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PERIOD CHANGES OF DWARF CEPHEIDS, I
CY AQUARII, EH LIBRAE, DY PEGASI

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ABSTRACT

The period changes of the dwarf cepheids CY Aqr, EH Lib and DY Peg are discussed and O-C diagrams of these stars are constructed. EH Librae has a highly stable, constant period. The period of CY Aquarii changed suddenly in 1952 ($\Delta P = -1.81 \times 10^{-7}$ day = 0.016 sec). Before the abrupt change its period showed small fluctuations, such fluctuations have also been shown since that time. The period of DY Pegasi has become shorter during the past 45 years. At present no distinction can be made between the continuous change (at the rate $\beta = -7.6 \times 10^{-13}$ days.cycle^{-1} = -0.03 sec.century^{-1}) or the abrupt change of period ($\Delta P = -6.5 \times 10^{-8}$ day) in 1961.

INTRODUCTION

Interest has been shown in the period changes of pulsating variable stars. A dwarf cepheid lends itself well to investigations of this kind because of the large number of cycles passing in a relatively short time, say in 10 or 20 years.

The bright (m<12 mag.) northern dwarf cepheids have been on the observing programme of our observatory for several years and very many photographic and photoelectric observations of these stars have been collected during the past almost fifty years. We feel that the time is now ripe for publishing our results and we plan to publish our observations and studies in a series of papers on the following stars: GP And, CY Aqr, RV Ari, YZ Boo, AD CMi, XX Cyg, DY Her, EH Lib, SZ Lyn, V567 Oph, DY Peg and AE UMa. In the present paper the results on CY Aqr, EH Lib and DY Peg are given. 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. *Oláh* and *Szeidl*, 1978).

The observations published here represent the work of observers at the Konkoly Observatory. The photographic plates were obtained by *I. Csada* (2 plates, 45 exp.), *L. Detre* (3 plates, 73 exp.), *D. Elter* (4 plates, 126 exp.), *I. Guman* (4 plates, 65 exp.) and *J. Sinka* (1 plate, 23 exp.). The table below summarizes the photoelectric observations of our observers.

Table 1

Number of observations

Observer	CY Aqr	EH Lib	DY Peg	Total
L. Detre	-	-	43	43
K. Gefferth	-	-	6	6
K. Olah	-	48	-	48
L. Patkos	112	-	-	112
L. Szabados	-	81	34	115
B. Szeidl	50	193	472	715
J. Tatai	-	-	60	60

All the available observations on each star are discussed separately and we construct the O-C diagrams as a means of studying the period changes.

CY AQUARII

The star BD +0°4900 was discovered to be variable by *Hoffmeister* (1934) on Berlin-Babelsberg patrol plates. The star first received the preliminary designation 391.1934 Aqr, shortly after it was given its final name CY Aqr. *Jensch*'s (1934a) early observation revealed a short period for this star - about 88 minutes. *Hoffmeister* confirmed this period. Later, *Jensch* (1934b) made a thorough visual investigation of this star. He also observed it photographically on old Babelsberg plates and was able to trace back its behaviour to 1928 to obtain the elements:

$$\text{Max.hel.} = \text{J.D. } 2427658.4103 + 0\overset{d}{.}0610388 \cdot E$$

Because of its very short period CY Aqr has attracted considerable attention in the past almost fifty years. It has always been a favourite object of visual observations. About 500 visual maxima have been published due to the work of *Ashbrook* (1949, 1954), *Barroso* (1969), *Braune* et al. (1972, 1977, 1979), *Busch* (1973, 1975, 1977, 1978), *Fedorov* (1950), *Figer* (1978), *Gossner* and *Ashbrook* (1946), *Graff* (1936), *Jensch* (1934a, b, 1935, 1937), *Kanishcheva* et al. (1966), *Kühn* (1951), *Lange* (1959), *Lange* and *Nekrasova* (1943), *Lause* (1934), *Mandell* et al. (1960), *Martynov* (1938), *Miczaika* (1938, 1946), *Parenago* (1935), *Pohl* and *Kizilirmak* (1964), *Rabkin* (1935), *Romanov* (1965), *Selivanov* (1934, 1936), *Smak* (1959), *Socher* (1955), *Soloviev* and *Shakovskoj* (1958), *Steinman* (1958), *Tsesevich* (1948) and *Wenzel* (1950, 1952). The star's short period, however, renders it a difficult object to study with high precision by visual methods. A more rigorous study made it evident that the visual maxima are unusable for the investigation of minute period changes. In view of this, we simply ignored the visual observations and confined ourselves to photographic and photoelectric observations.

