a measure of differential rotation in late type dwarf stars.

UZ Lib is a puzzle for now half a century. Parenago (1931) classified this star as RR Lyrae type with a period of $0\overset{d}{.}4413$. Wisniewski (1973) assumed that this object is a β Lyrae type eclipsing binary, with a sinusoidal light curve and a period of $9\overset{d}{.}49976$. However Evans and Bopp (1974) suspected it to be a BY Dra type star with a period of $4\overset{d}{.}75$ - as a consequence of its Ca II emission lines (Bidelman, 1954).

This object has been observed during the same time interval as EQ Vir with the same instrument. The measurements are shown in Fig.2.

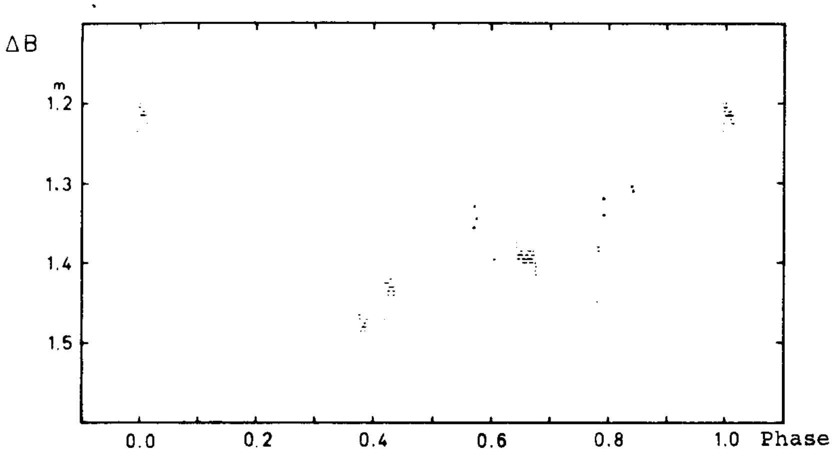

Figure 2: 1977 observations of UZ Lib.

They are plotted according to

$$2443222.15 + 4\overset{d}{.}75 \cdot E$$

i.e. the period suggested by Evans and Bopp. There is no difference in shape of the light curve halves, if the data are

drawn using Wisniewski's period twice that value. The shape of the light curve itself, however, has changed. The amplitude is only $0\overset{m}{.}26$ compared with $0\overset{m}{.}32$ five years earlier. There is a minimum $0\overset{p}{.}38$ after maximum and secondary minimum around $0\overset{p}{.}70$. The light curve, sometimes of irregular shape is a further hint that this star belongs to the BY Dra class of stars. The observations are well in agreement with the assumption of two or more separated active regions on UZ Lib. Because of the variability of the light curve it is impossible to improve the period. Also it is again not clear, how long a certain spot group on this star can survive to be linked with later observations.
The telescope, its equipment, and the reductions facilities have been supported by the Deutsche Forschungsgemeinschaft (grants Schm 160/9, 160/13, and 167/12). This should herewith be gratefully acknowledged.

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ON THE SUSPECTED ULTRASHORT PERIOD W UMa TYPE BINARIES BG CrA AND AB Tel *

Investigations of W UMa stars with periods shorter than $0^d.25$ are particularly interesting with respect to the stability limit of such objects. CC Comae ($P=0^d.22$) is so far the shortest period object photoelectrically confirmed. There are, however, still some objects listed in the fifth edition of the "Finding List" and the "GCVS" with shorter periods. In 1980 some southern short period W UMa stars have been observed photoelectrically with the ESO 1m telescope and a two channel UBV photometer. Inferior weather conditions affected the measurements reported here and prevented a completion of the light curves. However, the measurements are sufficient for a number of important conclusions. BG CrA has been observed on JD 2444440 (July 20).The observed run of $0^d.25$ shows only one minimum. Together with the discovery observations by van Gent (1932), a period of approximately twice the value previously determined for this star has been assumed as the best fit. The B and V light curves, shown in Figures 1 and 2, obey the ephemeris

$$2444440.5125 + 0^d.4446 \cdot E.$$

The assignment of phase 0.50 to the observed minimum is essentially arbitrary. Only a part of the light curve irregularities can be related to atmospheric influences. The general nature of the light curve resembles a complicated semidetached binary or magnetic active short period RS CVn stars. So BG CrA is possibly not a W UMa system.

*Based on observations made at the European Southern Observatory, La Silla, Chile.

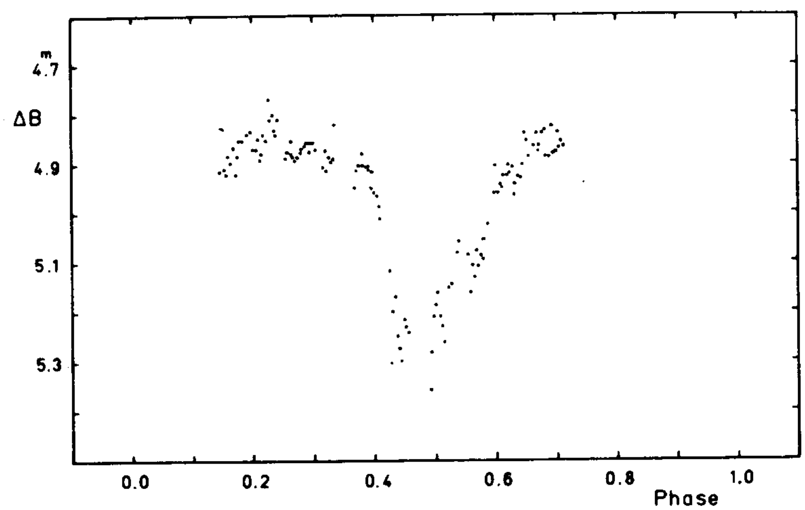

Figure 1 : B measurements of BG CrA

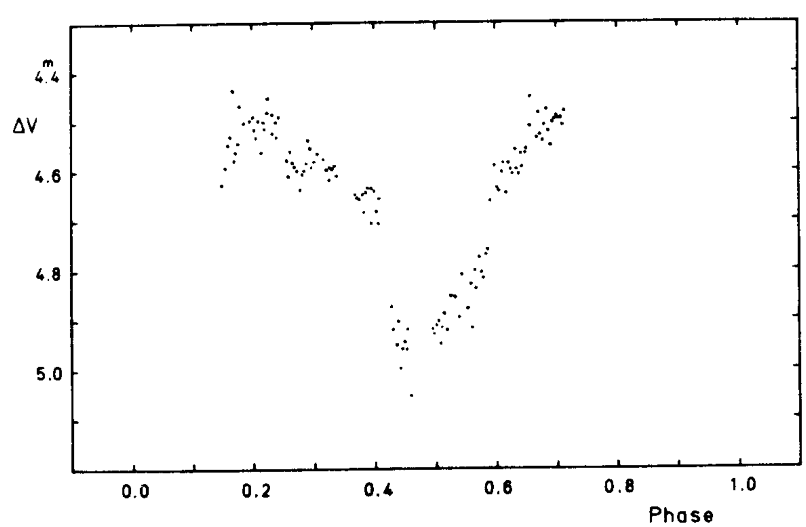

Figure 2 : V measurements of BG CrA

AB Tel has been discovered by Shapley et al. (1939). According to them, its period is $0\overset{d}{.}17$, and they classified it as eclipsing binary of W UMa type. The object has been observed on JD 2444435, 2444440 and 2444441 with the same instrument as BG CrA. The measurements are shown in Figures 3 and 4.

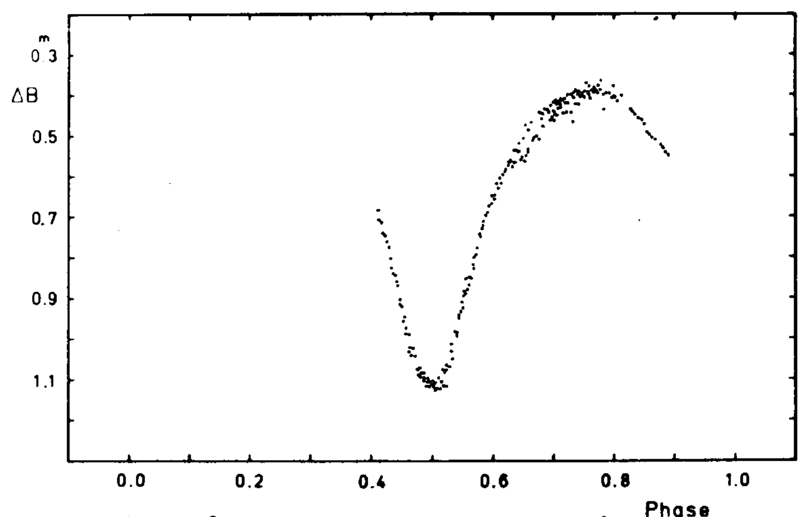

Figure 3 : B measurements of AB Tel

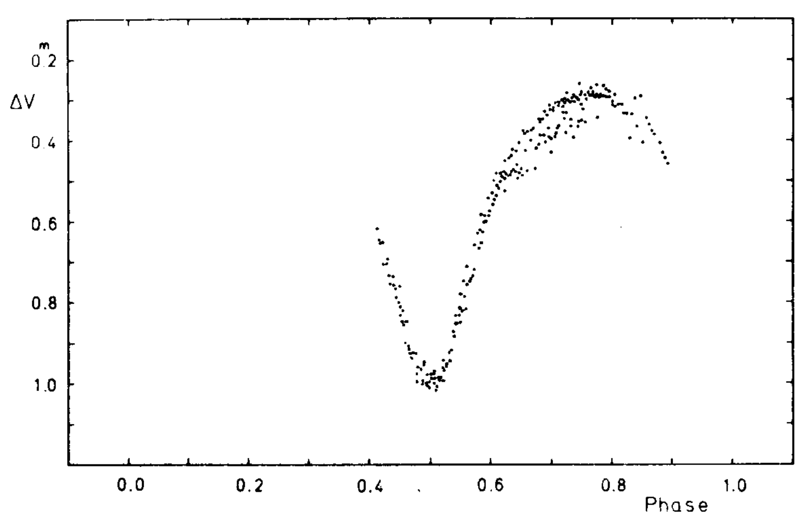

Figure 4 : V measurements of AB Tel

From the minima times

JD 2444435.5645

JD 2444441.7580

which refer to the same phase, a period of $0\overset{d}{.}32597$ has been determined. It is not known, however, if this minimum is a primary or a secondary one. So again a phase assignment of 0.50 to it is arbitrary. Obviously this object is indeed a genuine W UMa system. The minimum shows a slightly declining profile. There are indications that it represents an annular eclipse. From the large amplitude it is concluded that the mass ratio of the components is at least 0.5.

My thanks go to the ESO staff members who assisted me in the observations.

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SUPPLEMENTARY OBSERVATIONS OF AR Lac IN 1974

After the detection of radio outbursts in the RS CVn type eclipsing binary AR Lac by Hjellming and Blankenship (1973), there was a concentration of observations on this object in 1974 and the following years. Chambliss (1976) published photoelectric broad band photometry obtained between 1972 and 1974. Weiler (1978) carried out photoelectric spectrophotometry of the H and K and Hα line regions. Previous detailed spectroscopic investigations are available by Sanford (1951), and Naftilan and Drake (1977). Various authors looked succesfully for emission line variability of Hydrogen and Ca II.

This paper reports some results of 131 photoelectric measurements in V, obtained from May 29 to August 7, 1974 (JD 2442197-2442267) and 55 spectra obtained from June 1 to November 7, 1974 (JD 2442200-2442359). The photoelectric measurements have been obtained with the 36 cm Cassegrain telescope of Hoher List Observatory; the spectra have been taken with the Cassegrain spectrograph at the 106 cm telescope of Hoher List Observatory. The spectra cover a range of 3800 Å to 4900 Å with a dispersion of 29 Å/mm.

