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PERIOD CHANGES IN DWARF CEPHEIDS, II
YZ BOOTIS, XX CYGNI AND DY HERCULIS

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ABSTRACT

The period changes in the dwarf cepheids YZ Boo, XX Cyg and DY Her are discussed and O-C diagrams of these stars are constructed. The period of XX Cyg changed abruptly in 1942 ($\Delta P = +87 \times 10^{-9}$ day $= +0.0075$ sec). Besides the sudden increase of the period, it has also shown small fluctuations. With regard to YZ Boo there may be a slight continuous increase (at a rate $\beta = +10.6 \times 10^{-13}$ day cycle^{-1} $= +3.2 \times 10^{-2}$ sec century^{-1}) in its period. The period of DY Her has shown a definite continuous decrease at a rate $\beta = -37.2 \times 10^{-13}$ day cycle^{-1} $= -7.9 \times 10^{-2}$ sec century^{-1} during the time interval covered by photoelectric observations (1951-1979).

INTRODUCTION

As a continuation of our previous work (*Mahdy* and *Szeidl*, 1980) we publish here our results on the period changes in the dwarf cepheids YZ Boo, XX Cyg and DY Her. A description of the equipment used both for our photographic and our photoelectric observations can be found in several publications of the Konkoly Observatory (see e.g. *Olah* and *Szeidl*, 1978).

The observations presented here represent the work of the staff of Konkoly Observatory. The photographic plates were obtained by *Dr. Julia Balazs* (2 plates, 40 exp.), *Mr. D.Elter* (2 plates, 36 exp.), *Mr. K.Gefferth* (1 plate, 11 exp.) and *Mr. S. Horvath* (1 plate, 17 exp.). The table below summarizes the photoelectric observations of all observers concerned.

Table 1

Observer	YZ Boo	XX Cyg	DY Her	Total
L. Csank	427	126	-	553
L. Detre	60	175	-	235
M. Lovas	24	-	-	24
K. Olah	95	-	-	95
G. Paal	233	36	-	269
P. Sarkany	71	-	-	71
L. Szabados	101	-	-	101
B. Szeidl	261	349	224	834
Total	1272	686	224	2182

All the available observations on each star are discussed separately. We constructed the O–C diagrams using only photographic and photoelectric observations, and then by making use of the diagrams we studied the period changes of YZ Boo, XX Cyg and DY Her.

YZ BOOTIS

The variability of the star YZ Boo = BD +37°2635 = S 4768 = CSV 2335 was discovered by *Hoffmeister* (1949) at Sonneberg Observatory. He reported a light variation of one magnitude by estimating the Sonneberg sky-patrol plates. *Eggen* (1955) observed the star photoelectrically at Lick Observatory in 1955 and found it to vary in light with a period near 2 1/2 hours. He obtained 32 photoelectric observations without filters but did not give any epoch of maximum. Nevertheless two epochs could be determined in his figure.

Tsesevich (1958, 1966), using old Moscow and Odessa sky-patrol plates, determined two photographic epochs for the years 1939 and 1954. He also made some visual observations in 1957. In his book (*Tsesevich*, 1966) he also published some visual epochs of maximum observed by *Migach* and *Sacharov*.

Broglia and *Masani* (1957) carried out extensive photoelectric photometry of the star. During five nights in 1956 they obtained 95 blue and 97 yellow observations. They deduced 6 epochs of maximum and arrived at a period of 0.104 113 8 day. They found some evidence of the variations of the light curve from cycle to cycle even though their data cover only about 6 cycles out of a possible 105 in an 11 day interval.

In the fifties *Spinrad* (1959) made a detailed investigation of RR Lyrae stars. YZ Boo was also included in the programme and he collected 32 yellow and 31 blue photoelectric observations of this star during three nights. *Spinrad* also found some evidence for light curve variation, but the amplitude variation was less than 0.1 mag in blue.

Ahnert (1959) and *Strelkova* (1960, 1964) observed the star visually and obtained six maxima in 1959 and one maximum in 1958, respectively.

The first systematic photographic photometry of the star was carried out by *Tremko* and *Antal* (1959) at Skalnate Pleso Observatory in 1959. Based on their 162 photographic magnitudes they gave five epochs of maximum light and determined a period of 0.104 001 91 day.

In 1960 *Broglia* (1961) secured 189 blue observations of the variable at Merate Observatory and obtained six new epochs of maximum. Combining these new maxima with the old ones he was able to determine a highly accurate value of the period of YZ Boo: 0.104 091 543 day.

Heiser and *Hardie* (1964) obtained a total of 216 photoelectric observations on the UBV system. They found that the ascending branches of the light curve and the amplitudes were relatively repetitive but the descending branch might be subject to small changes from cycle to cycle. Near the 0.2 phase they detected undoubtedly real variations among various cycles. They also carried out a detailed investigation of the colour variation of the variable at different phases of light variation.

Fitch et al. (1966) obtained 48 UBV observations in 1964; these observations also provided an opportunity to determine the accurate photometric characteristics of the star and a new epoch of maximum.

Gieren et al. (1974) carried out photoelectric UBV photometry of the star on one night in 1974. They observed three consecutive cycles and found distinct changes in shape and amplitude of the light curve and mean luminosity of the variable. Since *Gieren* et al. did not investigate the constancy of the comparison star they used, some doubts arise in connection with the light curve changes (especially with the change in mean luminosity). They used all available photoelectric data and found the improved period: 0.104 091 56 day.

At Konkoly Observatory we commenced to observe YZ Boo in two colours in 1959. Since that time we have obtained 628 yellow and 644 blue observations. These are transformed to the international UBV system and are given in Tables 8 and 9, respectively, in the sense variable minus comparison. As comparison star we used BD +37°2634 (9.0). On two fairly poor nights we made tie-in observations of this star into the UBV system and obtained the magnitude and colour: V = $10\overset{m}{.}14$ and B-V = $0\overset{m}{.}60$.

The comparison star mostly used by others was BD +37°2639 for which *Spinrad* (1959) determined the following visual brightness and colour: V = $9\overset{m}{.}02$ and B-V = $1\overset{m}{.}38$.

The light curves obtained at Konkoly Observatory in the years 1959, 1973 1974, 1975 and 1979 show slight differences which can be ascribed to the observational errors and uncertainties in the transformation to the international system. The fairly large scatter of the observations in 1959, however, indicates that some real light curve variation may be present among the different cycles. It may well be worth trying to subject the homogeneous 1959 data to a careful period analysis in order to search for a beat period. In Figure 1 we plotted the 1959 data according to phase.

In Table 2 we have gathered all reliable data available to us pertaining to times of maximum brightness except the visual observations. Because of the large errors in the visual epochs of maximum we have simply ignored them. We used only the yearly means of those photoelectric maxima that are certain when carrying out a least-squares solution for the period. The resulting linear ephemeris is:

$$\text{Max. hel.} = \text{J.D. } 2442\ 146.3544 + 0.104\ 091\ 551 \cdot E$$
$$\pm.0003 \qquad\qquad \pm 6$$

or if we take into account the quadratic term, as well:

$$\text{Max. hel.} = \text{J.D. } 2442\ 146.3543 + 0^{d}.104\ 091\ 580 \cdot E + 5^{d}.3 \times 10^{-13} E^2.$$
$$\pm.0002 \qquad\qquad \pm 14 \qquad \pm 2.6$$

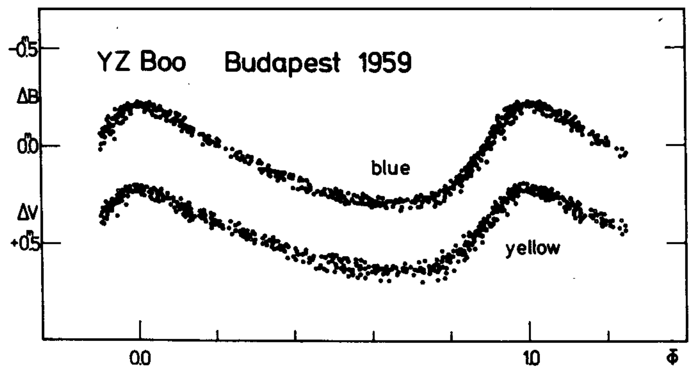

Figure 1: ΔV and ΔB observations of YZ Boo made in the year 1959, plotted against phase

It appears from the photoelectric works of *Eggen* (1955), *Broglia* and *Masani* (1957), *Spinrad* (1959), *Broglia* (1961), *Heiser* and *Hardie* (1964), *Fitch* et al. (1966), *Gieren* et al. (1974) and ourselves that the times of maximum recur periodically within the accuracy of measurements (about ±0.0015 day). Nevertheless, a slight continuous increase of the period (10.6×10^{-13} day/cycle) may have taken place in the interval 1955–1979. Further photoelectric observations will enable a decision to be made on the constancy of or the increase in the period.

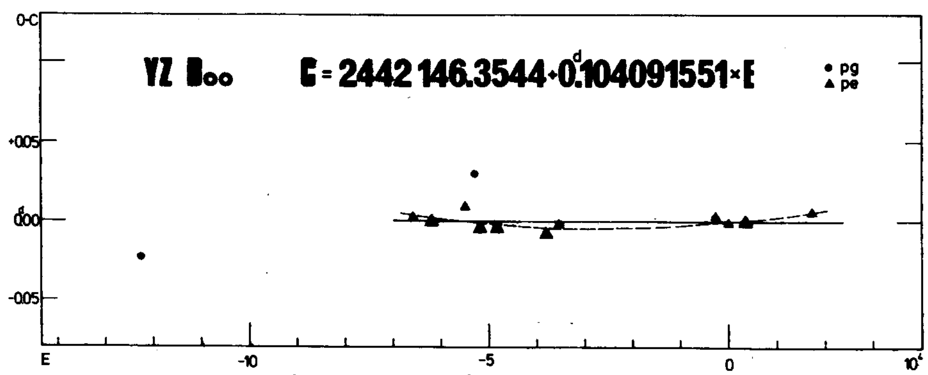

Figure 2: O–C diagram of YZ Boo

Table 2

Photographic and photoelectric maxima of YZ Boo

year	J.D.max.hel.	Remarks		O–C	E	$\overline{O-C}$	$\overline{E}$	n
1939	2429403.3603	pg	Ts	−0.0023	−122421	−0.0023	−122421	1
1954	(34926.3665:	pg	Ts	+0.0103:	− 69362)			
1955	35282.766	pe	Eg[1]	+0.0003	− 65938	+0.0002	− 65937	2
	.870	pe	Eg[1]	+0.0002	− 65937			
1956	35688.4090	pe	BM	−0.0015	− 62041	−0.0001	− 61993	5
	35689.4497	pe	BM	−0.0017	− 62031			
	35695.3862	pe	BM	+0.0016	− 61974			
	.4900	pe	BM	+0.0013	− 61973			
	35698.4032	pe	BM	−0.0001	− 61945			
	(35699.341:	pe	BM	+0.0009:	− 61936)			
1958	36428.8140	pe	Sp	+0.0003	− 54928	+0.0009	− 54923	2
	36429.7520	pe	Sp	+0.0015	− 54919			
1959	36603.4867	pg	TA	+0.0074	− 53250	+0.0030	− 53210	5
	36606.4985	pg	TA	+0.0005	− 53221			
	36607.4397	pg	TA	+0.0049	− 53212			
	.5403	pg	TA	+0.0014	− 53211			
	36613.4727	pg	TA	+0.0006	− 53154			
	36709.5510	pe	Pp	+0.0024	− 52231	−0.0005	− 52148	13
	36712.4634	pe	Pp	+0.0002	− 52203			
	36713.3985	pe	Pp	−0.0015	− 52194			
	.5031	pe	Pp	−0.0010	− 52193			
	36714.4389	pe	Pp	−0.0020	− 52184			
	36716.4174	pe	Pp	−0.0012	− 52165			
	.5222	pe	Pp	−0.0005	− 52164			
	36717.3545	pe	Pp	−0.0010	− 52156			
	36723.4963	pe	Pp	−0.0006	− 52097			
	36724.4332	pe	Pp	−0.0005	− 52088			
	.5380	pe	Pp	+0.0002	− 52087			
	36725.3701	pe	Pp	−0.0004	− 52079			
	.4733	pe	Pp	−0.0013	− 52078			
1960	37077.5112	pe	Br	−0.0010	− 48696	−0.0005	− 48376	5
	37098.4340	pe	Br	−0.0006	− 48495			
	37120.3975	pe	Br	−0.0005	− 48284			
	.5010	pe	Br	−0.0010	− 48283			
	37137.3654	pe	Br	+0.0005	− 48121			
	(37168.385:	pe	Br	+0.0008:	− 47823)			
1963	38206.6955	pe	HH	−0.0019	− 37848	−0.0009	− 37785	4
	38209.8200	pe	HH	−0.0001	− 37818			
	38214.7130	pe	HH	+0.0006	− 37771			
	38221.6845	pe	HH	−0.0021	− 37704			
1964	38466.9260	pe	FA	−0.0003	− 35348	−0.0003	− 35348	1
1973	41860.4151	pe	Pp	+0.0002	− 2747	+0.0002	− 2747	1
1974	42146.3546	pe	GA	+0.0002	0	−0.0002	+ 197	2
	(42183.4164	pg	Bu	+0.0054	+ 356)			
	42187.4700	pe	Pp	−0.0006	+ 395			
1975	42464.5624	pe	Pp	+0.0001	+ 3057	−0.0001	+ 3338	4
	.6666	pe	Pp	+0.0002	+ 3058			
	42522.4374	pe	Pp	+0.0002	+ 3613			
	42523.4772	pe	Pp	−0.0009	+ 3623			
1979	43936.6255	pe	Pp	+0.0005	+ 17199	+0.0005	+ 17199	1