From its discovery, the star was fairly regularly observed photographically until the early 50's and subsequently photoelectrically.

As early as in 1934 and 1935, *Balázs* and *Detre* (1935), *Dawson* (1934), *Gaposchkin* (1935), *Kulikovsky* (1937), *Schneller* (1936) and *Wachmann* (1935) made extensive photographic observations. They used fairly short exposure times in order not to distort the light curve. It is interesting to note that *Balázs* and *Detre* found no significant variations either in phase or height of maximum light whereas *Wachmann* found some deviations of the individual light curves from the mean one.

Gaposchkin (1935) and *Müller* (1935) made an attempt to determine the colour variation of CY Aqr. *Müller*'s exposure times were fairly long (6-14 minutes) compared with the star's period therefore not too much significance should be ascribed to his observations.

Wesselink (1941) started a thorough photographic investigation of this star at Leiden Observatory a month after the announcement of its discovery. His last exposure was made in the autumn of 1940 so that his homogeneous material consisted of 604 exposures covering over 36000 periods. Because the exposure times were sufficiently short ($1\frac{3}{4}$ - 2 minutes), the light curves were accurate enough to determine the correct value of the period:

$$P = 0.061\ 038\ 4798 \text{ day} \\ \pm .000\ 000\ 0061$$

The light curves appeared to be quite regular. For his period discussion *Wesselink* used a special point on the ascending branch of the light curves and did not give the epochs of maximum light. Using his mean light curve we were able to derive 18 times of maximum light from his rich observational material.

During the war less attention was paid to this star. The only publication was that of *Gossner* and *Ashbrook* (1946) who published three photographic maximum times for the year 1944.

Lohmann and *Miczaika* (1947), investigated the star's colour and light variation using their photographic and photovisual exposures made on two consecutive nights in 1946. The photovisual exposures were too long so they were not utilized to determine times of maximum light.

Alania (1954, 1956) also made photographic observations and published two epochs of light maximum but because of their very low accuracy they have been omitted from our discussion of period changes.

Both the photographic and the visual observations led to hopes of interesting results in the early 50's. Combining his observations with those of other astronomers *Ashbrook* (1954) stated that a phase jump of 0.0028 day had occurred about 1944-45. *Sauer* (1953) fancied waves on the visual light curve. Since 1950 a great number of photoelectric observations has been collected and we now know the photometric behaviour of the star fairly well. The light curve is smooth and is characteristic of the group to which the star belongs.

Detre was the first to observe CY Aqr photoelectrically. On four nights in 1950 and 1954 he made some two hundred observations without filters and obtained seven times of maximum light. As these observations were available, we thought it reasonable to publish here the epochs of the maxima mentioned (see Table 3).

Smith (1955) made a thorough investigation of the intrinsic variables with periods of less than 0.2 day and proposed the name "dwarf cepheids" for this group of stars. Among these objects he observed CY Aqr as well. Unfortunately, his observations are unavailable to the present authors.