The photoelectric measurements (Fig.1), plotted and compared with those by Chambliss, fill some of the gaps of this light curve. Of particular interest are the phases 0.72 and 0.47. Hall et al. (1976) claimed a minimum of the suggested RS CVn-wave like distortion in AR Lac at phase 0.72 in 1974. The measurements shown here do not confirm this result. They form a smooth light curve from phase 0.6 to 0.8 showing only the small curvature by the aspect changes of the slightly distorted components. On the other hand, an interpolation between the meas-

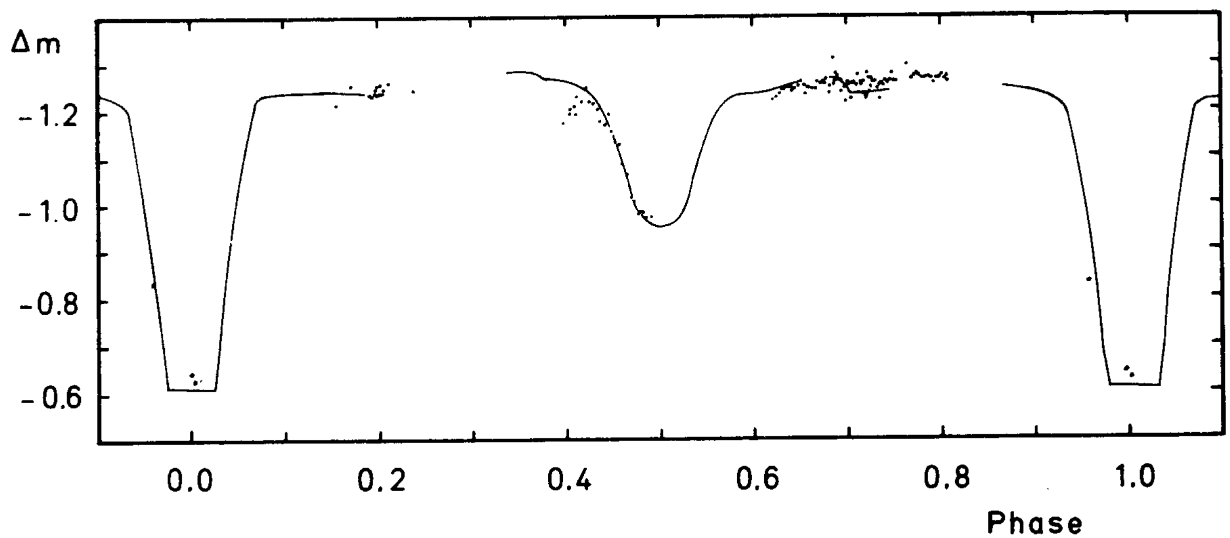

Figure 1.: V observations of AR Lac reduced to the comparison star used by Chambliss (1976). The central line of Chambliss' observations is plotted as solid line.

2

urements at phases 0.25 and 0.40 favour a lower first maximum of the light curve. Thus the analysis of the wave like distortion in AR Lac should be treated as preliminary for the 1974 entry.

Weiler reported an unusual decrease of the H and K emission line strength at phase 0.47 and interpreted it as eclipse effect of an active region on the secondary. The measurements shown here indicate a depression of the light curve around the first contact of the secondary eclipse. These measurements have been made at JD 2442197 and 2442201, 3.5 months apart from Weiler's observations. At JD 2442205 a spectrogram taken at phase 0.44 shows an unusually weak emission profile of the secondary components Ca II K line (the H line is less suited for such conclusions because of the blending with the Hε line). After phase 0.52 the 1974 light curve is the maximum of the three observation series by Chambliss, leading to an inclined transit minimum. It is suggested that all these phenomena are related to the same origin, indeed most probably the existence and eclipse of an active area on the secondary. This shall not exclude that also the Ca II emitting primary exhibits magnetic activity too.

The spectra, which are well spread over the phases with exception of a gap between $0\overset{p}{.}25$ and $0\overset{p}{.}43$, unfortunately do not show a significantly established variation of individual line strengths between the differently bright maxima or at phase 0.08 when Chambliss' 1974 measurements indicate another depression.

At primary minimum there seems to be a faint emission of Hβ, as found by Naftilan (1975) for RS CVn and duscussed by Naftilan and Drake (1976). This is virtually enhanced at phase 0.03, probably because of a mixture of the first Hβ absorption parts of the other component emerging from eclipse and the weaker Fe line at λ4859.7 Å of the secondary.Blending with Fe lines prevents a conclusion on emission in the Balmer lines of higher order.

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THE NEW PHOTOELECTRIC EPHEMERIS AND LIGHT CURVES OF NN CEPHEI

NN Cephei was announced as RR ? in the Second Supplement to the Third Edition of the General Catalogue of Variable Stars (1974) and a Beta Lyrae type eclipsing binary by Figer and Rolland (1977).

The system was observed photoelectrically at the Ege University Observatory on 21 nights between July 1979 and October 1980. The observations were made in yellow and blue colours with the 48 cm Cassegrain telescope equipped with an unrefrigerated EMI 9781 A photomultiplier tube and Johnson's standard B, V filters. A total of 740 and 624 observational points were obtained in B and V colour, respectively. BD +61°2388 was used as comparison throughout the observing period. The nonvariability of it was checked with BD +61°2385. The extinction coefficients in separate colours for each night were calculated from the observations of comparison star using the conventional method; then, all of the differential observations were corrected for differential extinction.

Three primary and four secondary minimum given in the following table were obtained.

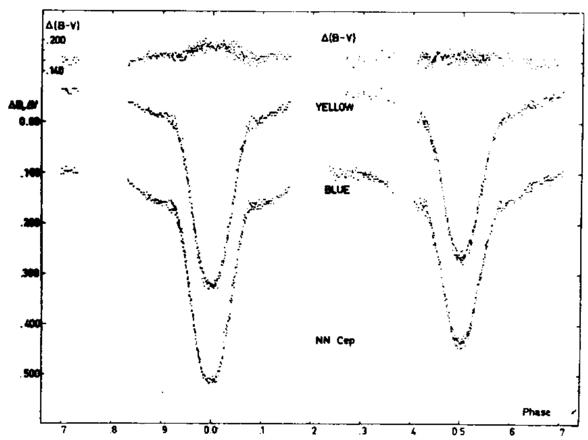
Times of minima of NN Cep

Hel.Min.J.D.	Filter	Min.	O-C
2444086.4796	B,V	II	-0.0003
438.4512	"	II	0.0011
474.4717	"	I	0.0013
504.3151	"	II	-0.0007
506.3741	"	II	0.0000
507.4026	"	I	-0.0007
511.5194	"	I	-0.0005

New light elements are determined using the above photoelectric minima by the method of least squares as,

$$\text{Hel.Min.J.D.} = 2444507.4033 + 2^{d}.058305 \cdot E.$$
$$\pm 4 \qquad\qquad \pm 5$$

The light and colour curves of the system are presented in the Figure where the magnitude differences between the variable and comparison stars have been plotted against the phases.



The phases in the Figure and the O-C values in the Table were calculated with the new light elements. The light curves show that the system is a β Lyrae type eclipsing binary. As it will be seen from the light curves there exist some complications on the shoulders of minima, particularly in B colour. The system varies about $0^{m}.414$ and $0^{m}.379$ at the primary, $0^{m}.338$ and $0^{m}.321$ at the secondary minimum in blue and yellow light, respectively. The solutions of light curves will be published elsewhere.

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Reference:

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FURTHER ON THE PERIOD OF NY CEPHEI

NY Cephei (HD 217312) was found by Heard and Fernie (1968) to be a double-lined spectroscopic binary with a period of $15^d.2767 \pm 0^d.0010$. Rao (1972) and Madore and Percy (1973) independently observed light variations which strongly suggested that this system was also an eclipsing variable. This was confirmed later in 1973 when Scarfe and Barlow (1974) followed the star through primary eclipse and calculated a time of minimum at JD(Hel.) 2441903.8136±0.0007, earlier than predicted on the basis of the minima observed by both Rao and Madore and Percy together with the period of Heard and Fernie. However it was felt premature to adjust the period at that time.

The period was revised to $15^d.27575 \pm 0^d.00010$ by Mayer et al. (1978) whose observations covered the egress from primary eclipse. Recently a revised period of $15^d.2756 \pm 0^d.0001$, based upon a time of minimum obtained in 1975, was given by Scarfe (1979) as part of a progress report on NY Cephei. The revised periods do not differ significantly either from each other or from the spectroscopic value, but both reduce the latter's uncertainty by an order of magnitude.

We have observed another primary eclipse of NY Cephei at the University of Victoria Observatory on the night of 1980

October 2-3 under fairly good sky conditions. The observations give a time of minimum light at JD(Hel.) 2444515.9630±0.0008 by the method of Kwee and van Woerden (1956), about 30 min. later than predicted by the ephemeris of Scarfe. Combining this result with the 1973 time of minimum yields another slightly revised period of $15^d.275727 \pm 0^d.000006$, but further reduces the uncertainty by another order of magnitude. A plot of all V observations within $0^d.25$ of primary eclipse obtained at this Observatory and those of Mayer et al., according to the ephemeris

Time of Pri. Min. = JD(Hel.) 2441903.8136 + 15.275727E,

show all the data to be consistent with this period.

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PHOTOGRAPHIC OBSERVATIONS OF THE POSSIBLE COUNTERPART OF THE X RAY SOURCE 1E 0643.0-1648

In IAU Circ. 3529 Chlebowski et al. communicated that this X-ray source is identified with a star 9' shouth of Sirius. According to that reference the star is optically variable and shows two states (V = 11^m and $13^m.5$). The object could be observed on about 60 Sonneberg astrographic plates scattered over the years 1941 to 1979. A fairly close series of 1962 October to 1963 February shows on blue sensitive plates, variations up and down between $11^m.7$ and $14^m.2$, the characteristic time-scale being roughly 25 days. Difficulties arose because of the near-by image of Sirius, especially when linking the comparison stars to the magnitudes in NGC 2287 of Hoag et al.

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TAU CYGNI

The star Tau Cyg, reported as suspected Delta Scuti variable (Pant et al. 1968, Frolov 1970, Kukarkin 1974), was observed photoelectrically in 6 nights since July 25, 1978 to October 9, 1979 with the UBV photometer described by Piccioni (1972) mounted on the 60 cm reflector telescope of the Bologna Observatory.

Sigma Cygni was used as comparison star. In the Table are reported the mean UBV magnitudes of Tau Cyg deduced from the

Table I

J.D.	$N_{mis.}$	V	B-V	U-B
2443715.385	3	3.711±.006	.411±.008	.034±.008
.425	5	3.709±.006	.414±.008	.029±.008
2443718.380	4	3.722±.005	.411±.007	.021±.008
.413	5	3.723±.002	.413±.003	.021±.004
.445	6	3.717±.002	.411±.003	.019±.004
2443736.431	6	3.722±.002	.420±.002	.011±.003
.468	2	3.730±.005	.421±.006	.010±.007
2443738.395	5	3.707±.004	.414±.006	.022±.006
.430	3	3.72 ±.01	.41 ±.01	.03 ±.01
.452	5	3.703±.007	.408±.008	.019±.008
.481	4	3.718±.003	.415±.006	.022±.006
.528	3	3.705±.008	.41 ±.01	.02 ±.01
.554	1	3.71 ±.01	.42 ±.01	.02 ±.01
2443747.355	4	3.704±.004	.417±.005	.022±.006
.372	4	3.718±.004	.415±.004	.027±.006
2444156.410	5	3.697±.001	.418±.002	.023±.002
.433	7	3.695±.003	.419±.004	.022±.004
.468	8	3.694±.003	.416±.003	.022±.003

magnitudes of Sigma Cyg published by Iriarte et al. (1965). A systematic calibration error of $0^m\!.02$ could be present in addition to the standard errors of the mean.