Remarks to Table 2: pg = photographic; pe = photoelectric; Ts = Tsesevich (1958, 1966); Eg = Eggen (1955); BM = Broglia and Masani (1957); Sp = Spinrad (1959); TA = Tremko and Antal (1959); Br = Broglia (1961); HH = Heiser and Hardie (1964); FA = Fitch et al. (1966); GA = Gieren et al. (1974); Bu = Busch (1976); Pp = Present paper; [1] = epoch determined by us

Unfortunately, not only do the visual observations usually have large errors but the photographic ones, too. *Tremko*'s and *Antal*'s (1959) careful photographic work shows that the accuracy of the photographic maximum is, at best, about 0.005 day. It may, however, exceed 0.01 day in an average case (see, for example, the maximum determined by *Tsesevich*, 1958, from the Odessa photographic material for the year 1954). In view of this, we should not attribute too much weight to the early photographic maximum obtained from the Moscow plate material. We cannot, however, preclude the possibility of a sine wave-like O-C diagram, i.e. a long-term periodic change in the period of YZ Boo.

XX CYGNI

The variability of this star was announced by *Ceraski* (1904) who stated that the range of light variation was from 10.7 to 11.6 magnitude, the period about 3.2 hours, and the light curve resembled the "cluster variables". The star received the preliminary designation 14.1904.

Shortly after the discovery of the light variation of XX Cygni its visual observations were commenced. Between 1904 and 1911 more than 2600 visual estimations had been obtained and almost 150 visual epochs of light maximum were deduced from these observations. *Schwab* (1906) gave a period of 0.134 859 day and found the light maximum and minimum to be fairly constant. *Graff* (1906) obtained a slightly shorter period: 0.134 846 day. *Blazhko* (1906) using his own visual observations of the years 1904, 1905 and 1906 arrived at the elements:

$$\text{Max. hel.} = \text{J.D. } 2416\ 563.411 + 0^{d}.134\ 864\ 3 \cdot E.$$

He found that light curve variation was present. *Luizet* (1908) and *Nijland* (1911) made further visual observations and gave the values of the period: 0.134 864 5 day and 0.134 865 0 day, respectively.

The first photographic observations were made by *Parkhurst* and *Jordan* (1906). Their 48 observations were obtained with 6 minute exposure time. The light variation was confirmed but their period was too short.

A comprehensive study of the light variation of XX Cyg was carried out by *Kron* (1912). He reduced all the visual observations obtained up to 1911 to the Potsdam visual system and critically discussed the data. He derived 140 epochs of maximum light and gave the elements with a quadratic term:

$$\text{Max. hel.} = \text{J.D. } 2416\ 563.41065 + 0\overset{d}{.}134\ 865\ 22\cdot E - 0\overset{d}{.}1578\times10^{-10}\cdot E^2.$$

According to *Kron* there exists a secondary maximum on the descending branch of the light curve about half a period from the main maximum, and this secondary maximum oscillates in the way given by the formula:

$$0\overset{d}{.}0625 - 0\overset{d}{.}0160 \sin\left[\frac{2\pi}{7.2}\left(\frac{E}{1000} + 0.8\right)\right]$$

Shapley and *Shapley* (1915) observed the star at Mt. Wilson in 1914 and 1915 and obtained 40 photographic observations with 1 minute exposure time and 37 photovisual observations with 2 minute exposure time. They argued against the existence of a secular term introduced by *Kron* (1912) but they found that neither the shape of the light curve nor the range was constant for successive periods and suspected a short-period oscillation in the time of maximum. *Shapley* and *Shapley* gave three epochs of maximum light for 1914 and one epoch for 1915. Two of the epochs of 1914 were, however, very uncertain and therefore we omitted them from our list of photographic and photoelectric maxima (Table 3).

A further 265 visual observations were obtained by *Blazhko* (1922) in 1919 and 1921. Supplementing the list of maxima by his 7 and 8 visual maxima from the years 1919 and 1921, respectively, *Blazhko* also questioned the secular variation of the period but he stated that periodic variations were present and gave the new elements:

$$\text{Max.hel.} = \text{J.D. } 2416\ 563.4098 + 0\overset{d}{.}134\ 865\ 027\cdot E + 0\overset{d}{.}00175 \sin(0\overset{\circ}{.}0103\cdot E + 22\overset{\circ}{.}6)$$

Nijland (1923) published his 227 original visual observations which had already been discussed by *Kron* (1912). A rediscussion of these data definitely showed that no secondary wave was present, and that the period of XX Cyg was sensibly constant: P = 0.134 865 27 day. *Nijland* also doubted *Kron*'s quadratic term.

Important photographic observations were made by *Jordan* (1929) in the years 1915 and 1921. He obtained 17 plates (containing 74 exposures) on six different nights. Exposures were in general 10 minutes in length. *Jordan* did not find any definite difference in the shape of the light curve or the phase of maximum at different cycles. He gave the period as P = 0.134 864 907 day.

Blazhko (1936) continued his visual observations and obtained a further 576 visual estimates from 1923 to 1934. Curiously enough, in contrast with *Jordan* (1929), *Blazhko* again found a periodic variation in the phase of light maxima:

$$\text{Max. hel.} = \text{J.D. } 2416\ 563.410 + 0\overset{d}{.}134\ 865\ 014 + 0\overset{d}{.}0019 \sin(0\overset{\circ}{.}01\cdot E + 20^\circ).$$

Table 3

Photographic and photoelectric maxima of XX Cyg

year	J.D.max.hel.	Remarks		O–C	E	$\overline{O-C}$	$\overline{E}$	n
1905	2417172.596	pg	PJ[1]	+0.0050	-100089	+0.0043	-100072	3
	17175.564	pg	PJ[1]	+0.0060	-100067			
	17176.504	pg	PJ[1]	+0.0019	-100060			
1914	20366.8729	pg	SS	+0.0027	- 76404	+0.0027	- 76404	1
1915	20574.9729	pg	SS	+0.0059	- 74861	+0.0041	- 74221	4
	20687.716	pg	Jo[1]	+0.0018	- 74025			
	20689.742	pg	Jo[1]	+0.0048	- 74010			
	20692.708	pg	Jo[1]	+0.0038	- 73988			
1921	22963.699	pg	Jo[1]	+0.0019	- 57149	+0.0019	- 57149	1
1933	27189.560	pg	Kl	+0.0008	- 25815	+0.0008	- 25815	1
1935	27961.392	pg	De	0.0000	- 20092	+0.0006	- 19854	7
	27962.471	pg	De	+0.0001	- 20084			
	27979.465	pg	De	+0.0011	- 19958			
	27980.410	pg	De	+0.0020	- 19951			
	27983.511	pg	De	+0.0011	- 19928			
	27993.490	pg	De	+0.0001	- 19854			
	28093.290	pg	De	-0.0001	- 19114			
1937	28694.520	pg	Kl	+0.0015	- 14656	+0.0015	- 14656	1
1950	33538.468	pg	Pp	+0.0007	+ 21261	+0.0007	+ 21261	1
1952	34150.486	pg	Pp	+0.0011	+ 25799	+0.0011	+ 25799	1
1953	34576.390	pg	Pp	+0.0012	+ 28957	+0.0012	+ 28957	1
	(34630.213	pg	Al	+0.0130	+ 29356)			
1954	35035.336	pg	Pp	+0.0013	+ 32360	+0.0013	+ 32360	1
1955	35258.5370	pe	De[2]	+0.0006	+ 34015	+0.0010	+ 34518	2
	35394.3468	pe	De[2]	+0.0013	+ 35022			
1957	36077.4395	pe	De[2]	+0.0024	+ 40087	+0.0017	+ 40320	7
	.5734	pe	De[2]	+0.0015	+ 40088			
	36080.4055	pe	De[2]	+0.0014	+ 40109			
	36081.4852	pe	De[2]	+0.0022	+ 40117			
	36136.2395	pe	De[2]	+0.0013	+ 40523			
	36143.2538	pe	De[2]	+0.0026	+ 40575			
	36165.2350	pe	De[2]	+0.0008	+ 40738			
1958	36403.4079	pe	Pp	+0.0020	+ 42504	+0.0020	+ 42635	3
	.5430	pe	Pp	+0.0022	+ 42505			
	36456.4096	pe	Pp	+0.0017	+ 42897			
1959	36815.4216	pe	Pp	+0.0029	+ 45559	+0.0023	+ 45666	4
	.5565	pe	Pp	+0.0029	+ 45560			
	36844.2818	pe	Pp	+0.0020	+ 45773			
	.4160	pe	Pp	+0.0013	+ 45774			
1965	38886.9495	pe	FA[3]	+0.0033	+ 60919	+0.0033	+ 60919	1
1972	41538.5311	pe	Pp	+0.0028	+ 80580	+0.0028	+ 80580	1
1974	42278.4010	pe	Pp	+0.0029	+ 86066	+0.0030	+ 86400	4
	42335.7191	pe	MF[3]	+0.0033	+ 86491			
	42338.6860	pe	MF[3]	+0.0032	+ 86513			
	42340.7085	pe	MF[3]	+0.0027	+ 86528			
1975	42655.7548	pe	MF[3]	+0.0042	+ 88864	+0.0042	+ 88864	1
1976	42973.7675	pe	MF[3]	+0.0051	+ 91222	+0.0045	+ 91276	5
	.9020	pe	MF[3]	+0.0047	+ 91223			
	42980.7795	pe	MF[3]	+0.0041	+ 91274			
	.9146	pe	MF[3]	+0.0043	+ 91275			
	42995.7495	pe	MF[3]	+0.0041	+ 91385			
1980	44455.3944	pe	Pp	+0.0043	+102208	+0.0043	+102208	1

Remarks to Table 3: PJ = Parkhurst and Jordan (1906); SS = Shapley and Shapley (1915); Jo = Jordan (1929); Kl = Kleißen (1938); De = Detre (1936); Pp = Present paper; Al = Alania (1954); FA = Fitch et al. (1966); MF = McNamara and Feltz (1980); [1] = determined by Detre (1936); [2] = from Detre's early unpublished photoelectric observations; [3] = determined by us

In order to disentangle the question of periodic variation *Detre* (1936) made a thorough investigation of XX Cyg. He made 316 photographic observations on 9 nights in 1935 between 6 June and 17 October. He discussed all the data on the star published up to 1935 and redetermined the epochs of maximum lights observed by different authors. He found no definite light curve variation and gave the linear elements:

$$\text{Max. hel.} = \text{J.D. } 2416\,564.4897 + 0\overset{d}{.}134\,865\,016\,2 \cdot E.$$

Kleißen (1938) also carried out photographic photometry on XX Cyg at Hamburg Observatory and obtained 44 observations in 1933 and 12 observations in 1937. Two maxima were covered and a secondary wave was found at phase 0.557 day.