The first photoelectric observations to be published were those of *Detre* and *Chang* (1960). Their nearly two hundred photoelectric measurements were made at the Purple Mountain Observatory, China, without filters on four nights in 1959. The variation in height and phase of the maxima was less than 0.06 mag. and 0.001 day, respectively, which showed a good repetitive nature of the light variation. *Detre* and *Chang* published only two epochs of maximum light but their observations allowed the determination of three further epochs. They also noticed that the O-C diagram could no longer be approximated by a linear formula and they derived an ephemeris with a quadratic term:

$$\text{Max.hel.} = \text{J.D. } 2427658.4079 + 0\overset{d}{.}061038576 \cdot E - 7\overset{d}{.}42 \times 10^{-13} \cdot E^2.$$

Hardie and *Tolbert* (1961) secured over sixteen hundred UBV observations on thirteen nights in 1959 and 1960. They found the light curves to be somewhat variable in shape and amplitude (about 0.1 mag.) at different cycles. A discussion of all the data available to them suggested that the period was gradually decreasing and a second-degree solution seems to have appeared to them as being satisfactory:

$$\text{Max.hel.} = \text{J.D. } 2431291.6657 + 0\overset{d}{.}061038475 \cdot E - 6\overset{d}{.}0 \times 10^{-13} \cdot E^2.$$

These same authors published only four epochs of maxima (*Hardie* and *Tolbert*, 1961). Their observations did, however, make it possible to determine the times of 22 individual maxima.

In the same year *Geyer* (1961) also published his study on short-periodic, pulsating variables. In his paper he gave an epoch of maximum light of CY Aqr.

Sanwal (1962) reported 39 times of maxima of this star observed at the Uttar Pradesh State Observatory, India, on twenty-two nights during the years 1959 to 1961. He found that the period had decreased significantly since the early observations.

In 1960 on one night 36 narrow band observations were secured by *McNamara* et al. (1961) for a study of the physical parameters of CY Aqr. One epoch of maximum was given by *McNamara* et al.; a further one could, however, be deduced from their observations.

Oosterhoff published *Ponsen*'s five_colour observations obtained on one night in August, 1961 (*Ponsen* and *Oosterhoff*, 1966). These observations have allowed us to determine an epoch of maximum light. *Fitch* et al. (1966) also observed this star in the UBV system on two nights in 1964 and gave two times of maximum.

In September-October 1964 *Karetnikov* and *Medvedev* (1966) also observed this star and collected almost 600 observations in B and V on 11 nights. They determined 11 times of maxima and, combining these epochs with all the others available to them, they obtained the new elements with a quadratic term:

$$\text{Max.hel.} = \text{J.D. } 2431291.6657 + 0\overset{d}{.}061038475 \cdot E - 6\overset{d}{.}35 \times 10^{-13} \cdot E^2.$$

Judging by their measurements, CY Aqr does not have a significant light curve variation (it being less than 0.1 mag. in the height of maximum in both colours).

Zissell (1968) obtained more than 2000 photoelectric observations in V during the autumns of 1965 and 1966. These observations covered twenty-four cycles and made possible an accurate study of the variations in the period of CY Aqr. In his study *Zissell* used the epochs of the magnitude on the rising branch at which the rising and descending branches were separated by 0.220 period. The corresponding epochs of that critical magnitude are given in his paper only. Since in our investigations we have always used the times of maximum light we had to determine these times from *Zissell*'s material. In contrast with *Detre* and *Chang*'s (1960), *Hardie* and *Tolbert*'s (1961) and *Karetnikov* and *Medvedev*'s (1966) results *Zissell* stated that the period was essentially constant, at least between 1953 and 1966:

$$P = 0.061\ 038\ 3405 \text{ day}$$
$$\pm .000\ 000\ 0022$$

and that an ephemeris with a quadratic term was inadequate as a means of accounting for all the observations. *Zissell* also found from his observations that the individual cycles were significantly different, especially at maximum. The variation in the height of maximum exceeded 0.1 mag.

Nather and *Warner* (1972) made sequential three colour observations of CY Aqr on two nights in November 1970, with fairly high time resolution. They did not find the irregularities on the light curves reported by other observers. Since *Nather* and *Warner*'s technique was superior to that of other observers, the reported irregularities can obviously be explained by the inferior technique. According to *Nather* and *Warner* the light curve of CY Aqr is smooth but small changes in the height of light maximum may occur. Their excellent observations also show that no dependence of time of maximum on colours could be obtained.