The present observations confirm that the star is certainly variable with an amplitude of about $0^m\!.02$; we do not find evindece of the period $0^d\!.143$ suggested by Paraskevopoulos (1921) and Henroteau (1922).

Considering all the available observations and the Abt (1961) remark against a rotational explanation of the variability, Tau Cyg seems to be a Delta Scuti star of variable-period type according the Breger (1979) classification with asymmetric light and velocity curves.

The authors wish to express the most sincere thanks to Mr. L. Oculi for his careful technical assistance.

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REQUEST FOR CONFIRMATION OF A NEW DISCOVERED ECLIPSING BINARY (SAO 072799)

On photographic observation of the BAV-program-star SW Lac I noticed that one of the comparison stars (SAO 072799=BD+37°4713) used in addition was getting weaker continuously about $0\overset{m}{.}4$ within 3 hours.

Three months later, on 18 January 1980 there was found a second descent to minimum light.

Since July 1980 I could get more than 400 exposures, but only on one series of 05 October 1980, at the first time, I could observe a total minimum of this 8th mag. star.

A secondary minimum was found on 28 September, with a depth of about $0\overset{m}{.}2$ and at P≈0.3. Especially it is remarkable that the relatively very short "d" at the secondary minimum lasts only about $0\overset{h}{.}6$ in comparison with the primary's "d" of about 2^h.

But for more details, a comprehensive series in the next three months should fill some gaps round about the total cycle, especially at the ascending part of the light curve.

For the moment I want to indicate the variability of SAO 072799, in order to activate some professional photoelectric observers.

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14 Lac: A NEW LIGHT VARIABLE Be STAR

14 Lac is a B3 IV star which has been suspected as a variable with an amplitude of few hundredths of a magnitude by Walker (1952).

This object was adopted as one of the comparison stars in a rather long series of U, B, V observations of the shell star o And, taken in 1969 at the Astrophysical Station of Serra La Nave of the Catania Observatory. The said observations, which are distributed over 32 nights from August to November, with several hours of measurements in each night, were kindly supplied to me by Prof.M.Rodono. A preliminary analysis of these observations shows that 14 Lac is variable with an amplitude of about 0.05 mag. in the three colours and with a possible periodicity (or pseudo-periodicity) of about 5 days.

In order to clarify the type of variability and since from narrow band photoelectric measurements 14 Lac was suspected by Andrews (1968) to be a star with Hα emission, a few grating spectra were collected on October and November 1980 with the Cassegrain spectrograph attached to the 137 cm reflector of the Merate Observatory. In particular, two 35 Å/mm red spectra show that the Hα line consists of a strong absorption core flanked by emission components, so that 14 Lac is a Be star. This conclusion is strengthened by the amplitude and timescale of light variations and by the relatively high projected rotational velocity of this object (225 km/sec, Abt and Hunter, 1962).

Full details relating to the light variability and the spectral characteristics of 14 Lac will be given elsewhere.

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FLARE STARS IN THE γ CYGNI REGION

Systematic observations of the region of γ Cygni were continued. For flare star search a total of 87 plates in U-light (ORWO ZU 21 + UG2 filter) and pg-light (ORWO ZU 21 without filter) centered on BD $+40^{\circ}4165$ have been obtained with effective time $85^{h}50^{m}$ between September 1979 and November 1980. The observations were carried out with the 40"/52" and 21"/21" Schmidt telescopes of the Byurakan Astrophysical Observatory and 20"/28" Schmidt telescope of the Bulgarian Astronomical Observatory at Rojen.

The number of plates, exposures and the effective time of observations for each telescope are presented in Table I.

Table I

Telescope	Light	Number of plates	Number of exposures	T_{eff}
40"/52"	U	15	90	15^{h}
21"/21"	pg	1	5	50^{m}
20"/28"	U	68	402	67^{h}
	pg	3	18	3^{h}

Seven flare stars were discovered. The following data for the observed flares are given in Table II: the serial number of the flare stars, discovered on the Byurakan observational material (B) and (R) - discovered on the Rojen observational material; coordinates for 1950.0; the approximate minimum brightness in U-light and the date of the flare up.

Table II

Number	RA (1950.0)	D (1950.0)	$m_{U\ min}$	Δm_U	Date of flare up
B2	$20^h26^m.2$	$40^\circ 06'$	$18^m.2$	$4^m.2$	13.09.1980
R1	27.3	40 16	21.0	5.5	29.10.1980
R2	30.1	43 01	21.0	4.7	18.06.1980
B3	30.4	43 06	19.5	3.4	12.09.1980
R3	33.3	42 21	17.6	2.2	15.08.1980
R4	34.3	39 51	>21.0	>5.4	16.08.1980
R5	34.5	40 37	>21.0	>4.8	17.07.1980

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FLARE STARS IN THE PLEIADES

In 1980 we have continued the patrol observations in the Pleiades region in order to discover flare stars. The observations were made with the 20"/28"-Schmidt telescope of the Bulgarian National Astronomical Observatory in Rojen.

Table I gives the data for observational material during the 30^h45^m total effective time of observations.

Table I

Telescope	Light	Time of exposure	Number of plates	Number of exposures	T_{eff}
20"/28"	U	10 min	30	169	28^h10^m
		5 min	5	31	2^h35^m

The data of observed flares are summarized in Table II.

Table II

Rojen N	H II	RA	D	m_{Umin}	Δm_U	Date	Identification Byurakan N
R 6		$3^h40^m.2$	+24°22′	21^m:	$6^m.7$	5.11.1980	
R 7		41.2	22 02	17.3	0.8	12.10.1980	B 18
					2.3	15.10.1980	
R 8	1827	42.4	23 40	17.9	5.0	18.10.1980	B 51
R 9	2411	43.7	24 01	16.9	2.4	15.10.1980	B 55
					2.0	17.10.1980	
R10		45.3	25 04	20:	5.7	9.10.1980	
R11		45.9	23 00	20:	6.5	8.10.1980	

The successive columns give the following data:

1. Rojen designation

2. Hertzsprung number

3 -4. Coordinates for 1900.0

5 - 6. Photographic magnitude at minimum and amplitude of the observed flare in U-light

7. Date of the flare event (UT)

8. Identification of the flare stars by the Byurakan lists.

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FLARE STARS IN ORION

In the course of a programme to discover flare stars in stellar aggregates we have started the patrol observations of Orion (M 42) nebula.

The observations were made with the 20"/28"-Schmidt telescope of the Bulgarian National Astronomical Observatory in Rojen on ORWO ZU 21 emulsion with UG 2 filter. 22 plates each with six successive exposures of 10 minutes were obtained and the total time of effective patrol was 22 hours.

Table I gives the information about the flare events.

Table I

Rojen N	Parenago N	RA(1900.0)	D(1900.0)	$m_{U\,min}$	Δm_U	Date(UT)	Identification
R 1		$5^h26^m34^s$	$-4^\circ17'.0$	$18^m.5$	$4^m.8$	17.11.1980	
R 2		28 17	-4 55.8	18.3	3.5	17.11.1980	43 (1)
R 3	1292	28 58	-4 20.6	16.1	3.1	14.01.1980	eα-3 (2)
R 4	2203	30 52	-5 05.5	>17.1	2.2	14.01.1980	CE Ori
R 5	2372	31 23	-5 08.9	15.8	1.7	18.01.1980	
R 6		32 40	-4 16.9	18.1	3.0	10.02.1980	
R 7		34 55	-6 28.2	17.4	2.4	17.11.1980	173 (3)
R 8		38 05	-4 32.0	16.2	1.0	10.02.1980	

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TWO NEW VARIABLE STARS IN THE γ CYGNI REGION

On the patrol plates for flare stars in the region of γ Cygni two variable stars were discovered, not designated in the GCVS (1969), GCVS 1, 2 and 3 Suppl. (1971-1976) and 62, 63, 64 Name list of variable stars (I.B.V.S. Nos. 1248, 1414, 1581).

The observational material with total effective time 85^h50^m is obtained by the method of multiple exposures, which gives the possibility to observe a quick variability of the order of one 10 minute exposure.

Table I gives the data about these stars: the coordinates for 1950.0, the limits of variation in U-light and the probable type of variation.

Table I

Number	RA (1950.0)	D (1950.0)	m_U max	m_U min	Type
1	$20^h16^m.2$	$41^\circ49'.0$	$15^m.0$	$17^m.0$	Ins
2	20 26.3	39 45.8	15.5	16.8	Ins,eα

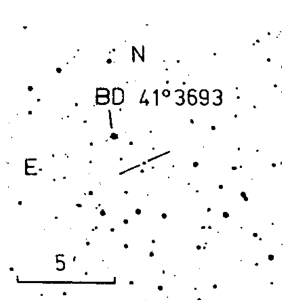

Figure 1

Variable 1. Between September 1979 and November 1980 this star had quick, irregular variations in brightness. It is situated in the nebulosity IC 1318a. Figure 1 presents the identification chart of the variable obtained from 40"/52"-Schmidt plate in V-light with 15 minute exposure.

Variable 2. In the same interval of observations the star had quick, irregular variations. It is situated in the nebulosity IC 1318c. The star is identical with the star No. 30 in the list of stars with H_α-emission of Kazaryan and Parsamyan (Astrofisika 7, 671, 1971). These authors give the value of the intensity of H_α-emission as very strong and sharp. On our spectral plates obtained between August 1977 and

September 1980 the star also had a very strong H_α-emission. The identification chart is given in the paper of Kazaryan and Parsamyan.

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PHOTOELECTRIC OBSERVATIONS OF THE FLARE STAR BY Dra IN 1975

Continuous photoelectric monitoring of the flare star BY Dra has been carried out at the Stephanion Observatory (λ=-22°49'44", φ=+37°45'15") during the year 1975, using the 30-inch Cassegrain reflector of the Department of Geodetic Astronomy, University of Thessaloniki. Observations have been made with a Johnson dual channel photoelectric photometer in the B colour of the international UBV system. The telescope and photometer will be described elsewhere. Here we mention only that the transformation of our instrumental ubv system to the international UBV system is given by the following equations:

for the time interval from 5-2-1975 to 24-6-1975

$V=v_o+0.001(b-v)_o+2.278$

$(B-V)=0.908+1.037(b-v)_o$

$(U-B)=-1.895+1.031(u-b)_o$,

for the time interval from 25-6-1975 to 30-7-1975

$V=v_o+0.119(b-v)_o+2.163$

$(B-V)=0.819+1.047(b-v)_o$

$(U-B)=-1.509+1.006(u-b)_o$.

The monitoring intervals in UT as well as the total monitoring time for each night are given in Table I. Any interruption of more than one minute has been noted. In the fourth column of Table I the standard deviation of random noise fluctuation σ(mag)= $2.5 \log (I_o+\sigma)/I_o$ for different times (UT) of the corresponding monitoring intervals is given.