Further visual observations were published by *Hacar* (1951), *Domke* and *Pohl* (1952) and *Oskanjan* (1953). Later on, *Alania* (1954) made some photographic observations and gave an epoch of light maximum which has turned out to be very uncertain.

Detre was the first who observed this star photoelectrically. He obtained 401 observations without filter on ten nights between 30 May 1955 and 23 November 1957. From these data nine photoelectric maxima could be determined. We give these maxima in Table 3.

Fitch et al. (1966) also observed this star and secured 30 UBV measures with the 36 inch telescope at Kitt Peak observing station of Steward Observatory on one night in 1965. We redetermined the time of maximum of their light curve using our mean light curve.

McNamara and *Feltz* (1980) obtained almost 1500 photometric uvbyβ observations of XX Cyg with the 24 inch telescope at Brigham Young University on eight nights in the time interval 1974-1976. They did not publish epochs of maximum light, but their data allowed us to determine nine times of maximum. Like *Fitch* et al., *McNamara* and *Feltz* also found the total light range of this star to be about 0.8 mag in V, which is the largest amplitude observed for any RRs variable. They also secured two single-trail spectrograms with the 200 inch telescope at a reciprocal dispersion of 18 A mm^{-1}. The total velocity range of XX Cyg is about 34 km sec^{-1} which is small compared with the large light amplitude.

Since 1950 a great number of unpublished photographic and photoelectric observations have been collected at the Konkoly Observatory, Budapest, in order to study the stability of the period of XX Cyg. The 87 photographic observations obtained on four nights in 1950, 1952, 1953 and 1954 are given in Table 10. In measuring the photographic plates we used the comparison stars of *Detre* (1936). These observations allowed us to determine 4 epochs of photographic maxima, one for each year.

The two colour (B,V) photoelectric investigation of this star was commenced at Konkoly Observatory in 1958. In all, 378 yellow and 308 blue observations have been obtained with the 24 inch reflector at Budapest with the exception of the 1974 and the 1980 observations. These were made with the 20 inch and 40 inch reflectors, respectively, at the Mountain Station of Konkoly Observatory. The differential photoelectric yellow and blue observations are given in Tables 11 and 12, and plotted against phase in Figure 3.

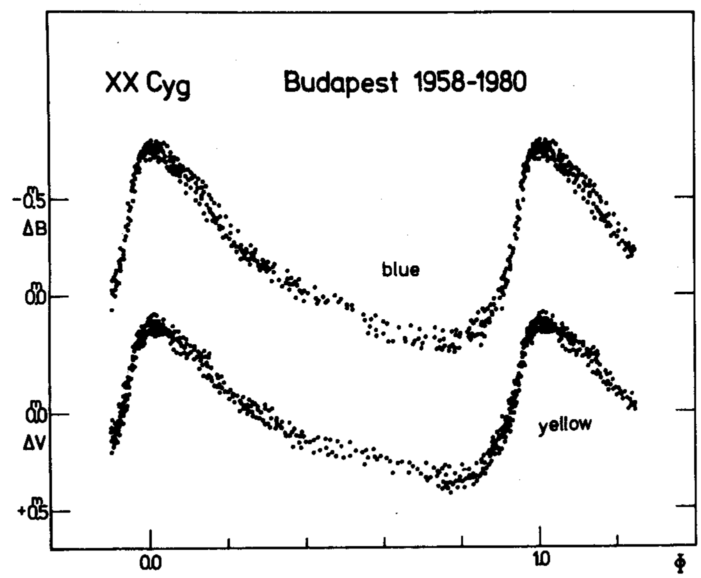

Figure 3: ΔV and ΔB observations of XX Cyg plotted against phase

The differential magnitudes (in the sense variable minus comparison) were corrected for transformation to the standard system and for differential extinction. As a comparison star we used star No. 7 of *Kron*'s list.

Our photoelectric data gave a further 10 epochs of maximum light.

All the available times of photographic and photoelectric maxima of XX Cyg are collected in Table 3. The O–C values were calculated by the formula:

$$C(J.D.\ max.hel.) = 2430\ 671.1010 + 0^{d}.134\ 865\ 070 \cdot E.$$

We formed yearly means of the epoch numbers and O–C values and then we calculated the mean epochs. These are given in Table 4. The O–C diagram of XX Cyg (Figure 4) was constructed by using the mean O–C values.

Table 4

Mean photographic and photoelectric maxima of XX Cyg

year	Mean Hel.Max.		W	E	O–C	$O-C_1$	$O-C_2$
1905	2417174.8880	pg	2	−100072	+0.0043	−0.0001	–
1914	20366.8729	pg	1	− 76404	+0.0027	−0.0007	–
1915	20661.2847	pg	2	− 74221	+0.0041	+0.0008	–
1921	22963.6990	pg	1	− 57149	+0.0019	−0.0006	–
1933	27189.5600	pg	1	− 25815	+0.0008	−0.0004	–
1935	27993.4905	pg	2	− 19854	+0.0006	−0.0003	–
1937	28964.5200	pg	1	− 14656	+0.0015	+0.0008	–
1950	33538.4680	pg	1	+ 21261	+0.0007	–	−0.0002
1952	34150.4860	pg	1	+ 25799	+0.0011	–	0.0000
1953	34576.3900	pg	1	+ 28957	+0.0012	–	−0.0001
1954	35035.3360	pg	1	+ 32360	+0.0013	–	−0.0001
1955	35326.3745	pe	1	+ 34518	+0.0010	–	−0.0005
1957	36108.8623	pe	2	+ 40320	+0.0017	–	−0.0001
1958	36421.0753	pe	2	+ 42635	+0.0020	–	+0.0002
1959	36829.8516	pe	2	+ 45666	+0.0023	–	+0.0003
1965	38886.9495	pe	1	+ 60919	+0.0033	–	+0.0007
1972	41538.5311	pe	1	+ 80580	+0.0028	–	−0.0007
1974	42323.4461	pe	2	+ 86400	+0.0030	–	−0.0007
1975	42655.7548	pe	1	+ 88864	+0.0042	–	+0.0004
1976	42981.0496	pe	2	+ 91276	+0.0045	–	+0.0005
1980	44455.3944	pe	1	+102208	+0.0043	–	−0.0001

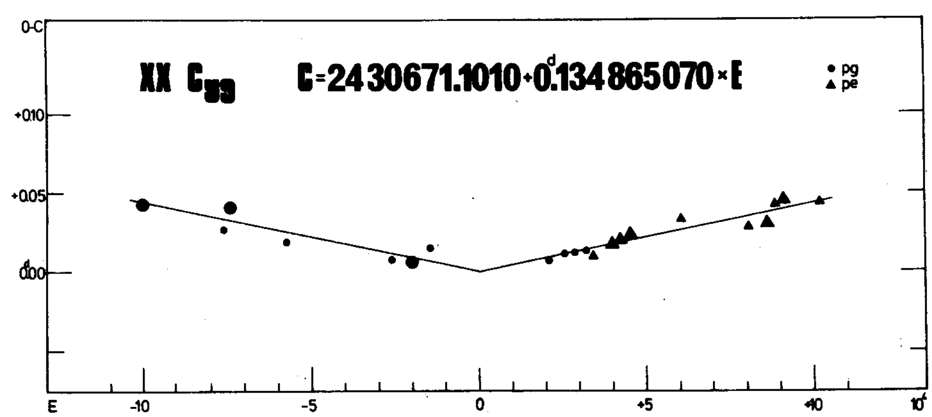

Figure 4: O–C diagram of XX Cyg

The O–C diagram of XX Cyg can be interpreted by two straight lines. This means that the period of this star has been constant, only it changed abruptly around 1942. Least-squares solutions give the following ephemerides before and after 1942:

$$C_1(\text{J.D. max. hel.}) = 2430\ 671.1010 + 0\overset{d}{.}134\ 865\ 026\cdot E, \text{ before 1942,}$$
$$\pm.0004 \qquad \pm 7$$

$$C_2(\text{J.D. max. hel.}) = 2430\ 671.1010 + 0\overset{d}{.}134\ 865\ 113\cdot E, \text{ after 1942.}$$
$$\pm.0003 \qquad \pm 4$$

In Table 4 the $O-C_1$ and $O-C_2$ values are also given; these clearly show that the period has indeed been constant during the past 75 years, apart from one sudden change by 87×10^{-9} day = 75×10^{-4} sec.

DY HERCULIS

DY Her = BD +12°3028 (9.5) was discovered to be variable by *Hoffmeister* (1935,1936), who gave the temporary designation 62.1935 Oph to the star and remarked that it was a short periodic variable star. *Soloviev* (1935) at first suspected the star to be a W UMa type variable, but shortly after (*Soloviev*, 1936, 1937) he determined the proper type of its variability and the preliminary and approximate value of its period (0.14858 day) from his 1936-37 visual observations. Later on he rediscussed his 240 visual observations made in the years 1936-1938, but he used a wrong period (*Soloviev*, 1952).

Tsesevich (1949) also observed the star visually in 1944 and 1947 and derived a new period: 0.148 586 65 day which, however, could not satisfactorily represent the observed maxima. Both *Soloviev* and *Tsesevich* claimed to notice light curve variation which has not been confirmed by modern photoelectric measurements.

Kühn (1951), and *Sauer* (1955) also made some visual estimates. They found some strange waves on the light curve which are not present either on the photographic or on the photoelectric light curves. There is little doubt that their observations were not sufficiently accurate.

From estimates on 1392 Harvard patrol plates *Gaposchkin* (1952) gave a period of 0.148 579 64 day. Oddly enough, his normal points formed with this period trace out a light curve with an amplitude of only some hundredth of magnitude. Thence it follows that his period is wrong. In addition to that, as *Gaposchkin* remarks, DY Her is an unsatisfactory object for the patrol plates because the average exposure time is about an hour, one third of the period. It is hardly surprising that he was unable to determine any epoch of maximum light from his observations.

With the help of 239 photographic observations secured between 23 March 1950 and 15 August *Ashbrook* (1954) succeeded in determining the correct period of DY Her. The new elements given by him are:

$$\text{Max. hel.} = \text{J.D. } 2433\ 439.4878 + 0\overset{d}{.}148\ 630\ 81\cdot E$$

His observations yielded 7 maxima. In his paper *Ashbrook* also listed *Harlan Smith*'s unpublished photoelectric maxima.

Alania (1954) gave an epoch of photographic maximum. Because his observations were fairly poor, little weight should be ascribed to his value.

The first photoelectric measurements of this star were made by *Broglia* and *Masani* (1955) in 1951. They continued the observation in 1954 and obtained more than 450 photoelectric measurements in four colours. In determining the times of maximum we used only the blue and yellow observations and have ignored the ultraviolet and orange observations because the scatter of the observations in those colours was larger than in blue and yellow. Discussing the times of maximum available to them *Broglia* and *Masani* suspected a change in the period around 1952.

Lenouvel and *Daguillon* (1954) observed the variable photoelectrically on 9 nights in 1951. They obtained some 997 observations in two colours. As comparison star they used BD +12°3027 and as check star BD +12°3033. Although *Lenouvel* and *Daguillon* gave only two times of maximum five further epochs could be derived from their observations. It is rather curious that they could not determine the correct period although their observations were of excellent quality. These observations do not reveal any significant cycle-to-cycle change of the light curve.

Fitch (1957) observed the star in the photoelectric UBV system a total of 5.1 cycles on 5 nights in 1955 and 1956 and added five further epochs of maximum light to the list of observed maxima. According to his observations the light curve of DY Her appeared regular and he found no evidence of non-repetitive or extremely peculiar behaviour of the star near maximum light as reported by visual observers (*Tsesevich*, 1949; *Kühn*, 1951; *Soloviev*, 1952 and *Sauer*, 1955). Their misinterpretation can easily be explained by the underestimated errors of visual observations and by their use of an erroneous period. *Fitch* rediscussed all the available maxima and assuming a uniform increase in the period he gave the elements:

$$\text{Max. Hel.} = \text{J.D. } 2433\,439.4872 + 0\overset{d}{.}148\,631\,13 \cdot E + 11^{d} \times 10^{-12} \cdot E^2 .$$
$$\pm .0004 \qquad \pm .000\,000\,05 \qquad \pm 2$$

Among other RR Lyrae stars *Spinrad* (1959) observed DY Her on 4 nights in 1958 and obtained 74 yellow and 72 blue photoelectric observations. As comparison he used BD +12°3027. He found some changes in the shape of maximum and the rise to maximum light from cycle-to-cycle, but he also remarked that the amplitude of the light variation was fairly stable. However, it should also be noted that *Spinrad*'s observations are somewhat poorer than other photoelectric photometries.

In the course of his programme on dwarf cepheids *Broglia* (1961) observed DY Her, too. During 1958-1960 he obtained 37 blue and 124 yellow photoelectric observations. Discussing 52 epochs of maximum spreaded over 24 years or 59000 cycles *Broglia* found the period of DY Her variable and derived a new ephemeris with quadratic term:

$$\text{Max. hel.} = \text{J.D. } 2433\ 439.4875 + 0\overset{d}{.}148\ 631\ 18 \cdot E + 53^{d} \times 10^{-13} \cdot E^2.$$
$$\pm.0003 \quad \pm.000\ 000\ 02 \quad \pm\ 10$$

Hardie and *Lott* (1961) secured over one thousand UBV observations on 11 nights in the spring and summer of 1959. According to their observations the light variations of this star appeared to be quite regular and repetitive and they also did not find any confirmation for the irregularities suggested by *Sauer* (1955) or the non-repetitive behaviour reported by *Tsesevich* (1949), *Soloviev* (1952) and *Spinrad* (1959).

Having discussed all available data *Hardie* and *Lott* suggested that the period of DY Her had been essentially constant from 1950 to 1959, and all observations in that interval could adequately be described by the relation:

$$\text{Max. hel.} = \text{J.D. } 2433\ 439.4871 + 0\overset{d}{.}148\ 631\ 27 \cdot E.$$

They also investigated the serious departures of *Soloviev*'s and *Tsesevich*'s earlier observations from this relation and they found that "the data seemed insufficient to clarify whether the period had been different between 1936-1950, whether their times were in error, or whether the period was subject to continual change". Assuming the last possibility they derived from a second-degree solution the following ephemeris:

$$\text{Max. hel.} = \text{J.D. } 2433\ 439.4879 + 0\overset{d}{.}148\ 631\ 10 \cdot E + 5\overset{d}{.}9 \times 10^{-12} \cdot E^2.$$

In the course of their photoelectric observations of RR Lyrae stars *Fitch* et al. (1966) obtained 120 measurements of DY Her in UBV on three nights in 1964. Using our mean light curve we determined a new epoch different from that given by them.

In order to find interstellar absorption corrections *Epstein* (1969) observed a number of RR Lyrae and AI Velorum type stars in the uvby intermediate band photoelectric system. DY Her was also on the programme and was observed on six nights in 1966. From the 34 photoelectric V measurements we were able to determine a normal maximum.

Geyer and *Hoffmann* (1974) published one time of maximum light with a mean error of 0.001 day.

Engaging in a long-term programme to investigate the evolutionary status of the dwarf cepheid variables on a star-by-star basis *Breger* and his colleagues (*Breger* et al. 1978) studied DY Her in detail in the uvbyβ photometric system during 17 nights in May and July 1977. These observations are of high precision and make it possible to determine an accurate normal maximum. The maximum light was observed on seven nights (J.D. 2443280, 283, 285, 286, 341, 342, 343) and no light curve variations could be noticed.

At Konkoly Observatory this variable was observed photoelectrically on two nights: 9/10 July, 1972 and 25/26 June, 1979 and 182 and 42 observations were secured, respectively. As comparison star BD +12°3030 and as check star BD +12°3031 were used. The magnitudes and colours for these stars have been adopted from *Hardie* and *Lott* (1961). Table 5 gives the photometric data of the comparison stars used by different authors.

Table 5

star	V	B-V	U-B	References
BD +12°3027	10.35	+0.37	-0.10	Fitch (1957)
	10.28	+0.39		Spinrad (1959)
BD +12°3030	9.34	+0.56	+0.11	Hardie and Lott (1961)
BD +12°3031	8.52	+0.72	+0.33	Hardie and Lott (1961)

Our photoelectric observations are given in Tables 14 and 15 and are plotted against phase in Figure 5. Almost all the photoelectric observations confirm the stable and repetitive character of this variable. Therefore we have the well-grounded suspicion that the large fluctuations in the shape of the light curve of DY Her found by visual observers are not real.

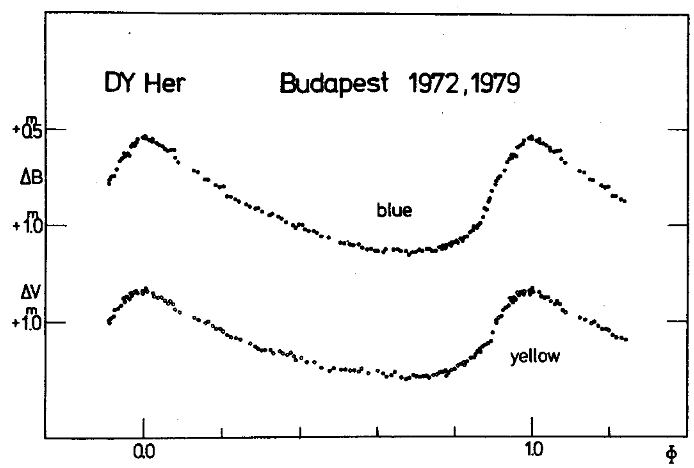

Figure 5: ΔV and ΔB observations of DY Her plotted against phase

In the plate collection of Konkoly Observatory we found a plate of DY Her with 17 multiple exposures made on 18 June, 1938. The measurements (Table 13) were made using *Ashbrook*'s (1954) comparison stars. Utilizing *Ashbrook*'s mean light curve we were able to determine a photographic epoch of maximum light. This epoch is very important because only visual observations of low accuracy existed before 1950.

All the photographic and photoelectric epochs available to us are gathered in Table 6. The O–C values were calculated by the ephemeris:

$$C = \text{J.D. } 2433\,439.4865 + 0^{d}.148\,631\,201 \cdot E.$$

Table 6

Photographic and photoelectric maxima of DY Her

year	J.D.max.hel.	Remarks		O–C	E	$\overline{O-C}$	$\overline{E}$	n
1938	2429068.393	pg	Pp	+0.0015	−29409	+0.0015	−29409	1
1950	33366.807	pg	As	+0.0012	− 489	+0.0006	+ 125	7
	33371.857	pg	As	−0.0023	− 455			
	33442.607	pg	As	−0.0008	+ 21			
	33501.614	pg	As	−0.0003	+ 418			
	33506.671	pg	As	+0.0032	+ 452			
	33507.563	pg	As	+0.0034	+ 458			
	33509.640	pg	As	−0.0004	+ 472			
1951	33767.5172	pe	BM	+0.0016	+ 2207	+0.0002	+ 2333	3
	33775.837	pe	Sm[1]	−0.0019	+ 2263			
	33815.5243	pe	BM	+0.0009	+ 2530			
1952	34068.940	pe	Sm[1]	+0.0004	+ 4235	+0.0006	+ 4745	17
	34097.923	pe	Sm[1]	+0.0003	+ 4430			
	34118.881	pe	Sm[1]	+0.0013	+ 4571			
	34119.771	pe	Sm[1]	−0.0005	+ 4577			
	34123.785	pe	Sm[1]	+0.0005	+ 4604			
	34133.744	pe	Sm[1]	+0.0012	+ 4671			
	34134.785	pe	Sm[1]	+0.0017	+ 4678			
	34137.755	pe	Sm[1]	−0.0009	+ 4698			
	34139.689	pe	Sm[1]	+0.0009	+ 4711			
	34149.794	pe	Sm[1]	−0.0010	+ 4779			
	34159.4570	pe	LD	+0.0010	+ 4844			
	34162.4295	pe	LD[2]	+0.0008	+ 4864			
	34178.4818	pe	LD[2]	+0.0010	+ 4972			
	34180.4140	pe	LD[2]	+0.0010	+ 4985			
	34182.4950	pe	LD[2]	+0.0011	+ 4999			
	34184.4277	pe	LD	+0.0016	+ 5012			
	34188.4390	pe	LD[2]	−0.0001	+ 5039			
1953	(34568.346	pg	Al	+0.0055	+ 7595)			
1954	34875.5633	pe	BM	+0.0021	+ 9662	+0.0016	+ 9996	5
	34888.4937	pe	BM	+0.0016	+ 9749			
	34945.4190	pe	BM	+0.0012	+10132			
	34956.4177	pe	BM	+0.0012	+10206			
	34960.4316	pe	BM	+0.0020	+10233			
1955	35241.789	pe	Fi	+0.0006	+12126	+0.0017	+12144	3
	.939	pe	Fi	+0.0019	+12127			
	35249.817	pe	Fi	+0.0025	+12180			
1956	35622.881	pe	Fi	+0.0022	+14690	+0.0022	+14720	2
	35631.799	pe	Fi	+0.0023	+14750			
1958	36336.757	pe	Sp[2]	+0.0025	+19493	+0.0024	+19590	5
	36337.799	pe	Sp[2]	+0.0041	+19500			
	.947	pe	Sp[2]	+0.0034	+19501			
	36338.834	pe	Sp[2]	−0.0013	+19507			

Table 6 (cont.)

year	J.D.max.hel.	Remarks		O–C	E	$\overline{O-C}$	$\overline{E}$	
	36404.3850	pe	Br	+0.0033	+19948			
1959	36681.8780	pe	HL[2]	+0.0019	+21815	+0.0020	+22053	10
	36694.8097	pe	HL[2]	+0.0026	+21902			
	36695.7010	pe	HL	+0.0021	+21908			
	36696.7410	pe	HL	+0.0017	+21915			
	36703.7267	pe	HL[2]	+0.0018	+21962			
	36704.7676	pe	HL[2]	+0.0022	+21969			
	36730.4806	pe	Br	+0.0020	+22142			
	36733.7500	pe	HL	+0.0016	+22164			
	36747.7226	pe	HL[2]	+0.0028	+22258			
	36782.6496	pe	HL[2]	+0.0015	+22493			
1960	37075.4538	pe	Br	+0.0022	+24463	+0.0022	+24463	1
1964	38476.0061	pe	FA[2]	+0.0027	+33886	+0.0027	+33886	1
1966	39252.9024	pe	Ep[2]	+0.0037	+39113	+0.0037	+39113	1
1972	41508.3797	pe	Pp	+0.0026	+54288	+0.0026	+54288	1
1973	41840.4222	pe	GH	+0.0030	+56522	+0.0030	+56522	1
1977	43341.7445	pe	BE	+0.0015	+66623	+0.0015	+66623	1
1979	44050.4181	pe	Pp	+0.0015	+71391	+0.0015	+71391	1

Remarks to Table 6: Pp = Present paper; As = Ashbrook (1954); BM = Broglia and Masani (1955); Sm = Smith (Ashbrook, 1954); LD= Lenouvel and Daguillon (1954); Al = Alania (1954); Fi = Fitch (1957); Sp= Spinrad (1959); Br= Broglia (1961); HL = Hardie and Lott (1961); FA = Fitch et al. (1966); Ep = Epstein (1969); GH = Geyer and Hoffmann (1974); BE=Breger et al. (1978); [1] = given by Ashbrook (1954); [2] = determined by us

Mean O–C value and mean epoch number were formed for each observing season separately; these are given in Table 6 under the headings $\overline{O-C}$ and $\overline{E}$ and are plotted in Figure 6. Then the yearly mean epochs of the observed photographic and photoelectric light maxima were calculated (Table 7). The photoelectric data were used only to carry out a second order least-squares solution which resulted in the ephemeris:

$$C_{qr} = \text{J.D. } 2433\,439.4865 + 0\overset{d}{.}148\,631\,353 \cdot E - 18\overset{d}{.}6 \times 10^{-13} \cdot E^2 .$$
$$\pm.0002 \qquad\qquad \pm 14 \qquad \pm 1.9$$