During the 22.27 hours of monitoring time one flare was observed the characteristics of which are given in Table II. For this flare following characteristics (Andrews et al. 1969) are given: a/ the date and universal time of flare maximum, b/ the duration before and after the maximum (t_b and t_a, respectively),

Table I

Monitoring intervals in 1975

Date 1975	Monitoring intervals (UT)	Total monitoring time	σ(UT)
June 20	$21^h59^m-22^h28^m$, $22^h32^m-23^h01^m$,		$0.01(22^h15^m)$, $0.002(22^h51^m)$.
	23 05 -23 11.	1^h04^m	
21-22	23 44 -23 55, 00 04 -00 18,		0.01(23 46), 0.01(00 25),
	00 22 -00 57, 01 01 -01 25.	1 24	0.01(01 03).
26-27	23 36 -00 02, 00 06 -00 40,		0.01(23 38), 0.01(00 08),
	00 44 -01 18.	1 34	0.01(00 46).
29-30	19 56 -20 23, 20 26 -20 44,		0.01(19 59), 0.01(20 29),
	20 57 -21 30, 23 05 -23 34,		0.01(20 59), 0.002(23 08),
	23 37 -24 00, 00 04 -00 29,		0.01(23 40), 0.01(00 08),
	00 43 -01 07, 01 10 -01 37.	3 26	0.01(01 00), 0.01(01 12).
June-July 30-1	20 26 -20 57, 21 00 -21 27,		0.01(20 27), 0.01(21 03),
	21 30 -22 02, 23 27 -00 01,		0.01(21 33), 0.01(23 30),
	00 04 -00 36, 00 39 -01 25.	3 22	0.01(00 05), 0.01(00 41).
July 1-2	21 32 -22 00, 22 04 -22 34,		0.02(21 41), 0.01(22 30),
	22 37 -22 48, 22 51 -23 07,		0.02(22 58), 0.01(23 37),
	23 21 -23 50, 23 54 -00 26,		0.01(00 10), 0.01(00 32),
	00 30 -00 50, 01 04 -01 24.	3 06	0.01(01 17).
3-4	20 30 -20 57, 21 16 -21 38,		0.01(20 33), 0.01(21 19),
	21 42 -22 15, 22 30 -22 58,		0.01(21 45), 0.01(22 32),
	23 02 -23 12, 23 19 -23 23,		0.01(23 41), 0.01(00 26),
	23 26 -23 59, 00 21 -00 48,		0.01(01 10).
	00 51 -01 24.	3 37	
6-7	20 59 -21 28, 21 34 -22 01,		0.01(21 00), 0.003(21 38),
	22 04 -22 35, 23 49 -00 24,		0.003(22 23), 0.01(23 54),
	00 28 -00 57, 01 00 -01 21.	2 52	0.01(00 30), 0.01(01 15).
7	21 33 -21 59, 22 14 -22 43,		0.01(21 50), 0.01(22 20),
	22 47 -23 11, 23 14 -23 46.	1 51	0.01(23 05), 0.01(23 23).

Total: $22^h16^m=22^h.27$

Table II

Characteristics of the flare observed

Flare No	Date 1975	U.T. max	t_b min	t_a	Duration min	$\frac{I_f-I_o}{I_o}$ max	P min	Δm mag	σ mag	Air mass
1	July 1	$22^h38^m.92$	0.51	3.89	4.40	0.19	0.21	0.19	0.01	1.92

as well as the total duration of the flare, c/ the value of the ratio $(I_f-I_o)/I_o$ corresponding to flare maximum, where I_o is the intensity deflection less sky background of the quiet star and I_f is the total intensity deflection less sky background of the star plus flare, d/ the integrated intensity of the flare over its total duration including pre-flares, if present, $P=\int(I_f-I_o)/I_o dt$,

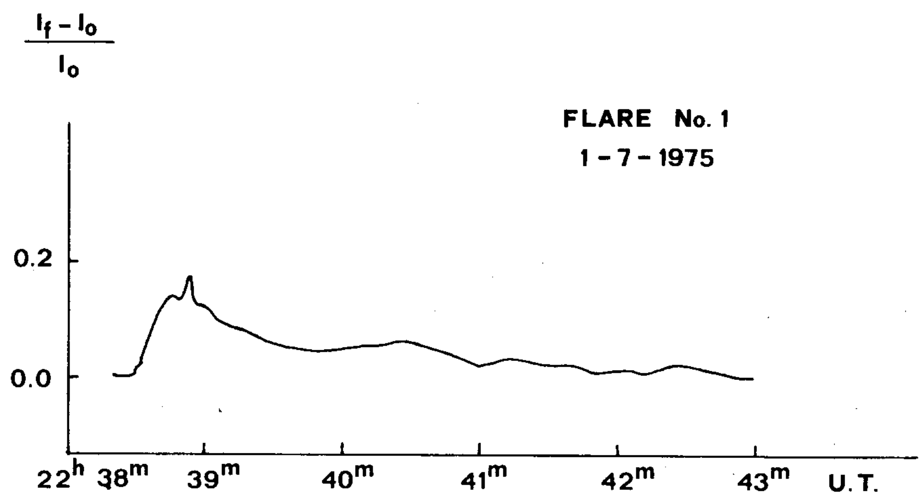

Figure 1

e/ the increase of the apparent magnitude of the star at flare maximum $\Delta m(b)=2.5\log(I_f/I_o)$, where b is the blue magnitude of the star in the instrumental system, f/ the standard deviation of random noise fluctuation $\sigma(mag)=2.5\log(I_o+\sigma)/I_o$ during the quiet-state phase immediately preceding the beginning of the flare and g/ the air mass at flare maximum. The light curve of the observed flare in the b colour is shown in Fig. 1.

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Reference:

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PHOTOMETRY OF TWO SUSPECTED LONG PERIOD CEPHEIDS

Van Genderen and The (1978) show that the G0Ia supergiant HD159378 (=Tr 27-102), a member of the open cluster Trumpler 27, varies in brightness and colour with a period of 70 to 90 days. Since it is situated at the blue edge of the Cepheid strip it may be a very long period cepheid. However, its light curve shows minima of unequal depth similar to that seen in RV Tauri stars.

Eichendorf and Reipurth (1980) suggest that another G0Ia star, V810 Cen, (= HD101947 = HR5411) may be a cepheid with a period of 125 days. They find it lies on the blue edge of the instability strip and near the period-luminosity relation for cepheids. The phase between the light and colour variations and the lack of IR excess in JHKL indicate that it is unlikely to be an RV Tauri, even though it also has unequal minima.

Both stars were usually monitored once or twice each week spent by the authors on the 0.5 (or 1.0 metre) telescopes at Sutherland SAAO. Both stars were observed by the author in the Cape Kron BVRI system using an extended S20 phototube. The observations were transformed to the system of Cousins (1976) using E region standards, and two "local standards" near to HR4511, the adopted values for which are given in Table I. Since the apertures used were in the range, 20" - 33", the faint companion to HD159378 mentioned by van Genderen and The was usually included.

Several observations of HR4511 were also made in the Johnson UBV system using S11 phototubes. These were tied to the standards given in Table I.

The observations are given in Table II (HR4511) and Table III (HD159378).

Table I

Standard	V	B-V	U-B	V-R	V-I
HR 4475	5.140	1.110	1.068	0.558	1.063
HR 4485	5.937	1.022	0.850	0.512	0.986

Table II

Photometry of HR 4511

HJD -2440000	V	B-V	U-B	V-R	V-I
3682.30	5.10	0.85	0.41		
3716.25	5.07	0.81		0.46	0.88
3911.57	5.02	0.80		0.46	0.79
3914.54	4.99	0.79		0.46	0.77
3969.41	4.95	0.75		0.42	0.82
3978.50	4.95	0.77		0.42	0.79
3979.43	4.97	0.76		0.44	0.81
4038.32	5.05	0.82		0.46	0.86
4039.27	5.04	0.83		0.46	0.86
4060.29	4.98	0.79		0.44	0.83
4249.59	5.04	0.78		0.42	0.87
4250.59	5.03	0.79		0.42	0.87
4270.58	5.02	0.82		0.44	0.85
4278.62	5.03	0.81	0.42		
4279.61	5.04	0.81	0.42		
4281.53	5.04	0.81	0.42		
4297.45	5.04	0.80		0.45	0.86
4298.57	5.03	0.80		0.44	0.85
4301.53	5.04	0.80		0.45	0.86
4312.46	5.03	0.79	0.41		
4368.39	4.96	0.75	0.40		
4390.22	4.99	0.75	0.40	0.42	0.82
4391.23	5.00	0.76	0.41	0.42	0.82
4392.24	5.00	0.76	0.41	0.43	0.83
4393.23	5.00	0.76	0.40	0.43	0.82
4422.26	5.09	0.81		0.45	0.87
4424.27	5.08	0.81		0.44	0.85

Table III

Photometry of HD 159378

HJD -2440000	V	B-V	V-R	V-I
3970.65	8.50	1.97	1.21	2.39
4036.49	8.53	2.04	1.18	2.39
4038.46	8.52	2.06	1.19	2.39
4059.50	8.48	1.93	1.19	2.38
4060.41	8.45	1.89	1.19	2.37
4094.28	8.40	1.90	1.20	2.34
4096.31	8.37	1.91	1.19	2.33
4099.42	8.36	1.88	1.18	2.32
4114.27	8.35	1.88	1.18	2.33
4115.31	8.36	1.88	1.19	2.33
4422.45	8.46	1.91	1.20	2.32
4423.42	8.45	1.91	1.21	2.33

(a) HD159378 became gradually brighter and bluer between Julian Dates 244 4037 and 2444115. There is insufficient data and too large a time gap to be able to improve on the periods given by van Genderen and The; however the period may exceed 100 days.

(b) HR4511 appears to have varied irregularly between V = 4.95 and 5.08 during the period JD 2443910 - 2444423. There is no evidence for Eichendorf and Reipurth's period of 125 days. The star is bluest at maximum.

Both these stars appear similar to the superluminous supergiants HR5171 and 6392 (Dean 1980) in that they show irregular long period fluctuations. They are thus unlikely to be cepheids.

I would like to thank Dr J. W. Menzies and Mr J. D. Laing for their UBV observations of HR4511.

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SEARCH FOR AN ECLIPSE OF HR 913

The star HR 913 was discovered by R.F. Griffin (1980) to be a double-lined spectroscopic binary with a period of 363.10 days. Griffin gives the spectral types of the components to be F8 V and G5 V. He predicts the possibility of an eclipse on 1980 September 30.8 (JD 2444513.3) with an uncertainty of 0.5 days. The duration of a central eclipse would also be about half a day.

The author searched for the eclipse on four nights with the No. 4 16-inch telescope at Kitt Peak National Observatory. Differential V and B photometric observations were obtained using ρ^1 Eri as a comparison star. The observations were corrected for differential atmospheric extinction and transformed to the standard UBV system. The observations are shown in the Table below.

TABLE

Hel. J.D. (2 440 000 +)	ΔV	ΔB
4510.9288	0.443	-0.007
4510.9329	0.441	-0.006
4510.9370	0.438	-0.008
4511.8762	0.442	
4511.8793	0.436	
4512.8284	0.442	
4512.9340	0.446	
4513.7986	0.439	
4513.9442	0.443	
4513.9544	0.447	0.002
4513.9592	0.447	0.000
4513.9937	0.439	-0.005

The data bracket the predicted time of eclipse and show no evidence of an eclipse. However, a 0.5 day eclipse very close to the predicted time would have occurred entirely between the last observation obtained on JD 2444512 and the first observation on JD 2444513 and, hence, would not have been observable from the longitude of Kitt Peak.

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Reference:

Griffin, R.F., 1980, The Observatory 100,113

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ON THE INTERCONNECTION OF THE PULSATIONAL AND ORBITAL PERIOD VALUES FOR BINARY SYSTEMS

We pay attention to the existence of the unusual "synchronization" between pulsational and orbital motion in the close eclipsing and spectroscopic binaries containing pulsating components of different types: the orbital period contains almost an integer of pulsation cycles. Earlier several authors have already noticed the same effect for individual stars: Delta Scuti star AB Cas (O.A. Chekanikhina, M.S. Frolov, B.N. Irkaev, Inf. Bull. var. Stars, No. 1382, 1978), RR Lyrae stars V 80 in the dwarf galaxy Ursa Minor and RW Ari (K.A. Sidorov, Var. Stars 20, 557, 1978). Probably RW Ari is single RR Lyrae star according to recent observations.