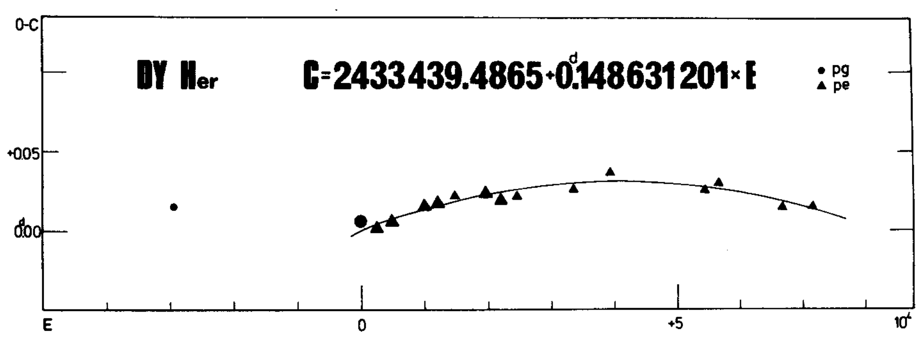

Figure 6: O–C diagram of DY Her

Table 7

Mean photographic and photoelectric maxima of DY Her

year	J.D.max.hel.		W	E	O–C	$O-C_{qr}$
1938	2429068.3930	pg	0	−29409	+0.0015	–
1950	33458.0660	pg	0	+ 125	+0.0006	+0.0006
1951	33786.2433	pe	2	+ 2333	+0.0002	−0.0001
1952	34144.7421	pe	2	+ 4745	+0.0006	−0.0001
1954	34925.2056	pe	2	+ 9996	+0.0016	+0.0003
1955	35244.4655	pe	2	+12144	+0.0017	+0.0001
1956	35627.3400	pe	1	+14720	+0.0022	+0.0004
1958	36351.1741	pe	2	+19590	+0.0024	+0.0001
1959	36717.2524	pe	2	+22053	+0.0020	−0.0004
1960	37075.4538	pe	1	+24463	+0.0022	−0.0004
1964	38476.0061	pe	1	+33886	+0.0027	−0.0003
1966	39252.9024	pe	1	+39113	+0.0037	+0.0006
1972	41508.3797	pe	1	+54288	+0.0026	−0.0002
1973	41840.4222	pe	1	+56522	+0.0030	+0.0003
1977	43341.7445	pe	1	+66623	+0.0015	−0.0004
1979	44050.4181	pe	1	+71391	+0.0015	+0.0002

The deviations $O-C_{qr}$ are within the observational errors therefore the continuous decrease of the period in the time interval covered by photoelectric observations (1951–1979) can be taken for certain, and the rate of period decrease is -37.2×10^{-13} day cycle^{-1}. In this context we are reminded of *Fitch*'s (1957), *Broglia*'s (1861) and *Hardie*'s and *Lott*'s (1961) result. They found a period increase if they took into account the visual observations. These contradictory results also prove clearly that the visual observations of dwarf cepheids are of inadequate precision and useless in a more refined period analysis.

Our photographic observations of the year 1938 show that the period of DY Her behaved in a different way before 1951 than after it. Our single photographic maximum (the only one before 1950) is not sufficient to trace the behaviour of the period of this variable up to 1950.

GENERAL REMARKS

The O–C diagram of both metal rich variables YZ Boo ($\Delta s = 0$, *Preston*, 1959) and DY Her (*McNamara*, 1978) indicates that the periods of these stars are changing continuously at a constant rate. The period of YZ Boo has been increasing, whereas the period of DY Her has shown a definite continuous decrease during the time interval covered by photoelectric observations. EH Lib, the third metal rich variable (investigated in our previous paper) has a constant period. Although the sample of stars investigated is too small, the following statement seems to be reasonable. The continuous change in or the constancy of the period may be characteristic of the population I dwarf cepheids. It may also be interesting to note that the scatter of the points on the O-C diagram of these three stars does not exceed the observational error.

XX Cyg, the third star studied in this paper is metal poor (*McNamara* and *Feltz*, 1980). The abrupt change in its period is conspicuous. The other metal poor dwarf cepheids, CY Aqr and DY Peg were studied in our previous paper. CY Aqr also exhibited and DY Peg seemed to show abrupt change in their respective periods. It is also remarkable that the periods are not stable, they show small fluctuations, too. The abrupt changes in the period of metal poor dwarf cepheids may be due to mixing in the semiconvective zone as suggested by *Sweigart* and *Renzini* (1979). In this context it is also interesting to note, that the period noise of the three investigated metal poor variables is larger than that of the metal rich dwarf cepheids.

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Budapest - Szabadsaghegy, 8 March 1981

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Table 8

Photoelectric yellow observations of YZ Boo

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2436709		2436712		2436713		2436714	
.4952	+0.568	.4194	+0.634	.3799	+0.549	.4465	+0.286
.4973	.566	.4215	.650	.3815	.544	.4509	.347
.4994	.579	.4257	.642	.3849	.464	.4530	.357
.5039	.590	.4278	.661	.3866	.426	.4550	.379
.5059	.624	.4298	.647	.3881	.387	.4614	.411
.5080	.621	.4350	.649	.3915	.342	.4635	.426
.5132	.627	.4371	.637	.3932	.289	.4677	.442
.5153	.632	.4392	.635	.3948	.257	.4697	.439
.5191	.642	.4441	.595	.3967	.218	.4718	.456
.5233	.641	.4517	.431	.3987	.204	.4760	.490
.5254	.625	.4559	.318	.4029	.248	.4781	.496
.5275	.598	.4580	.270	.4049	.276	.4802	.512
.5320	.576	.4600	.237	.4066	.287	.4854	.569
.5341	.533	.4642	.209	.4105	.316	.4875	.590
.5362	.497	.4663	.234	.4165	.340	.4895	.619
.5431	.354	.4684	.242	.4179	.360	.4937	.627
.5452	.300	.4725	.282	.4202	.358	.4958	.651
.5494	.246	.4746	.300	.4248	.397	.4979	.650
.5514	.232	.4767	.338	.4267	.409	.5020	.657
.5535	.239	.4809	.371	.4290	.446	.5041	.655
.5577	.270	.4833	.386	.4336	.471	.5062	.660
.5598	.298	.4854	.413	.4359	.482	.5125	.659
.5619	.309	.4909	.434	.4378	.539	.5145	.665
.5660	.363	.4937	.446	.4420	.551	.5187	.661
.5681	+0.398	.4965	.476	.4443	.558	.5208	.652
		.5026	.512	.4461	.588	.5229	.657
2436712		.5050	.537	.4528	.633	.5281	.584
.3493	+0.322	.5078	.541	.4547	.638	.5302	.506
.3534	.229	.5149	.595	.4563	.644	.5322	.465
.3597	.208	.5174	.632	.4820	.637	.5353	.401
.3618	.241	.5202	.639	.4864	.563	.5366	.382
.3639	.248	.5264	.641	.4885	.468	.5380	.334
.3680	.271	.5291	.641	.4900	.450	.5408	.281
.3701	.276	.5320	.659	.4937	.369	.5422	.262
.3722	.296	.5381	.646	.4954	.298	.5436	+0.237
.3764	.335	.5408	.638	.4970	.278		
.3784	.351	.5507	.514	.5002	.231	2436716	
.3805	.391	.5530	.458	.5019	.212	.3269	+0.333
.3847	.411	.5581	.322	.5037	.205	.3293	.365
.3868	.467	.5602	.291	.5053	.215	.3344	.397
.3889	.483	.5623	+0.257	.5070	+0.233	.3366	.408
.3930	.500					.3387	.422
.3951	.493	2436713		2436714		.3436	.454
.3972	.526	.3494	+0.587	.4221	+0.540	.3456	.487
.4014	.559	.3542	.593	.4255	.470	.3477	.501
.4028	.560	.3561	.604	.4272	.459	.3519	.529
.4048	.581	.3637	.628	.4311	.348	.3540	.544
.4090	.574	.3667	.636	.4336	.277	.3561	.568
.4111	.575	.3711	.635	.4365	.230	.3602	.603
.4132	.593	.3751	.622	.4418	.234	.3623	.625
.4173	+0.613	.3783	+0.582	.4444	+0.262	.3644	+0.637

Table 8 (cont.)

Photoelectric yellow observations of YZ Boo

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2436716		2436717		2436724		2436725	
.3717	+0.664	.3455	+0.351	.4244	+0.327	.3473	+0.546
.3741	.666	.3488	.282	.4275	.277	.3509	.514
.4012	.562	.3506	.248	.4293	.257	.3529	.467
.4043	.459	.3525	.231	.4312	.231	.3545	.450
.4064	.416	.3567	.225	.4344	.212	.3578	.399
.4106	.314	.3588	.227	.4358	.206	.3591	.383
.4127	.297	.3609	.266	.4372	.225	.3612	.318
.4147	.244	.3650	.292	.4404	.263	.3642	.287
.4189	.223	.3665	.307	.4454	.309	.3656	.269
.4210	.227	.3685	.323	.4475	.331	.3670	.223
.4231	.258	.3727	.374	.4513	.357	.3698	.222
.4272	.300	.3748	+0.425	.4534	.383	.3712	.223
.4293	.307			.4555	.412	.3726	.220
.4314	.318	2436723		.4603	.450	.3754	.235
.4363	.356	.4444	+0.570	.4624	.479	.3767	.239
.4383	.375	.4486	.585	.4645	.499	.3784	.247
.4404	.387	.4507	.623	.4694	.503	.3814	.311
.4446	.435	.4548	.636	.4714	.522	.3828	.329
.4522	.502	.4569	.634	.4735	.520	.3841	.346
.4543	.518	.4590	.631	.4784	.554	.3869	.360
.4585	.574	.4632	.636	.4805	.563	.3883	.389
.4606	.582	.4652	.631	.4825	.571	.3954	.455
.4627	.594	.4673	.639	.4874	.589	.3981	.458
.4668	.627	.4715	.625	.4895	.595	.4002	.461
.4689	.640	.4736	.599	.4916	.607	.4044	.508
.4710	.652	.4757	.584	.4964	.623	.4065	.532
.4752	.668	.4798	.510	.4985	.634	.4086	.535
.4772	.677	.4819	.465	.5006	.636	.4127	.538
.4793	.681	.4840	.430	.5051	.638	.4148	.550
.4835	.694	.4882	.312	.5072	.639	.4169	.578
.4856	.697	.4902	.282	.5093	.637	.4211	.600
.4943	.701	.4923	.264	.5147	.625	.4231	.613
.4988	.692	.4968	.239	.5161	.593	.4252	.622
.5006	.681	.4989	.223	.5175	.573	.4294	.621
.5025	.638	.5010	.226	.5203	.543	.4315	.624
.5055	.588	.5100	.334	.5217	.531	.4336	.635
.5069	.538	.5142	.355	.5231	.491	.4377	.644
.5082	.504	.5166	+0.353	.5258	.424	.4398	.652
.5115	.439			.5272	.398	.4416	.648
.5129	.396	2436724		.5286	.376	.4457	.641
.5143	.341	.4006	+0.610	.5314	.298	.4478	.620
.5170	.291	.4043	.603	.5328	.264	.4499	.610
.5184	.256	.4057	.594	.5342	.237	.4529	.586
.5198	.239	.4089	.588	.5369	.232	.4543	.572
.5240	.229	.4106	.578	.5383	.227	.4557	.555
.5282	.243	.4119	.564	.5397	.235	.4585	.505
.5295	.262	.4154	.536	.5425	.248	.4598	.477
.5309	.271	.4168	.500	.5439	.253	.4612	.458
.5337	.330	.4184	.461	.5453	.272	.4647	.400
.5351	.367	.4217	.397	.5481	.295	.4661	.354
.5365	+0.388	.4231	+0.364	.5503	+0.309	.4675	+0.312

Table 8 (cont.)