We have prepared the list of known Delta Scuti, Beta Canis Majoris and Cepheid pulsating stars in the short period eclipsing or spectroscopic binary systems. This list contains 27 objects with both orbital and pulsation periods known (in the case of multiperiodicity we prefer the period corresponding to the highest light amplitude). For 16 of these having the error of the ratio $N=P_{orb}/P_{puls}$ not exceeded ±0.05 we have calculated the value $\Delta = |P_{orb}/P_{puls} - A|$, where A is the nearest integer. Δ is the measure of deviation rate from the case of the exact synchronization (Δ=0).

It stands to reason that the error of the ratio P_{orb}/P_{puls} depends not only on the period errors but also on the ratio value itself. Therefore one can say nothing on this effect in the case of wide pairs.

The data on 16 binaries with pulsating components are given in Table I; eclipsing systems are denoted by asterisks. V 80 in UMi is the unique really eclipsing RR Lyrae star known to-day, which has been discovered by P.N. Kholopov (Var. Stars 18, 117, 1971).

EN Lac is the first known to-day eclipsing system with the Beta CMa pulsating star.Both components of the spectroscopic binary Delta Del are Delta Scuti variables.

Table I

No.	Name	Type	$N=\frac{P_{orb}}{P_{puls}}$	$\Delta=\left\|\frac{P_{orb}}{P_{puls}}-A\right\|$
1*	V 80 (UMi)	RR	4.15	0.15
2	FF Aql	Cep	320.96	0.04
3	BL Tel	Cep?	11.95	0.05
4	KW Aur	Delta Sct	43.01	0.01
5*	Y Cam	Delta Sct	49.74	0.26
6	Delta Del	Delta Sct	{299.38 261.82	{0.38 0.18
7	V 644 Her	Delta Sct	102.98	0.02
8*	AI Hya	Delta Sct	60.06	0.06
9	BS 8210	Delta Sct	49.75	0.25
10	Nu Cen	Beta CMa	15.00	0.00
11	Beta Cep	Beta CMa	57.18	0.18
12	V 600 Her	Beta CMa	25.27	0.27
13*	EN Lac	Beta CMa	71.51	0.49
14	Psi Ori	Beta CMa?	8.20	0.20
15	Gamma Peg	Beta CMa	45.01	0.01
16	Alpha Vir	Beta CMa	23.10	0.10

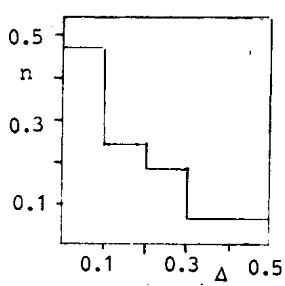

Figure 1

In Fig. 1 we show the distribution in number versus the value Δ for these objects. One can see that the case of the strict synchronization (Δ=0) is the most probable state for these systems.

Maybe our result on Y Cam, one of the eclipsing binaries with a Delta Sct pulsating component, is the evidence of the unusual pulsation in the presence of the close companion. We have observed this object photoelectrically during three nights JD 2444222-4 by using the 48-cm reflector of the Alma-Ata High Altitude station of the Sternberg Astronomical Institute. We have confirmed the results which had been received earlier by P. Broglia and F. Marin (Astron. Astrophys., 34, 89, 1974) on Delta Scuti nature of the brighter component of this Algol system (Fig. 2). The light amplitude is strongly changing during our short time observing in-

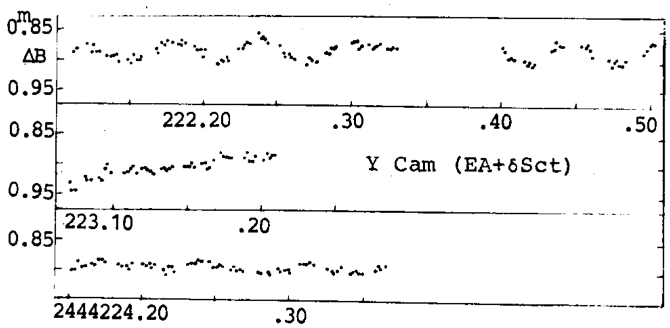

Figure 2

terval from $0^m.05$ to about $0^m.01$ in B light. The period also varies from $0^d.056$ to $0^d.073$.

We have determined the average period for the pulsating component $0^d.066458$ on the basis of long series of observations published for Y Cam (P. Broglia, P. Conconi, Milano-Merate Publ. No. 27, 1973) by using S. Yu. Shugarov's programme for period determination. The observations during minima were excluded. We were surprised that it was possible to obtain the mean curve based on only single period during 13000 pulsation cycles for such a "semiregular" star. This mean light curve is shown in Fig. 3.

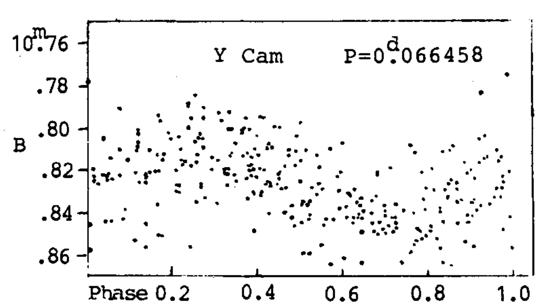

Figure 3

Maybe, just the presence of the close companion makes the star pulsate much more regularly than in the single case.

What is the reason of the "synchronization" between the pulsation of the component and the orbital movement in shortperiodic binaries?

Maybe, this is an effect of the tidal action of the close companion on the pulsational process in accordance with the well known Fitch's hypothesis. Maybe, however, this is the coincidence of the P_{puls} and not the P_{orb} but the axial rotation period P_{rot} of the same pulsating star. Indeed, $P_{orb}=P_{rot}$ for many binaries. If so, the binarity is only the good tool for discovering the coincidence because P_{rot} is unknown for the single pulsator due to the "sin i" factor.

In the light of the second hypothesis one can suppose that the range of dispersion seen in Fig. 1 must be smaller in reality: for several systems possibly $P_{orb} \neq P_{rot}$. Just in these cases the large values of Δ (poor synchronization) can occur. It would be interesting to test this, maybe Delta Del is one of such systems.

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NEW PERIOD INCREASE IN THE CEPHEID S Vul

The aim of this paper is twofold:

1. To emphasize that S Vul is a Cepheid variable not a semiregular star as classified in the General Catalogue of Variable Stars (Kukarkin et al. 1969-1970).
2. To call attention to a new period increase that occurred quite recently.

The stability of the light curve can clearly be seen when comparing Fernie's (1970) observations with the recent photoelectric light curve. Fernie also suggested that S Vul should be classified as a Cepheid. As a matter of fact, the only evidence which seems to support its belonging to the semiregular stars is the shape of the light curve during two or three cycles in the visual series of observations made by Schönfeld (Valentiner, 1900). The overwhelming majority of Schönfeld's light curves are typical of a Cepheid variable as are all the other visual, photographic and photoelectric light curves.

The variable star S Vul was observed photoelectrically in the B and V colours of the Johnson system at Konkoly Observatory. The telescope used was the 24 inch reflector equipped with an unrefrigerated EMI 9502B photomultiplier. The star BD +26°3672 was used as the comparison star. Its magnitudes V = $10^{m}.10$ and B-V = $0^{m}.68$ were adopted from Fernie's (1969) paper. The observations (made in 1979 and 1980) are listed in Table 1 and shown plotted in Fig. 1. Systematic differences both in V and B-V between the average magnitudes determined by Fernie and on the basis of the present photometry can be pointed out; these differences are partly due to close companions of the comparison and of the variable stars as well as to the possibly different diameters of the diaphragm used in the two photometries.

Table 1

J.D.Hel. 2444000+	V	B-V	J.D.Hel. 2444000+	V	B-V
049.484	$9^{m}.27$	$1^{m}.73$	150.313	$8^{m}.98$	$1^{m}.47$
054.422	9.41	1.74	157.291	9.00	1.57
066.424	9.19	1.68	159.290	8.97	1.66
100.526	9.08	1.65	166.253	9.09	1.68
108.407	9.17	1.78	167.267	9.06	1.69
111.431	9.24	1.78	173.241	9.19	1.77
113.367	9.32	1.81	372.478	9.08	1.64
129.376	9.42	1.71	455.406	9.21	1.75
140.380	9.05	1.51	486.316	8.93	1.53
143.375	8.92	1.48	495.409	8.93	1.50
147.334	8.87	1.56			

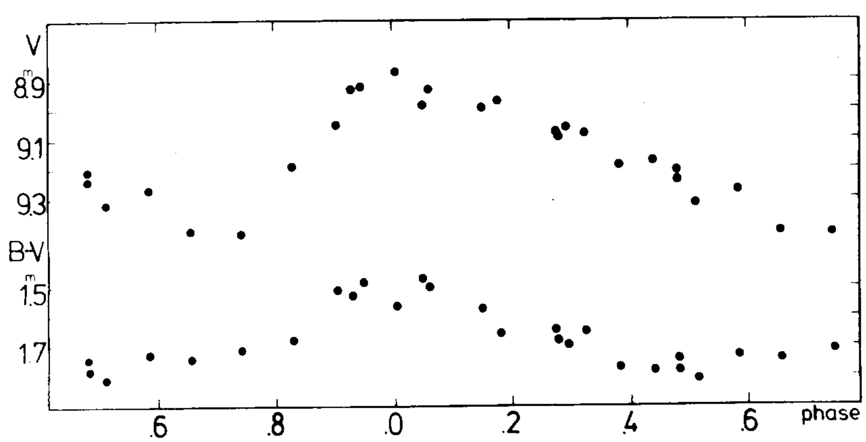

Figure 1

Although there are several papers dealing with the period changes in S Vul (Ahnert, 1948, Makarenko, 1978; Wachmann, 1966) a new O-C diagram has been constructed. In constructing this, newly determined maximum times based on the original observations of the individual observers have been used instead of the published normal maxima. When only the moments of the normal maxima were published the yearly average normal maxima were calculated. These points in the O-C diagram (see Fig. 2 and Table 2) have lower weight. The O-C diagram has a cyclic structure. The presence of a 25 year long cycle was revealed by Makarenko (1978). The new photoelectric observations support this value of the cy-