Photoelectric yellow observations of YZ Boo

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2436725		2442187		2442464		2442523	
.4703	+0.246	.4613	+0.320	.6662	+0.186	.4822	+0.211
.4716	.241	.4623	.294	.6683	.206	.4838	.233
.4730	.231	.4630	.279	.6693	.198	.4875	.297
.4758	.253	.4638	.266	.6724	.229	.4918	.312
.4779	.272	.4646	.250	.6734	.238	.4942	.336
.4793	.283	.4654	.238	.6764	.276	.4952	+0.348
.4828	.306	.4662	.209	.6778	.311		
.4841	.319	.4672	.196	.6797	.335	2442524	
.4855	.324	.4681	.195	.6811	+0.344	.4190	+0.181
.4883	+0.365	.4692	.190			.4204	.189
		.4700	.198	2442522		.4228	.243
2441860		.4707	.207	.4057	+0.624	.4276	.309
.3875	+0.625	.4753	.235	.4067	.619	.4290	.318
.3882	.615	.4761	.235	.4091	.625	.4321	.343
.3899	.622	.4769	.238	.4100	.598	.4336	.370
.3906	.607	.4778	.243	.4141	.584	.4378	.393
.3924	.605	.4913	.337	.4182	.564	.4392	.411
.3938	.598	.4929	.340	.4215	.511	.4422	.434
.3951	.579	.4940	.349	.4225	.487	.4434	.436
.3965	.563	.5021	.426	.4249	.422	.4474	.452
.3982	.518	.5029	.442	.4288	.352	.4488	.458
.4010	.457	.5038	.446	.4344	.224	.4522	+0.480
.4021	.439	.5047	.453	.4372	.193		
.4038	.404	.5057	+0.477	.4386	.212	2443936	
.4066	.334			.4467	.281	.5305	+0.233
.4077	.314	2442464		.4477	.294	.5315	.235
.4093	.281	.5606	+0.206	.4638	.448	.5333	.286
.4100	.264	.5620	.195	.4648	.453	.5343	.287
.4118	.239	.5648	.198	.4675	.483	.5364	.319
.4128	.218	.5662	.214	.4691	+0.506	.5371	.330
.4146	.206	.5711	.270			.5392	.339
.4153	.211	.5738	.295	2442523		.5399	.339
.4174	.208	.5749	.316	.4132	+0.469	.5420	.370
.4181	.211	.6190	.598	.4169	.519	.5427	.383
.4204	.233	.6207	.600	.4184	.534	.5440	.390
.4215	.247	.6238	.601	.4214	.542	.5475	.440
.4239	.270	.6248	.593	.4259	.568	.5486	.448
.4264	.307	.6280	.621	.4314	.599	.5503	.450
.4271	.318	.6294	.605	.4348	.599	.5513	.471
.4292	.343	.6322	.603	.4419	.660	.5534	.466
.4302	.362	.6377	.608	.4447	.631	.5541	.461
.4319	.387	.6408	.595	.4460	.647	.5562	.476
.4329	+0.403	.6440	.595	.4493	.669	.5572	.491
		.6481	.540	.4506	.663	.5593	.483
2442187		.6502	.512	.4538	.622	.5604	.484
.4478	+0.593	.6544	.429	.4548	.622	.5621	.503
.4496	.550	.6572	.351	.4617	.518	.5628	.513
.4545	.477	.6582	.322	.4629	.458	.5649	.517
.4559	.460	.6606	.278	.4655	.400	.5656	.520
.4568	.431	.6620	.245	.4668	.374	.5677	.521
.4577	+0.413	.6648	+0.200	.4789	+0.186	.5683	+0.540

Table 8 (cont.)

Photoelectric yellow observations of YZ Boo

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2443936		2443936		2443936		2443936	
.5704	+0.562	.5878	+0.634	.6128	+0.418	.6274	+0.173
.5711	.571	.5888	.639	.6145	.368	.6288	.174
.5729	.582	.5906	.655	.6152	.344	.6295	.187
.5739	.581	.5920	.650	.6190	.265	.6326	.233
.5760	.600	.5933	.642	.6197	.222	.6374	.290
.5784	.605	.5947	.633	.6211	.202	.6381	.297
.5795	.603	.6038	.632	.6222	.186	.6399	.307
.5815	.605	.6055	.592	.6236	.183	.6409	.325
.5829	.612	.6062	.568	.6246	.160	.6433	.342
.5847	.607	.6090	.513	.6263	+0.168	.6444	+0.360
.5857	+0.617	.6114	+0.453				

Table 9

Photoelectric blue observations of YZ Boo

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2436709		2436712		2436712		2436713	
.4962	+0.244	.3607	−0.203	.4548	−0.075	.3484	+0.226
.4983	.240	.3670	.161	.4569	.143	.3533	.255
.5004	.246	.3691	.150	.4590	.171	.3552	.271
.5049	.266	.3712	.139	.4632	.202	.3596	.296
.5070	.268	.3753	.059	.4653	.214	.3703	.280
.5091	.269	.3774	.018	.4673	.195	.3722	.276
.5143	.278	.3795	−0.003	.4715	.173	.3743	.261
.5181	.290	.3837	+0.055	.4736	.160	.3774	.229
.5202	.291	.3857	.067	.4757	.147	.3791	.183
.5244	.249	.3878	.075	.4819	−0.013	.3807	.167
.5264	.224	.3920	.134	.4843	0.000	.3842	.099
.5285	.200	.3941	.159	.4896	+0.034	.3857	.057
.5330	.158	.3962	.180	.4923	.058	.3874	+0.014
.5351	.122	.4003	.221	.4951	.092	.3908	−0.081
.5372	+0.086	.4017	.226	.5012	.139	.3923	.098
.5421	−0.036	.4038	.237	.5034	.165	.3940	.149
.5441	.119	.4080	.241	.5063	.179	.3958	.172
.5462	.178	.4100	.235	.5161	.248	.3977	.191
.5504	.215	.4121	.240	.5190	.298	.4017	.176
.5525	.208	.4163	.263	.5251	.314	.4039	.160
.5546	.187	.4184	.298	.5278	.306	.4057	.147
.5587	.169	.4205	.307	.5305	.288	.4096	.113
.5608	.147	.4246	.308	.5367	.298	.4144	.074
.5629	.090	.4267	.315	.5394	.277	.4172	−0.059
.5671	.048	.4288	.331	.5420	.265	.4234	+0.017
.5691	−0.015	.4340	.316	.5495	.129	.4258	.039
		.4361	.290	.5520	+0.068	.4276	.061
2436712		.4382	.289	.5570	−0.065	.4325	.123
.3503	−0.092	.4430	.219	.5592	.150	.4350	.130
.3545	.203	.4486	.098	.5612	−0.189	.4369	.138
.3587	−0.226	.4507	+0.046			.4408	+0.154

Table 9 (cont.)

Photoelectric blue observations of YZ Boo

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2436713		2436714		2436716		2436723	
.4434	+0.180	.5197	+0.276	.4658	+0.236	.4559	+0.291
.4450	.180	.5218	.279	.4679	.248	.4579	.294
.4538	.271	.5270	.212	.4699	.261	.4621	.291
.4593	.288	.5291	.148	.4741	.282	.4642	.281
.4851	.178	.5312	.101	.4762	.291	.4663	.290
.4876	.136	.5346	+0.019	.4783	.294	.4704	.270
.4893	+0.091	.5359	−0.015	.4824	.303	.4725	.256
.4928	0.000	.5373	.060	.4845	.306	.4746	.233
.4945	−0.084	.5401	.116	.4932	.320	.4788	.139
.4962	.114	.5415	.140	.4977	.313	.4809	.097
.4993	.197	.5429	−0.164	.4997	.282	.4829	+0.063
.5011	.221			.5015	.251	.4871	−0.066
.5028	.213	2436716		.5048	.185	.4892	.116
.5045	.219	.3258	−0.120	.5062	.150	.4913	.167
.5062	−0.211	.3281	.095	.5076	.109	.4954	.206
		.3331	.051	.5108	+0.025	.4979	.209
2436714		.3356	−0.022	.5122	−0.017	.5000	.212
.4211	+0.225	.3377	+0.016	.5136	.079	.5045	.169
.4245	.129	.3422	.056	.5164	.139	.5069	.129
.4263	+0.083	.3446	.062	.5177	.183	.5090	.099
.4301	−0.038	.3467	.079	.5191	.206	.5132	.064
.4324	.134	.3508	.136	.5219	.211	.5152	−0.032
.4347	.186	.3529	.152	.5233	.210		
.4409	.203	.3550	.155	.5247	.206	2436724	
.4432	.189	.3592	.228	.5275	.183	.3996	+0.284
.4456	.152	.3613	.249	.5302	.169	.4036	.264
.4500	.136	.3633	.249	.5330	.142	.4050	.257
.4520	.119	.3675	.276	.5344	.131	.4082	.248
.4540	.077	.3699	.301	.5358	−0.097	.4099	.236
.4586	.045	.3731	.297			.4113	.230
.4604	−0.020	.4002	.198	2436717		.4147	.186
.4625	+0.006	.4033	.091	.3434	+0.046	.4161	.164
.4666	.050	.4054	+0.040	.3448	0.000	.4175	.112
.4687	.061	.4095	−0.094	.3478	−0.132	.4210	+0.035
.4708	.077	.4116	.139	.3497	.167	.4224	−0.018
.4750	.125	.4137	.186	.3515	.216	.4238	.050
.4770	.134	.4179	.204	.3555	.216	.4268	.106
.4791	.157	.4199	.203	.3578	.214	.4286	.163
.4843	.222	.4220	.177	.3599	.191	.4302	.190
.4864	.229	.4262	.153	.3640	.159	.4337	.206
.4885	.236	.4283	.110	.3656	.139	.4351	.210
.4927	.268	.4304	.097	.3675	.119	.4365	.210
.4947	.284	.4352	.057	.3719	.044	.4397	.180
.4968	.301	.4373	.047	.3738	−0.027	.4446	.125
.5010	.302	.4394	−0.035	.3758	+0.022	.4464	.109
.5031	.304	.4436	+0.019			.4503	.062
.5052	.307	.4512	.095	2436723		.4523	−0.026
.5093	.287	.4533	.107	.4434	+0.263	.4544	+0.007
.5114	.286	.4574	.142	.4475	.263	.4593	.038
.5135	.290	.4595	.155	.4496	.279	.4614	.065
.5177	+0.285	.4616	+0.170	.4538	+0.270	.4634	+0.092

Table 9 (cont.)

Photoelectric blue observations of YZ Boo

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2436724		2436725		2441860		2442187	
.4683	+0.126	.3774	−0.171	.3920	+0.244	.4934	−0.013
.4704	.160	.3791	.128	.3931	.230	.4943	−0.011
.4725	.179	.3821	.074	.3947	.214	.4953	+0.002
.4773	.216	.3835	.070	.3958	.196	.5025	.077
.4794	.219	.3848	.056	.3979	.137	.5033	.092
.4815	.232	.3876	−0.012	.4007	.082	.5042	.097
.4864	.251	.3968	+0.067	.4035	+0.013	.5051	.097
.4884	.260	.3992	.082	.4042	−0.014	.5064	+0.111
.4905	.275	.4034	.125	.4063	.081		
.4954	.290	.4054	.151	.4070	.096	2442464	
.4975	.305	.4075	.165	.4090	.156	.5599	−0.222
.4996	.319	.4117	.170	.4097	.167	.5613	.234
.5041	.322	.4138	.176	.4114	.208	.5655	.215
.5062	.321	.4159	.206	.4125	.212	.5690	.182
.5082	.320	.4200	.231	.4139	.218	.5704	−0.181
.5140	.296	.4221	.244	.4149	.222	.6183	+0.265
.5154	.264	.4242	.254	.4167	.213	.6200	.268
.5168	.238	.4284	.258	.4177	.212	.6231	.285
.5196	.179	.4304	.268	.4201	.202	.6241	.295
.5210	.168	.4325	.280	.4208	.195	.6273	.276
.5224	.132	.4367	.289	.4229	.179	.6287	.275
.5251	.076	.4388	.299	.4236	.173	.6315	.288
.5265	+0.013	.4409	.291	.4257	.147	.6329	.283
.5279	−0.009	.4447	.276	.4267	.137	.6356	.281
.5307	.071	.4468	.266	.4299	.093	.6370	.281
.5321	.119	.4488	.243	.4316	.069	.6391	.269
.5335	.157	.4522	.234	.4326	−0.060	.6401	.255
.5363	.203	.4536	.217			.6433	.238
.5376	.206	.4550	.190	2442187		.6495	.120
.5390	.213	.4578	.130	.4483	+0.261	.6537	+0.029
.5418	.198	.4591	.102	.4501	.240	.6565	−0.034
.5432	.189	.4605	+0.088	.4554	.117	.6575	.077
.5446	.160	.4640	−0.017	.4563	.092	.6599	.159
.5474	.132	.4654	.045	.4573	.061	.6613	.173
.5489	−0.104	.4668	.098	.4580	+0.033	.6641	.213
		.4696	.188	.4618	−0.086	.6655	.223
2436725		.4710	.205	.4626	.111	.6676	.227
.3482	+0.216	.4723	.209	.4635	.134	.6690	.226
.3519	.155	.4758	.212	.4642	.160	.6717	.195
.3536	.118	.4772	.186	.4651	.186	.6731	.185
.3554	.081	.4786	.162	.4658	.208	.6759	.149
.3585	+0.010	.4821	.130	.4666	.219	.6771	.146
.3598	−0.040	.4835	.127	.4676	.221	.6794	.109
.3619	.084	.4848	.125	.4686	.240	.6804	−0.098
.3649	.136	.4876	−0.087	.4704	.230		
.3663	.181			.4710	.216	2442522	
.3677	.208	2441860		.4756	.169	.4050	+0.262
.3705	.219	.3871	+0.280	.4766	.164	.4062	.253
.3719	.208	.3878	.267	.4773	.162	.4087	.252
.3733	.222	.3896	.256	.4781	.155	.4096	.248
.3760	−0.199	.3903	+0.251	.4925	−0.027	.4135	+0.233

Table 9 (cont.)

Photoelectric blue observations of YZ Boo

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2442522		2442523		2443936		2443936	
.4187	+0.171	.4455	+0.269	.5302	-0.189	.5864	+0.270
.4210	.127	.4485	.258	.5308	.192	.5885	.257
.4220	.103	.4533	.229	.5329	.177	.5892	.263
.4244	+0.055	.4542	.247	.5367	.135	.5913	.279
.4283	-0.048	.4567	.178	.5388	.087	.5923	.271
.4292	.100	.4579	.166	.5395	.079	.5940	.273
.4323	.176	.4611	.105	.5413	.051	.6017	.238
.4336	.208	.4649	+0.027	.5423	.052	.6052	.193
.4366	.240	.4698	-0.107	.5440	.027	.6058	.186
.4410	.220	.4730	.201	.5447	-0.009	.6086	.118
.4420	.198	.4744	.245	.5468	+0.034	.6107	.062
.4507	.126	.4769	.251	.5482	.045	.6121	+0.034
.4556	.061	.4782	.232	.5531	.085	.6149	-0.031
.4566	.040	.4812	.228	.5538	.082	.6163	.081
.4598	-0.009	.4830	.207	.5558	.094	.6170	.111
.4607	+0.012	.4859	.184	.5565	.102	.6183	.152
.4631	.027	.4910	.138	.5586	.113	.6194	.201
.4643	.051	.4936	.085	.5600	.131	.6208	.230
.4667	.058	.4948	-0.075	.5614	.159	.6218	.237
.4681	+0.076			.5624	.159	.6232	.245
		2442524		.5645	.167	.6239	.241
2442523		.4183	-0.252	.5652	.162	.6260	.249
.4097	+0.119	.4197	.232	.5670	.166	.6267	.251
.4126	.126	.4266	.161	.5680	.174	.6284	.241
.4137	.148	.4283	.125	.5701	.200	.6291	.249
.4163	.149	.4313	.120	.5708	.206	.6315	.233
.4176	.177	.4329	.082	.5725	.212	.6322	.219
.4222	.184	.4364	-0.014	.5732	.212	.6340	.207
.4252	.220	.4385	+0.009	.5753	.227	.6350	.207
.4265	.238	.4412	.033	.5767	.250	.6371	.179
.4296	.236	.4429	.025	.5788	.253	.6378	.167
.4308	.242	.4464	.064	.5798	.255	.6392	.134
.4341	.237	.4482	.091	.5822	.270	.6406	.121
.4398	.235	.4530	+0.138	.5833	.271	.6427	.097
.4412	+0.259			.5850	+0.272	.6440	-0.075

Table 10

Photographic observations of XX Cyg

J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}
2433538		2433538		2433538		2433538	
.3369	11.61	.3619	11.82	.3932	12.28	.4265	12.43
.3397	11.61	.3702	12.06	.3959	12.14	.4293	12.47
.3425	11.48	.3730	12.01	.3987	12.21	.4320	12.46
.3480	11.63	.3758	12.12	.4098	12.29	.4376	12.37
.3536	11.84	.3814	12.06	.4154	12.28	.4404	12.33
.3564	11.74	.3876	12.16	.4182	12.38	.4439	12.32
.3591	11.80	.3904	12.10	.4209	12.33	.4466	12.28

Table 10 (cont.)

Photographic observations of XX Cyg

J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}
2433538		2434150		2434576		2434576	
.4494	12.15	.4626	12.32	.3562	12.54	.4006	11.58
.4522	12.17	.4675	12.23	.3589	12.40	.4034	11.68
.4550	12.15	.4702	12.16	.3617	12.43		
.4578	12.03	.4730	11.98	.3645	12.35	2435035	
.4605	11.90	.4758	11.97	.3673	12.39	.3236	12.16
.4633	11.60	.4786	11.70	.3700	12.30	.3264	11.93
.4661	11.55	.4814	11.56	.3728	12.22	.3292	11.65
.4689	11.47	.4841	11.47	.3756	12.10	.3319	11.52
.4723	11.52	.4869	11.48	.3784	12.03	.3347	11.51
.4751	11.54	.4897	11.48	.3812	11.92	.3375	11.47
.4779	11.63	.4925	11.45	.3839	11.71	.3431	11.48
.4807	11.55	.4952	11.53	.3867	11.48	.3458	11.55
		.4980	11.63	.3895	11.46	.3486	11.57
2434150		.5008	11.63	.3923	11.45	.3514	11.60
.4571	12.39	.5064	11.75	.3950	11.44	.3545	11.68
.4598	12.30	.5091	11.80	.3978	11.49		

Table 11

Photoelectric yellow observations of XX Cyg

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2436403		2436403		2436456		2436815	
.3936	+0.219	.5030	+0.351	.4001	+0.004	.4216	−0.441
.3964	+0.039	.5065	.333	.4032	−0.232	.4232	.439
.3989	−0.073	.5089	.367	.4050	.377	.4271	.405
.4013	.252	.5114	.421	.4069	.416	.4293	.419
.4051	.356	.5144	.343	.4103	.435	.4311	.370
.4077	.484	.5235	.267	.4117	.430	.4345	.319
.4107	.464	.5258	.158	.4136	.423	.4387	.294
.4151	.376	.5294	+0.028	.4173	.408	.4405	.266
.4184	.354	.5319	−0.048	.4210	.350	.4443	.189
.4260	.252	.5343	.164	.4247	.284	.4460	.163
.4284	.192	.5365	.285	.4265	.235	.4479	.079
.4312	.149	.5397	.379	.4284	.199	.4522	.056
.4334	.114	.5420	.498	.4341	.137	.4542	−0.003
.4366	.060	.5443	.516	.4360	.115	.4563	+0.012
.4388	.014	.5475	.448	.4379	.098	.4604	.054
.4409	−0.025	.5495	.371	.4418	.088	.4625	.023
.4445	+0.020	.5519	.327	.4437	.075	.4646	.056
.4488	.072	.5544	−0.309	.4455	.053	.4698	.099
.4509	.078			.4492	.045	.4722	.155
.4546	.116	2436456		.4511	−0.024	.4743	.151
.4568	.174	.3865	+0.334	.4529	+0.026	.4792	.192
.4595	.178	.3902	.227			.4813	.181
.4639	.207	.3920	.231	2436815		.4833	.207
.4690	.214	.3939	.196	.4165	−0.345	.4875	.231
.4717	.225	.3972	.153	.4189	.392	.4896	.226
.4815	+0.267	.3987	+0.036	.4200	−0.415	.4917	+0.199

Table 11 (cont.)

Photoelectric yellow observations of XX Cyg

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2436815		2436844		2441538		2441538	
.4958	+0.233	.2750	−0.241	.4150	−0.331	.5340	−0.446
.4979	.232	.2765	.334	.4164	.310	.5361	.443
.5000	.226	.2771	.367	.4192	.203	.5368	.422
.5046	.315	.2777	.413	.4206	.192	.5385	.417
.5099	.312	.2783	.399	.4247	.091	.5392	.421
.5129	.297	.2790	.415	.4317	.054	.5421	.398
.5144	.319	.2796	.432	.4331	.037	.5435	.387
.5158	.340	.2802	.430	.4358	.026	.5463	.336
.5172	.341	.2816	.427	.4372	−0.015	.5477	−0.320
.5202	.403	.2822	.435	.4400	+0.036		
.5215	.397	.2828	.417	.4414	.044	2442278	
.5229	.328	.2835	.429	.4442	.049	.3692	+0.370
.5260	.318	.2841	.424	.4456	.087	.3703	.373
.5274	.357	.2849	.417	.4483	.099	.3724	.394
.5289	.392	.2871	.429	.4539	.126	.3779	.381
.5318	.328	.2877	.420	.4567	.136	.3791	.362
.5333	.270	.2882	.408	.4581	.140	.3803	.335
.5347	.260	.2888	.404	.4608	.141	.3814	.301
.5377	.204	.2893	−0.397	.4622	.172	.3823	.299
.5392	.133	.3990	+0.282	.4650	.152	.3885	.166
.5407	.107	.4009	.185	.4692	.207	.3896	.146
.5435	+0.049	.4022	.145	.4706	.195	.3905	.104
.5448	−0.055	.4029	.139	.4733	.189	.3916	+0.047
.5463	.095	.4034	.136	.4747	.247	.3926	−0.030
.5490	.242	.4040	.113	.4775	.235	.3936	.144
.5503	.330	.4045	.105	.4789	.253	.3948	.233
.5516	.394	.4051	.069	.4817	.263	.3959	.291
.5528	.456	.4056	+0.060	.4831	.257	.3979	.376
.5556	.503	.4069	−0.014	.4858	.263	.3990	.401
.5572	.516	.4073	.025	.4872	.281	.4000	.434
.5603	.492	.4078	.038	.4914	.266	.4009	.431
.5636	.452	.4083	.100	.4942	.291	.4020	.425
.5654	−0.382	.4087	.149	.4956	.315	.4031	.412
		.4093	.172	.4982	.278	.4044	.414
2436844		.4101	.237	.4996	.283	.4091	.333
.2640	+0.216	.4115	.328	.5039	.276	.4101	.318
.2645	.203	.4120	.344	.5067	.300	.4114	.312
.2652	.206	.4126	.370	.5108	.250	.4126	.314
.2658	.178	.4132	.415	.5146	.182	.4137	.293
.2664	.151	.4137	.427	.5178	.153	.4214	.199
.2676	.131	.4142	.453	.5205	+0.070	.4223	.174
.2685	.092	.4148	.456	.5212	−0.014	.4233	.147
.2693	.085	.4161	.461	.5229	.078	.4244	−0.139
.2699	.075	.4167	.468	.5236	.105		
.2705	+0.039	.4173	.447	.5254	.353	2444454	
.2719	−0.011	.4179	.450	.5261	.367	.4141	+0.386
.2725	.056	.4184	.455	.5278	.428	.4153	.401
.2730	.069	.4189	.444	.5285	.444	.4165	.385
.2736	.144	.4194	.433	.5306	.463	.4177	.395
.2740	.166	.4207	.431	.5313	.473	.4189	.369
.2745	−0.193	4212	−0.415	.5330	−0.469	.4202	+0.363

Table 11 (cont.)