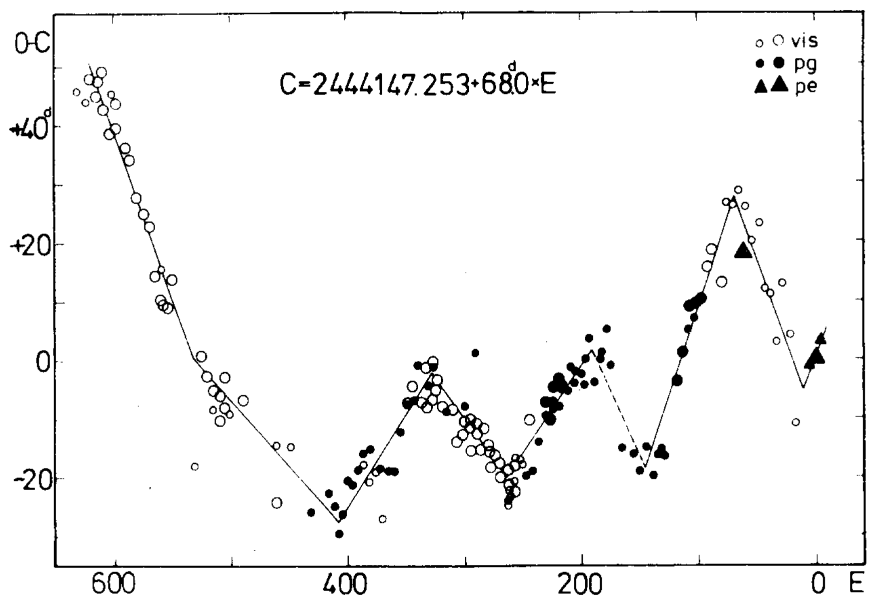

Figure 2

Table 2 The O-C residuals

J.D.Hel.	E	O-C	Type	Weight	Reference
2401353.129	-630	+45.876	vis	0.5	Turner, Blagg[1] (1917)
2401827.161	-623	+43.908	vis	0.5	Turner, Blagg[1] (1917)
2402103.238	-619	+47.985	vis	1	Turner, Blagg[1] (1917)
2402440.436	-614	+45.183	vis	1	Turner, Blagg[1] (1917)
2402510.712	-613	+47.459	vis	1	Valentiner[2] (1900)
2402784.518	-609	+49.265	vis	1	Valentiner[2] (1900)
2402846.258	-608	+43.005	vis	1	Turner, Blagg[1] (1917)
2403182.080	-603	+38.827	vis	1	Valentiner[2] (1900)
2403256.691	-602	+45.438	vis	0.5	Turner, Blagg[1] (1917)
2403522.788	-598	+39.535	vis	1	Valentiner[2] (1900)
2403527.262	-598	+44.009	vis	1	Turner, Blagg[1] (1917)
2403995.650	-591	+36.397	vis	1	Valentiner[2] (1900)
2404333.399	-586	+34.146	vis	1	Valentiner[2] (1900)
2404667.087	-581	+27.834	vis	1	Valentiner[2] (1900)
2405072.289	-575	+25.036	vis	1	Valentiner[2] (1900)
2405478.180	-569	+22.927	vis	1	Valentiner[2] (1900)
2405741.661	-565	+14.408	vis	1	Valentiner[2] (1900)
2406009.754	-561	+10.501	vis	1	Valentiner[2] (1900)
2406150.9	-559	+15.6	vis	0.5	Chandler (1877)
2406213.078	-558	+9.825	vis	1	Beljawsky[3] (1910)
2406416.470	-555	+9.217	vis	1	Zinner[4] (1932)
2406829.175	-549	+13.922	vis	1	Zinner[4] (1932)
2408021.035	-531	-18.218	vis	0.5	Turner, Blagg[1] (1917)
2408379.984	-526	+0.731	vis	1	Wilsing (1897)
2408716.424	-521	-2.829	vis	1	Wilsing (1897)

Table 2 (cont.)

J.D.Hel.	E	O-C	Type	Weight	Reference
2409051.145	-516	-8^{d}.108	vis	0.5	Wilsing (1897)
2409122.246	-515	-5.007	vis	1	Hagen (1891)
2409393.161	-511	-6.092	vis	1	Hagen (1891)
2409457.036	-510	-10.217	vis	1	Turner, Blagg[1] (1917)
2409799.189	-505	-8.064	vis	1	Turner, Blagg[1] (1917)
2409804.214	-505	-3.039	vis	1	Hagen (1891)
2410138.108	-500	-9.145	vis	0.5	Turner, Blagg[1] (1917)
2410888.287	-489	-6.966	vis	1	Hagen (1891)
2412774.986	-461	-24.267	vis	1	Parkhurst (1894)
2412784.9	-461	-14.4	vis	0.5	Hisgen (1896)
2413532	-450	-15	vis	0.5	Hisgen (1896)
2414881	-430	-26	pg	0.5	Hufnagel (1929)
2415768.4	-417	-22.9	pg	0.5	Hufnagel (1929)
2416174.4	-411	-24.9	pg	0.5	Hufnagel (1929)
2416441.9	-407	-29.4	pg	0.5	Hufnagel (1929)
2416648.9	-404	-26.4	pg	0.5	Hufnagel (1929)
2416926.6	-400	-20.7	pg	0.5	Hufnagel (1929)
2417129.9	-397	-21.4	pg	0.5	Hufnagel (1929)
2417472.4	-392	-18.9	pg	0.5	Hufnagel (1929)
2417813	-387	-18	vis	0.5	Sperra (1909)
2417815	-387	-16	pg	0.5	Hufnagel (1929)
2418150.3	-382	-21.0	vis	0.5	Sperra (1913)
2418223.9	-381	-15.4	pg	0.5	Hufnagel (1929)
2418560.0	-376	-19.3	pg	0.5	Hufnagel (1929)
2418832.6	-372	-18.7	pg	0.5	Hufnagel (1929)
2418959.843	-370	-27.310	vis	0.5	Jost (1913)
2419308.4	-365	-18.9	pg	0.5	Hufnagel (1929)
2419648.4	-360	-18.9	pg	0.5	Hufnagel (1929)
2419994.9	-355	-12.4	pg	0.5	Hufnagel (1929)
2420407.5	-349	-7.8	pg	0.5	Hufnagel (1929)
2420407.820	-349	-7.433	vis	1	Doberck (1919)
2420748.4	-344	-6.9	pg	0.5	Hufnagel (1929)
2420750.593	-344	-4.660	vis	1	Doberck (1919)
2421026	-340	-1	pg	0.5	Hufnagel (1929)
2421155.864	-338	-7.389	vis	1	Doberck (1919)
2421427.123	-334	-8.130	vis	1	Leiner (1922)
2421433.731	-334	-1.522	vis	1	Doberck (1919)
2421566.9	-332	-4.4	pg	0.5	Hufnagel (1929)
2421768.038	-329	-7.215	vis	1	Leiner (1922)
2421842	-328	-1	pg	0.5	Hufnagel (1929)
2421842.925	-328	-0.328	vis	1	Doberck (1919)
2422109.848	-324	-5.405	vis	1	Leiner (1922)
2422247.852	-322	-3.401	vis	1	Leiner (1923)
2422447.253	-319	-8.000	vis	1	Leiner (1923)
2422650	-316	-9	pg	0.5	Hufnagel (1929)
2422990.390	-311	-8.863	vis	1	Leiner (1923)
2423257.038	-307	-14.215	vis	1	Leiner (1923)
2423666.163	-301	-13.090	vis	1	Ahnert (1931)
2423736.714	-300	-10.539	vis	1	Beyer (1930)
2423739	-300	-8	pg	0.5	Hufnagel (1929)
2423941.070	-297	-10.183	vis	1	Beyer (1930)
2424071.709	-295	-15.544	vis	1	Ahnert (1931)
2424075.977	-295	-11.276	vis	1	Beyer (1930)
2424279.301	-292	-11.952	vis	1	Beyer (1930)

Table 2 (cont.)

J.D.Hel.	E	O-C	Type	Weight	Reference
2424360	-291	$+1^d$	pg	0.5	Hufnagel (1929)
2424414.689	-290	-12.564	vis	1	Beyer (1930)
2424415.584	-290	-11.669	vis	1	Ahnert (1931)
2424683.746	-286	-15.507	vis	1	Beyer (1930)
2424755.467	-285	-11.786	vis	1	Ahnert (1931)
2425092.458	-280	-14.795	vis	1	Beyer (1930)
2425156.608	-279	-18.645	vis	1	Nielsen[5] (1932)
2425159.361	-279	-15.892	vis	1	Ahnert (1931)
2425498.968	-274	-16.285	vis	1	Beyer (1930)
2425701.879	-271	-17.374	vis	1	Beyer (1930)
2425834.996	-269	-20.257	vis	1	Ahnert (1931)
2426170.4	-264	-24.9	vis	0.5	Ahnert (1948)
2426170.73	-264	-24.52	pg	0.5	Nassau, Townson (1932)
2426241.4	-263	-21.9	vis	0.5	Kukarkin (1931)
2426241.782	-263	-21.471	vis	1	Nielsen[5] (1932)
2426244.260	-263	-18.993	vis	1	Terkán (1935)
2426307.9	-262	-23.4	vis	0.5	Ahnert (1948)
2426514.4	-259	-20.9	vis	0.5	Ahnert (1948)
2426580.425	-258	-22.828	vis	1	Nielsen[5] (1932)
2426584.899	-258	-18.354	vis	1	Terkán (1935)
2426654.4	-257	-16.9	vis	0.5	Ahnert (1948)
2426858.3	-254	-17.0	vis	0.5	Ahnert (1948)
2426993.6	-252	-17.7	vis	0.5	Ahnert (1948)
2427331.7	-247	-19.6	pg	0.5	Nassau, Ashbrook (1943)
2427544.802	-244	-10.451	pvis	1	Azhusenis (1956)
2427672.4	-242	-18.9	pg	0.5	Nassau, Ashbrook (1943)
2428017.3	-237	-14.0	pg	0.5	Nassau, Ashbrook (1943)
2428363.673	-232	-7.580	pg	1	Azhusenis (1956)
2428429.9	-231	-9.4	pg	0.5	Nassau, Ashbrook (1943)
2428432.3	-231	-6.9	pg	0.5	Ahnert (1948)
2428633.142	-228	-10.111	pg	1	Azhusenis (1956)
2428703.4	-227	-7.9	pg	0.5	Ahnert (1948)
2428840.4	-225	-6.9	pg	0.5	Ahnert (1948)
2428842.592	-225	-4.661	pg	1	Azhusenis (1956)
2428974.8	-223	-8.5	pg	0.5	Nassau, Ashbrook (1943)
2429114.4	-221	-4.9	pg	0.5	Ahnert (1948)
2429115.985	-221	-3.268	pg	1	Azhusenis (1956)
2429247.4	-219	-7.9	pg	0.5	Ahnert (1948)
2429455.0	-216	-4.3	pg	0.5	Ahnert (1948)
2429522.4	-215	-4.9	pg	0.5	Nassau, Ashbrook (1943)
2429793.9	-211	-5.4	pg	0.5	Ahnert (1948)
2429934.0	-209	-1.3	pg	0.5	Ahnert (1948)
2430135	-206	-4	pg	0.5	Nassau, Ashbrook (1943)
2430205.3	-205	-2.0	pg	0.5	Ahnert (1948)
2430544.9	-200	-2.4	pg	0.5	Ahnert (1948)
2430678.9	-198	-4.4	pg	0.5	Ahnert (1948)
2430819	-196	0	pg	0.5	Ahnert (1948)
2431026.9	-193	+3.6	pg	0.5	Ahnert (1948)
2431291	-189	-4	pg	0.5	Ahnert (1948)
2431635.4	-184	+0.1	pg	0.5	Ahnert (1948)
2431772.4	-182	+1.1	pg	0.5	Ahnert (1948)
2432048.4	-178	+5.1	pg	0.5	Ahnert (1948)
2432178.0	-176	-1.3	pg	0.5	Ahnert (1948)
2432844.0	-166	-15.3	pg	0.5	Wachmann (1966)

Table 2 (cont.)

J.D.Hel.	E	O-C	Type	Weight	Reference
2433523	-156	-16^{d}	pg	0.5	Wachmann (1966)
2433928	-150	-19	pg	0.5	Wachmann (1966)
2434204.4	-146	-14.9	pg	0.5	Wachmann (1966)
2434675.4	-139	-19.9	pg	0.5	Wachmann (1966)
2435018.9	-134	-16.4	pg	0.5	Wachmann (1966)
2435155.9	-132	-15.4	pg	0.5	Wachmann (1966)
2435358.7	-129	-16.6	pg	0.5	Wachmann (1966)
2436119.506	-118	-3.747	pg	1	Chuprina (1968)
2436464.413	-113	+1.160	pg	1	Chuprina (1968)
2436808	-108	+5	pg	0.5	Wachmann (1966)
2436811.936	-108	+8.683	pg	1	Chuprina (1968)
2437150	-103	+7	pg	0.5	Wachmann (1966)
2437152.576	-103	+9.323	pg	1	Chuprina (1968)
2437493.422	-98	+10.169	pg	1	Chuprina (1968)
2437906	-92	+15	pg	0.5	Wachmann (1966)
2437906.746	-92	+15.493	pg	1	Chuprina (1968)
2438249.795	-87	+18.542	pg	1	Chuprina (1968)
2438652.244	-81	+12.991	pvis	1	Chuprina (1968)
2439006.9	-76	+26.6	pvis	0.5	Makarenko (1978)
2439345.7	-71	+26.4	pvis	0.5	Makarenko (1978)
2439755.9	-65	+28.6	pvis	0.5	Makarenko (1978)
2440017.349	-61	+18.096	pe	3	Fernie (1970)
2440093.5	-60	+26.2	pvis	0.5	Makarenko (1978)
2440495.4	-54	+20.1	pvis	0.5	Makarenko (1978)
2440906.4	-48	+23.1	pvis	0.5	Makarenko (1978)
2441235.4	-43	+12.1	pvis	0.5	Makarenko (1978)
2441506.6	-39	+11.3	pvis	0.5	Makarenko (1978)
2441906	-33	+3	pvis	0.5	Makarenko (1978)
2442256	-28	+13	pvis	0.5	Makarenko (1978)
2442655.4	-22	+4.1	pvis	0.5	Makarenko (1978)
2442980	-17	-11	pvis	0.5	Makarenko (1978)
2443738.161	-6	-1.092	pe	1	Turner (1980)
2444147.253	0	0.000	pe	3	present paper
2444422.573	+4	+3.320	pe	2	present paper

Remarks: [1] Observer: Baxendell, [2] Obs.: Schönfeld, [3] Obs.: Glasenapp, [4] Obs.: Hartwig, [5] Obs.: Möller Nicolaisen and Pedersen

Table 3

Interval	P
E<-532	$67^{d}.379$
-532<E<-408	67.804
-408<E<-331	68.299
-331<E<-264	67.764
-264<E<-190	68.298
-190<E<-143	67.511
-143<E< -73	68.672
-73<E< -11	67.496
-11<E	68.464

cle length since a new period increase took place at about J.D. 2443000. The value of the instantaneous period is about $68^{d}.5$. The values of the period for the earlier intervals (see Table 3) are essentially the same as determined by Wachmann (1966).

Further observations of S Vul are planned at Konkoly Observatory.

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PHOTOGRAPHIC OBSERVATIONS OF 1980 ECLIPSE OF CI CYGNI

Photographs were taken with two cameras, focal lengths 50 and 130 cm, with two emulsions, Tri X and 103a-O. The former was exposed with the yellow-green filter which gives the brightness very close to visual magnitude.

The results between J.D. 2444300 and 4500 are shown in Fig. 1, in which the upper curve is photovisual and the lower curve is photographic.

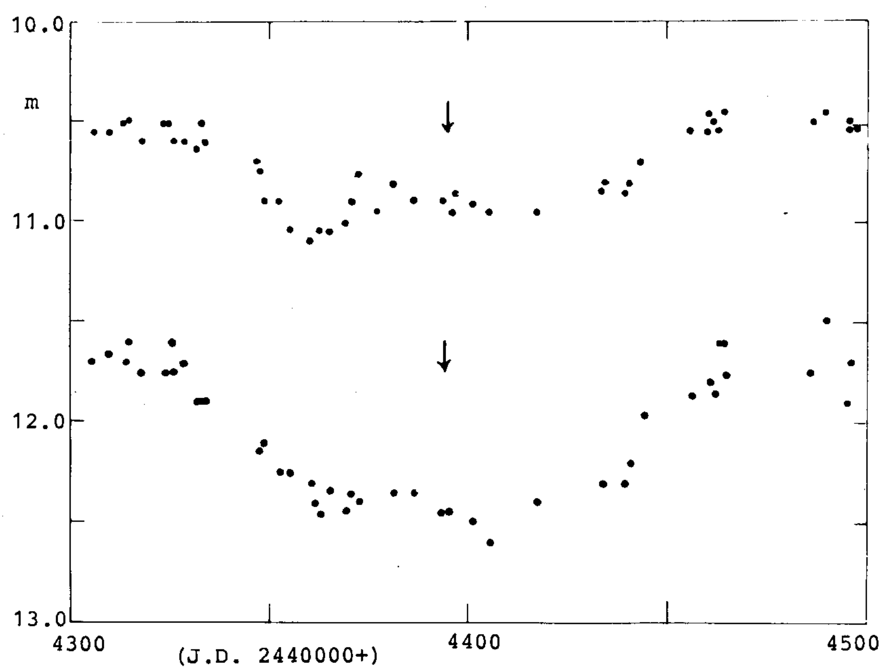

Fig.1. m_{pv}(upper) and m_{pg}(lower) light curves of CI Cyg. Arrows are estimated dates of minimum.

The depth of the minimum was very shallow compared with the previous minima, being only $0\overset{m}{.}4$ in visual region and $0\overset{m}{.}7$ in photographic region, probably because the eclipse occurred when the hot component was near the faintest stage. The minimum magnitudes in both regions are in good agreement with the 1975 and 1977-78 eclipses observed by Belyakina (1976, 1979).

The times of middle of eclipse are estimated and shown by arrows in the Figure. They are on J.D. 2444395 for photovisual curve, and 4394 for photographic curve. Together with the observations by Belyakina in the last two minima, the period 855^d seems to be fairly correct. From the present observations, D and d were estimated as 133^d and 72^d respectively, though the estimations were not less difficult due to the irregular variations of short period throughout the eclipse.

The detailed results will be published elsewhere.

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References:

Belyakina, T.S., 1976, I.B.V.S. No. 1169
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FLARE ACTIVITY OF V914 Sco

V914 Sco (= CSV2851) was shown to be a BY Dra-type variable (Busko, Quast and Torres, 1977), with a B amplitude of about 0.15 mag and probable period of 2.69 days. Herbig (1977) called attention to its duplicity, quoting an M3eV spectral type for the brighter component and M4eV for the fainter one. We estimated, based on photoelectric scans with small diaphragm, a difference of about 2 mag in the visual for the two components.

In 4 nights between April and June 1980, the star was monitored photoelectrically in the U band with the 1.6m telescope of Brazilian Astrophysical Observatory. A photometer with DC strip chart recording was used. Both components of the pair were included in the diaphragm.

Following the precepts of Kunkel (1973), flare light was referred not to the quiescent state of the star, which is poorly determined in ultraviolet, but to suitable comparison stars. The rate of occurrence of flares of peak magnitude less than U can be described by $R = \exp(U-U_o)$, with the parameter U_o being a measure of the level of flare activity.

Table I - Coverage

JD 2444000+	U.T. From - To
352.5	$6^h16^m.0$ - $7^h27^m.0$, $7^h28^m.4$ - $8^h\ 0^m.4$
358.5	5 22.0 - 5 49.0, 5 50.1 - 6 30.3, $6^h50^m.5$ - $7^h02^m.1$,
	7 04.4 - 7 23.2, 7 24.6 - 7 38.0, 7 39.8 - 8 03.2,
	8 04.5 - 8 16.9, 8 18.3 - 8 22.0
365.5	4 41.2 - 5 01.8, 5 02.8 - 5 53.2, 5 54.3 - 6 15.5,
	6 16.7 - 6 56.5, 6 57.6 - 8 00.2
380.5	3 53.3 - 3 57.0, 4 00.0 - 4 14.0, 4 15.5 - 4 46.6,
	4 47.8 - 5 10.2, 5 11.3 - 5 25.5, 5 26.5 - 6 05.3

In a total coverage time of 9.54 hours, 28 events with $U_{peak}<16.5$ were observed. Tables I and II summarize the data. The meaning of the symbols is the same as in Busko and Torres (1976). A value of U_o = 14.6 ± 0.2 can be derived from this sample, using only the events above the completeness threshold U_{faint} = 15.2 (Figure 1).

There is no published trigonometric parallax for this star. If we adopt a distance modulus of 0.5 mag supposing it to be a main sequence star, we obtain an absolute value for the activity $M_{u,o}$ = 14.1.

Table II - Event Data

JD 2444000+	Sec z	U	$T_{0.5}$ (min)	$T_{0.2}$ (min)	Obs
352.765	1.048	13.86	.65		
.800	1.088	13.39	.40	4.u	
.772	1.053	15.72u	1.u		L
.814	1.116	15.49u	1.u		L
358.733	1.043	15.07	2.1		
.740	1.045	15.58	3.3u		
.746	1.047	14.33	.20	1.3	
.751	1.049	15.26	.16		
.756	1.053	15.96u	.15u		L
.762	1.059	13.94	.54		I
.789	1.098	16.44u	.7u		L
.826	1.200	14.94	.90		
.830	1.217	15.93	.36		
.825	1.197	14.91	1.28		
365.699	1.045	12.75	1.32	5.12	
.708	1.043	15.76	.4u		L
.720	1.044	14.35	2.8u		
.76u	1.074	15.44			L
.776	1.111	13.17	1.5		
.789	1.141	16.03u	3.1u		L
.806	1.198	14.87	.50		
.808	1.205	14.19	.20		
.813	1.223	15.43	1.4u		I
.819	1.250	15.05	> .90		I
.824	1.272	14.97	1.40		
380.667	1.043	15.93u	>2.1		I
.673	1.043	16.46	3.1		
.709	1.066	13.61	3.0	5.6	D

Even if we assume that the activity is equally divided between the two components, this would be a high activity at this spec-

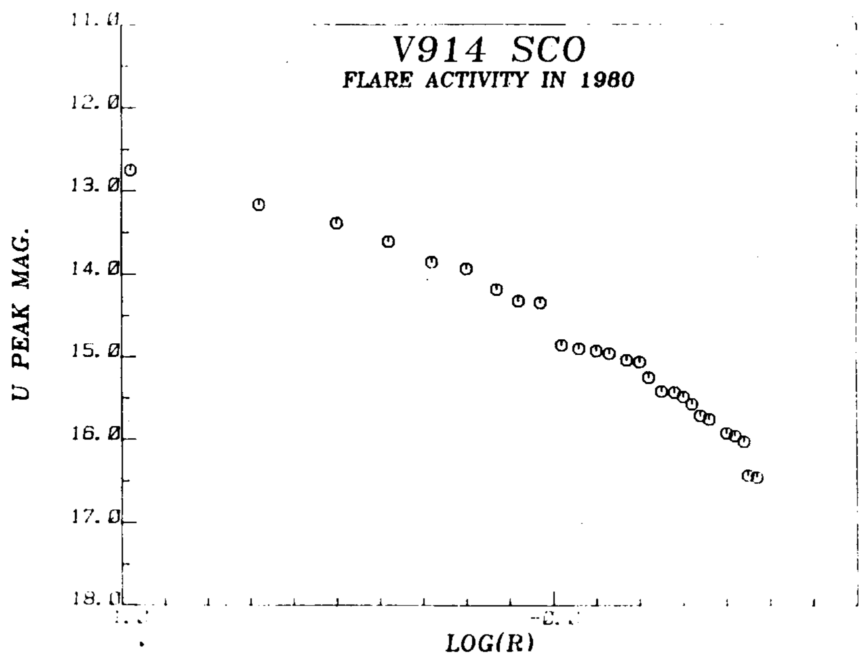

Figure 1: Cumulative rate of occurrence (in hr^{-1}) of flares brighter than magnitude U in V914 Sco.

tral type, although the activity of BY Dra stars is in general high (Busko and Torres, 1978). Such a high activity has been found only in Gliese 182 (de la Reza, Torres and Busko, 1981).