Photoelectric yellow observations of XX Cyg

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2444454		2444454		2444455		2444455	
.4214	+0.361	.4673	−0.280	.3793	+0.187	.4136	−0.252
.4226	.361	.4698	.194	.3805	+0.161	.4148	.241
.4238	.348	.4710	.175	.3867	−0.184	.4211	.121
.4255	.341	.4735	.110	.3879	.300	.4223	.089
.4365	.193	.4813	.034	.3892	.371	.4235	.098
.4377	.126	.4825	.038	.3904	.428	.4248	.066
.4389	.081	.4837	.011	.3916	.459	.4260	.041
.4401	+0.003	.4849	−0.008	.3928	.478	.4272	.047
.4413	−0.043	.4874	+0.022	.3941	.487	.4284	.041
.4425	.147	.4886	.037	.3953	.476	.4309	.023
.4438	.241	.4898	+0.053	.3965	.480	.4321	−0.005
.4450	.346			.3977	.468	.4380	+0.060
.4518	.460	2444455		.4039	.394	.4391	.074
.4530	.461	.3695	+0.336	.4050	.377	.4404	.107
.4542	.452	.3707	.340	.4063	.367	.4416	.117
.4555	.435	.3719	.340	.4075	.356	.4441	.114
.4567	.426	.3732	.329	.4087	.352	.4453	.112
.4579	.411	.3745	.323	.4100	.321	.4465	.119
.4592	.389	.3756	.278	.4112	.317	.4477	.141
.4604	.394	.3768	.260	.4124	−0.296	.4489	+0.150
.4661	−0.294	.3781	+0.225				

Table 12

Photoelectric blue observations of XX Cyg

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2436403		2436403		2436403		2436456	
.3923	+0.027	.4558	−0.033	.5431	−0.784	.4201	−0.594
.3950	−0.099	.4579	+0.010	.5455	.721	.4238	.565
.3977	.198	.4607	.026	.5485	.671	.4256	.542
.4001	.345	.4655	.035	.5506	.638	.4275	.514
.4026	.614	.4829	.196	.5532	−0.629	.4327	.383
.4063	.709	.4860	.209			.4351	.308
.4091	.741	.4883	.199	2436456		.4370	.300
.4122	.710	.4916	.239	.3856	+0.206	.4409	.264
.4167	.643	.4956	.222	.3893	.148	.4427	.244
.4200	.583	.4986	.253	.3911	.133	.4446	.222
.4234	.500	.5015	.271	.3930	.102	.4483	.190
.4273	.398	.5076	.274	.3965	+0.071	.4502	.178
.4298	.411	.5129	.292	.3980	−0.039	.4520	−0.152
.4324	.355	.5224	.143	.3994	.134		
.4355	.261	.5246	.130	.4022	.403	2436815	
.4388	.195	.5268	+0.018	.4041	.497	.4160	−0.676
.4421	.166	.5306	−0.120	.4059	.649	.4183	.725
.4456	.138	.5329	.199	.4096	.708	.4194	.740
.4478	.131	.5355	.397	.4110	.720	.4208	.747
.4499	.078	.5386	.664	.4127	.699	.4224	.743
.4533	−0.051	.5406	−0.733	.4163	−0.656	.4262	−0.700

Table 12 (cont.)

Photoelectric blue observations of XX Cyg

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2436815		2436815		2441538		2444454	
.4285	−0.674	.5549	−0.758	.5275	−0.717	.4193	+0.261
.4302	.634	.5564	.781	.5282	.752	.4218	.216
.4336	.534	.5580	.781	.5303	.778	.4250	.217
.4380	.480	.5598	.758	.5310	.787	.4259	+0.211
.4396	.429	.5629	.705	.5327	.782	.4369	−0.017
.4435	.383	.5646	−0.672	.5337	.770	.4381	.079
.4451	.351			.5354	.755	.4393	.175
.4470	.313	2441538		.5364	.728	.4405	.239
.4511	.233	.4143	−0.596	.5382	.727	.4417	.364
.4532	.200	.4157	.571	.5389	.707	.4429	.456
.4553	.194	.4185	.485	.5414	.672	.4442	.551
.4594	.170	.4199	.476	.5428	.659	.4454	.680
.4615	.135	.4226	.416	.5456	.615	.4522	.803
.4636	.126	.4240	.370	.5470	−0.587	.4534	.791
.4685	.088	.4268	.338			.4546	.799
.4712	.070	.4310	.264	2442278		.4559	.785
.4733	−0.018	.4324	.240	.3697	+0.271	.4571	.748
.4782	+0.012	.4393	.161	.3719	.277	.4583	.724
.4803	.024	.4435	.135	.3730	.273	.4596	.713
.4823	.031	.4449	.094	.3809	.262	.4608	.679
.4865	.019	.4476	.085	.3818	.219	.4665	.565
.4886	.047	.4532	−0.043	.3829	+0.132	.4677	.524
.4907	.068	.4560	+0.007	.3890	−0.001	.4689	.474
.4948	.125	.4574	+0.022	.3901	.068	.4702	.452
.4969	.159	.4601	0.000	.3911	.153	.4714	.392
.4990	.176	.4615	+0.031	.3921	.220	.4739	.366
.5032	.237	.4643	.059	.3931	.295	.4817	.230
.5089	.231	.4657	.051	.3942	.450	.4829	.231
.5122	.238	.4699	.098	.3953	.585	.4853	.224
.5136	.227	.4726	.122	.3964	.649	.4865	.181
.5151	.244	.4740	.106	.3974	.707	.4878	.167
.5165	.216	.4768	.133	.3995	.780	.4890	.172
.5195	.220	.4782	.145	.4004	.795	.4902	−0.145
.5209	.235	.4824	.163	.4015	.809		
.5222	.225	.4865	.153	.4026	.786	2444455	
.5252	.189	.4893	.176	.4038	.796	.3699	+0.232
.5267	.206	.4949	.166	.4049	.773	.3711	.215
.5282	.202	.4975	.186	.4096	.658	.3724	.205
.5310	.176	.5018	.184	.4120	.645	.3736	.208
.5325	.144	.5032	.211	.4131	.626	.3748	.162
.5340	.129	.5060	.193	.4143	.603	.3760	.142
.5369	.080	.5074	.134	.4218	.440	.3773	.092
.5384	.072	.5101	.088	.4228	.429	.3785	.074
.5400	+0.050	.5115	.075	.4238	.403	.3797	+0.013
.5429	−0.086	.5143	+0.050	.4249	−0.411	.3809	−0.031
.5442	.134	.5171	−0.025			.3871	.459
.5456	.252	.5198	.058	2444454		.3884	.588
.5484	.489	.5208	.181	.4145	+0.276	.3896	.688
.5496	.568	.5226	.313	.4157	.280	.3908	.728
.5510	.662	.5233	.372	.4169	.267	.3920	.773
.5522	−0.731	.5257	−0.637	.4181	+0.284	.3933	−0.778

Table 12 (cont.)

Photoelectric blue observations of XX Cyg

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2444455		2444455		2444455		2444455	
.3945	−0.767	.4091	−0.624	.4240	−0.260	.4383	−0.083
.3957	.784	.4104	.612	.4252	.248	.4408	.068
.3969	.755	.4116	.568	.4264	.220	.4420	.063
.3982	.756	.4128	.539	.4276	.191	.4432	.062
.4042	.683	.4141	.523	.4289	.198	.4445	.061
.4055	.663	.4153	.506	.4301	.191	.4457	.027
.4067	.662	.4215	.329	.4313	.161	.4469	.023
.4079	−0.646	.4227	−0.277	.4325	−0.145	.4481	−0.015

Table 13

Photographic observations of DY Her

J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}
2429068		2429068		2429068		2429068	
.3843	10.24	.3975	10.20	.4107	10.35	.4211	10.39
.3864	10.13	.4003	10.21	.4149	10.32	.4232	10.29
.3885	10.15	.4045	10.26	.4170	10.34	.4253	10.41
.3906	10.19	.4086	10.30	.4191	10.30	.4302	10.44
.3954	10.17						

Table 14

Photoelectric yellow observations of DY Her

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2441508		2441508		2441508		2441508	
.3723	+0.899	.4147	+1.083	.4522	+1.246	.4879	+1.285
.3737	.880	.4161	.095	.4550	.251	.4890	.297
.3761	.845	.4203	.117	.4564	.250	.4904	.280
.3772	.847	.4220	.129	.4585	.255	.4911	.278
.3789	.840	.4227	.142	.4599	.255	.4932	.267
.3800	.824	.4244	.150	.4619	.261	.4939	.266
.3828	.853	.4254	.149	.4626	.246	.4953	.260
.3855	.874	.4279	.149	.4654	.269	.4964	.270
.3893	.906	.4286	.166	.4689	.259	.4976	.258
.3904	.909	.4314	.154	.4713	.273	.4983	.251
.3987	.980	.4321	.166	.4720	.288	.5001	.231
.4001	0.990	.4342	.173	.4744	.283	.5011	.226
.4029	1.006	.4348	.167	.4754	.263	.5025	.214
.4036	.002	.4365	.182	.4782	.292	.5032	.210
.4057	.022	.4372	.202	.4800	.302	.5050	.191
.4067	.038	.4396	.192	.4810	.297	.5061	.189
.4085	.038	.4417	.215	.4828	.280	.5075	.159
.4092	.048	.4446	.212	.4838	.286	.5081	.159
.4112	.070	.4473	.242	.4855	.292	.5098	.130
.4126	+1.079	.4508	+1.257	.4862	+1.289	.5108	+1.124

Table 14 (cont.)

Photoelectric yellow observations of DY Her

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2441508		2441508		2444050		2444050	
.5126	+1.074	.5233	+0.860	.3995	+1.150	.4189	+0.855
.5133	1.048	.5240	+0.848	.4023	.119	.4203	.841
.5150	0.995			.4064	1.006	.4231	.869
.5157	.981	2444050		.4078	0.976	.4245	.874
.5171	.939	.3856	+1.259	.4106	.919	.4273	.891
.5182	.934	.3870	.284	.4120	.884	.4287	.902
.5203	.877	.3939	.227	.4148	.851	.4314	.938
.5213	+0.871	.3981	+1.177	.4162	+0.848	.4328	+0.951

Table 15

Photoelectric blue observations of DY Her

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2441508		2441508		2441508		2441508	
.3717	+0.622	.4282	+0.936	.4796	+1.131	.5175	+0.706
.3730	.629	.4307	.950	.4807	.149	.5196	.647
.3758	.569	.4317	.960	.4821	.136	.5210	.623
.3765	.551	.4335	.979	.4835	.132	.5230	.574
.3786	.538	.4362	0.997	.4848	.122	.5237	+0.579
.3793	.536	.4369	1.004	.4858	.128		
.3814	.550	.4386	0.992	.4876	.119	2444050	
.3821	.556	.4393	0.995	.4883	.119	.3849	+1.114
.3848	.574	.4410	1.018	.4901	.130	.3863	.112
.3862	.585	.4420	.025	.4908	.130	.3891	.083
.3890	.606	.4442	.023	.4925	.111	.3905	.080
.3897	.605	.4449	.031	.4935	.108	.3932	.079
.3980	.710	.4470	.051	.4950	.100	.3946	.055
.3994	.717	.4501	.058	.4960	.097	.3974	.000
.4022	.756	.4543	.086	.4973	.100	.3988	1.001
.4032	.758	.4557	.088	.4980	.083	.4016	0.906
.4064	.787	.4581	.094	.4998	.087	.4030	.872
.4078	.796	.4592	.099	.5008	.064	.4057	.780
.4088	.795	.4616	.096	.5022	.061	.4071	.742
.4109	.843	.4623	.112	.5047	.030	.4099	.661
.4119	.844	.4647	.120	.5057	.020	.4113	.642
.4140	.858	.4661	.118	.5071	1.004	.4141	.583
.4154	.868	.4678	.127	.5078	0.985	.4196	.538
.4182	.886	.4685	.130	.5094	.951	.4224	.546
.4196	.899	.4710	.134	.5105	.911	.4238	.564
.4217	.910	.4717	.120	.5119	.852	.4266	.595
.4223	.909	.4751	.121	.5129	.816	.4280	.609
.4241	.923	.4765	.118	.5147	.760	.4307	.646
.4272	+0.941	.4779	+1.130	.5154	+0.743	.4321	+0.664