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VYSS 124 AS A BY Dra VARIABLE

The star Vyss 124 (AC +22°214-129, Yale 2399.1) was included in the search program on red dwarfs of the I.T.A. Astronomical Observatory (Ferraz-Mello, S. and Torres, C.A.O., 1971) due to its hydrogen emission lines (Bidelmann, W.P., 1954). It was observed photoelectrically in B and V colours in 14 different nights against two comparison stars (BD +21°2173 and BD +20°2457). At that time we found a rather large dispersion in the data.

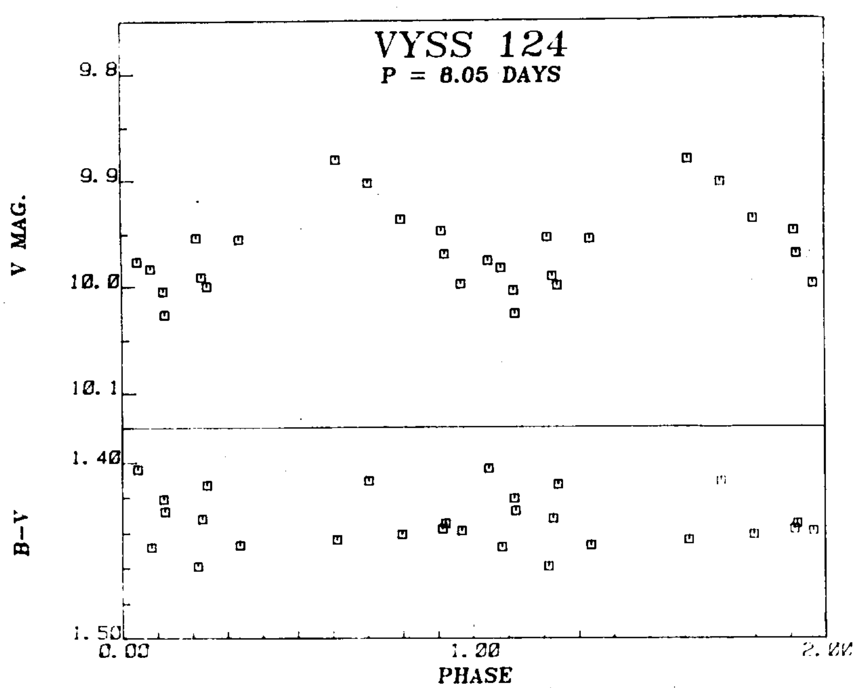

Figure 1: Light curve of Vyss 124

We now reanalysed the data and used more refined period search techniques. In both colours, and against both comparison stars there appears a variation with a period of 8.05 days. Fig.1 shows the light curve using the first comparison star; it can be seen that the amplitude is on the order of 0.1 mag. We note that with a period of 8.05 days this star will be one of the slowest BY Dra variables and it therefore deserves more attention. Nevertheless, an inspection of Fig. 1 shows that the points are not well distributed in phase, so more observations are needed.

Our adopted magnitudes and colour indices for the comparison stars were:

BD +21°2173	$V = 9^{m}.35$	$B-V = 1^{m}.17$
BD +20°2457	$V = 9.57$	$B-V = 1.35$

Eggen (1968) published photometric observations of Vyss 124 (V = 10.20, B-V = 1.365) which are fainter and bluer compared with our results. The spectral classification of Joy and Abt (1974) is dM0e, which is compatible with both measures. Gliese and Jahreiss (1979) use Eggen's values to estimate a distance of 20 pc. Our results may imply that the star is nearer.

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References:

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Gliese, W. and Jahreiss, H., 1979, Astron. Astrophys. Suppl. 38,423
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PHOTOELECTRIC MINIMA OF THE ECLIPSING BINARY DM PERSEI

The eclipsing binary DM Per (BD $+55^{\circ}616$, HD 14871) was observed photoelectrically at Ege University Observatory and three primary and three secondary minima were obtained. The observations were made in B, V filters with the 48 cm Cassegrain telescope equipped with an unrefrigerated EMI 9781 A photomultiplier.

BD $+55^{\circ}590$ (HD 14331) was used as comparison star.

The (O-C) values were calculated with the following elements given by Scaltriti (1976):

$$\text{MinI (Hel)} = 2441920.4543 + 2\overset{d}{.}7277427 \cdot E$$

Table I

Times of minima

Min. (Hel.)	O-C	Filter	Min.
2444491.3405	-0.0113	B,V	II
499.5237	-0.0113	B,V	II
506.3519	-0.0025	B,V	I
510.4348	-0.0112	B,V	II
517.2671	+0.0018	B,V	I
566.3676	+0.0029	B,V	I

An interesting feature observed during the observations of primary minima was the variable depth. The level of light obtained on November 22, 1980 was about $0\overset{m}{.}03$ brighter than those obtained on September 23, and October 4, 1980.

Another remarkable feature is that the mid-primary does not show any shift while a noticeable displacement of mid-secondary can be seen from the (O-C) values given in Table I. This could be due to the eccentricity of the orbit of the system.

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Scaltriti, F., 1976, Astron. Astrophys. Suppl. 25,291

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DETERMINATIONS OF SIX TIMES OF MINIMA, AND A NEW EPHEMERIS FOR BS Dra

During a recent investigation of the photometric orbit of BS Dra by Popper and Etzel[1], it became necessary to redetermine the ephemeris of the system. The B, V observations used in the determinations of the six additional times of minima given here were described by Popper and Dumont.[2] These determinations were then combined with all previous ones known at the time to derive the new ephemerides given below.

The determinations of the times of minima made use of the symmetry of the eclipses to determine the temporal mean of the ascending and descending branches in a manner very similar to the method of Hertzsprung.[3] Observations on the steeper portions of the curve were reflected onto the opposite branch by linear interpolation to give a time of minimum for each observation. The mean of all these gave the time of minimum determination, along with an estimate of the uncertainty. This method was automated by computer programming to allow flexibility. It was found to be a superior method compared to polynomial fitting of the observations within the minima. Such a method, using third-order polynomials, was proposed by Breinhorst et al.[4] for use with asymmetric light curves. Whereas the results of the simple temporal averaging were fairly insensitive to the selection of observations for a given eclipse, the polynomial fitting was sensitive both to the distribution of the observations and to the order of the polynomial. Polynomial orders of two to five were used in the tests. Similar problems with polynomial fitting, and other such methods, were reported by Van Diest[16] in connection with asymmetric minima. Table I lists the results of the determinations for six observed minima.

Table I

Mean B & V Determinations of Times of Minima for BS Dra
From the Observations of Popper and Dumont[2]

Date U.T.	Minima P/S	No. Obs. V/B	HJD (obs) +2400000	s.e.
13 Jul 72	P	35/31	41511.8842	±.0006
18 Jul 72	S	16/16	41516.9311	±.0007
14 Aug 72	S	42/41	41543.8428	±.0005
19 Aug 72	P	12/15	41548.8891	±.0005
1 Jun 73	P	52/52	41834.8302	±.0004
22 Oct 73	S	15/17	41977.8009	±.0006

A search of the literature available at the time when the investigation by Popper and Etzel was commencing yielded 36 other determinations of times of minima. These, along with the determinations from Table I, are given in Table II. Also given are the epoch and O-C (computed from the adopted ephemeris), the weight and type of determination, and the reference(s). Unit weights were generally assigned to photoelectric (pe) determinations in one filter, double weights to the average of two-color photoelectric determinations, weights of 0.2 to visual estimates (vis), and 0.1 to photographic values (pg). Some photographic determinations were rejected due to their obviously poor quality, but the remaining ones did improve the period derived from using the photoelectric observations alone.

Table II

Ephemeris Solution for BS Dra -- All Determinations
Assuming $J.D._{min}$ = 2,441,461.4245 + 3.3640103 E

HJD (obs) +2400000	Epoch	O - C	wt.	Method	ref.
26444.467	-4464.0	-.016	0.1	pg	5
26942.369	-4316.0	.013	0.1	pg	5
26942.390	-4316.0	.034	0.0	pg	5
26942.408	-4316.0	.052	0.0	pg	5
27216.522	-4234.5	-.001	0.1	pg	5
27312.396	-4206.0	-.001	0.1	pg	5
28020.522	-3995.5	.001	0.1	pg	5
28782.422	-3769.0	-.048	0.0	pg	5
28809.373	-3761.0	-.009	0.1	pg	5
29911.460	-3671.5	-.001	0.1	pg	5
29438.467	-3574.0	.015	0.1	pg	5
36420.422	-1498.5	-.033	0.0	pg	5
36452.368	-1489.0	-.045	0.0	pg	5
41392.452	- 20.5	-.010	0.2	vis	6
41461.4252	0.0	.0007	2.0	pe	7, 8
41471.5163	3.0	-.0003	1.0	pe	7, 8
41471.5166	3.0	.0000	1.0	pe	7, 8
41488.3335	8.0	-.0031	1.0	pe	7, 8
41488.3345	8.0	-.0021	1.0	pe	7, 8

Table II (Continued)

HJD (obs) +2400000	Epoch	O - C	wt.	Method	ref.
41493.3817	9.5	-.0009	1.0	pe	7, 8
41493.3838	9.5	.0012	1.0	pe	7, 8
41498.4290	11.0	.0004	1.0	pe	9
41508.5199	14.0	-.0008	1.0	pe	9
41511.8842	15.0	-.0005	2.0	pe	This study
41516.9311	16.5	.0004	2.0	pe	This study
41543.8428	24.5	.0000	2.0	pe	This study
41548.8891	26.0	.0003	2.0	pe	This study
41594.3040	39.5	.0011	1.0	pe	7
41631.3123	50.5	.0052	1.0	pe	9
41772.5934	92.5	-.0021	1.0	pe	9
41794.4600	99.0	-.0016	1.0	pe	9
41826.4196	108.5	.0000	1.0	pe	7, 8
41834.8302	111.0	.0005	2.0	pe	This study
41977.8009	153.5	.0008	2.0	pe	This study
42302.4277	250.0	.0006	1.0	pe	8, 10
42302.4280	250.0	.0009	1.0	pe	8, 10
42371.3907	270.5	.0014	1.0	pe	10
42435.312	289.5	.006	0.2	vis	11
42529.491	317.5	-.007	0.2	vis	12
42958.405	445.0	-.004	0.2	vis	13
42990.368	454.5	.001	0.2	vis	14
43059.321	475.0	-.008	0.2	vis	15

It was initially assumed that the separations of the minima were exactly $0^{P}.5$ from individual preliminary ephemeris solutions on the primary and secondary eclipses. The subsequent analysis by Popper and Etzel showed $e \cos \omega$ to be less than 0.0001 and there is also no significant difference in the average weighted O-C for the two minima.

The adopted ephemeris and standard errors for the 42 determinations in Table II are:

$$J.D._{min} = \underset{\pm.0004}{2,441,461.4245} + \underset{\pm.0000006}{3.3640103}\,E,$$

with the standard error of one minimum of normalized unit weight being 0.0025 days, which is a slightly shorter period than found by Ibanoglu et al.[8] A solution setting all photoelectric determinations equal to unit weight, regardless of the number of colors used for a single quoted value, gave the same solution. A test solution using only the 23 photoelectric determinations yielded the ephemeris

$$J.D._{min} = \underset{\pm.0004}{2,441,461.4244} + \underset{\pm.0000038}{3.3640144}\,E,$$

with a standard error of 0.0014 days, which is essentially identical to that found by Ibanoglu et al. The difference between the two values of the period illustrates the value of including earlier low-weight photographic determinations for improving the period. It is noteworthy to point out the usefulness of visual determinations even in this mechanized era of astronomy.

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