Elst (1972) looked for overtones in the pulsation of CY Aqr. He analysed *Zissell*'s (1968) and his own 255 UBV observations and found a beat period of P_b= 0.1222 day. He remarked, however, that the beat phenomenon of this star was very small and therefore his results could not be regarded as definitive.

Fitch (1973) reanalysed the published photoelectric observations and found that CY Aqr had a beat period of probable length 0.17766 day. His result can be interpreted using the present theory of pulsation whereas *Elst*'s result is not consistent with that.

Percy (1975) rediscussed all the observations available to him. According to his investigation the period of CY Aqr remained constant from 1934 to 1951, changed abruptly in 1951, and since then it has remained constant again. He also analysed several well observed light curves of this star by the maximum entropy method of spectral analysis and found that the beat period of *Elst* (1972) was not real; it was, rather, an artifact of his harmonic analysis method.

A fairly high speed photoelectric photometry was carried out by *Geyer* and *Hoffmann* (1974, 1975a) with a double-beam photometer in B and V for five consecutive cycles in October 1973. They published six times of maxima. It is worth mentioning that their observations did not confirm the beat period given by either *Elst* (1972) or *Fitch* (1973). They considered it likely that the beat phenomenon of this star was fictitious.

Recently, *Ficarrotta* and *Romoli* (1979) performed photoelectric observations in B and V, and published 14 times of light maxima for the years 1974 and 1977.

Since 1935 a great number of photographic and photoelectric observations have been collected at the Konkoly Observatory, Budapest, in order to study the stability of the period of CY Aqr. The 267 photographic observations obtained on ten nights between 1935 and 1952 are given in Table 9. In measuring the photographic plates we used the comparison stars of *Balázs* and *Detre* (1935). These observations allowed us to determine 12 epochs of photographic maxima.

The photoelectric investigation of this star in two colours was commenced at Konkoly Observatory in 1972. In all, 162 observations have been collected and are given in Tables 10-11. As a comparison star we used BD $+0^{\circ}4903$. Table 2 gives the comparison stars for CY Aqr used by different authors.

Table 2

Comp. star	V	B-V	U-B	References
BD $+0^{\circ}4902$	9.72	+0.76	+0.38	Hardie and Tolbert (1961)
BD $+0^{\circ}4903$	10.19	+1.32		Geyer (1961)
	10.08	+1.19		present paper
BD $+0^{\circ}4906$	9.69	+0.50		Karetnikov and Medvedev (1966)

The differential magnitudes were corrected for transformation to the standard system and for differential extinction. In Figure 1 all our photoelectric B and V observations are plotted against phase.

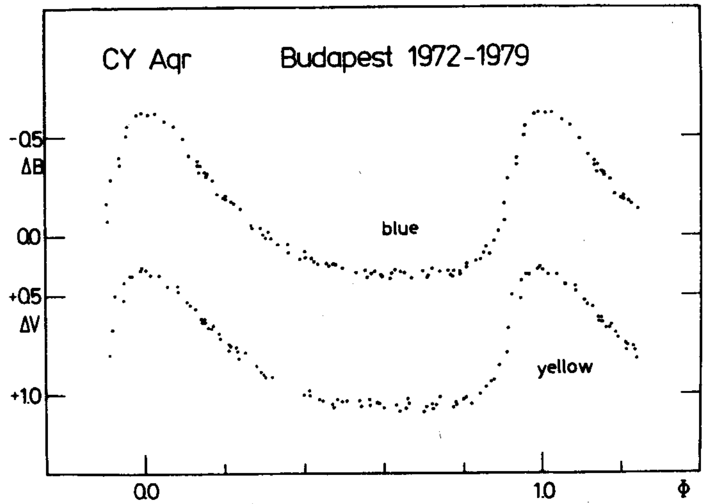

Figure 1: B and V light curves of CY Aqr

In Table 3 we have gathered all the photographic and photoelectric maxima available to us; as we mentioned earlier, we disregarded the visual maxima. The O-C diagram (Figure 2) was completed by using the ephemeris:

$$\text{Max.hel.} = \text{J.D. } 2434308.4310 + 0\overset{d}{.}061038395 \cdot E.$$

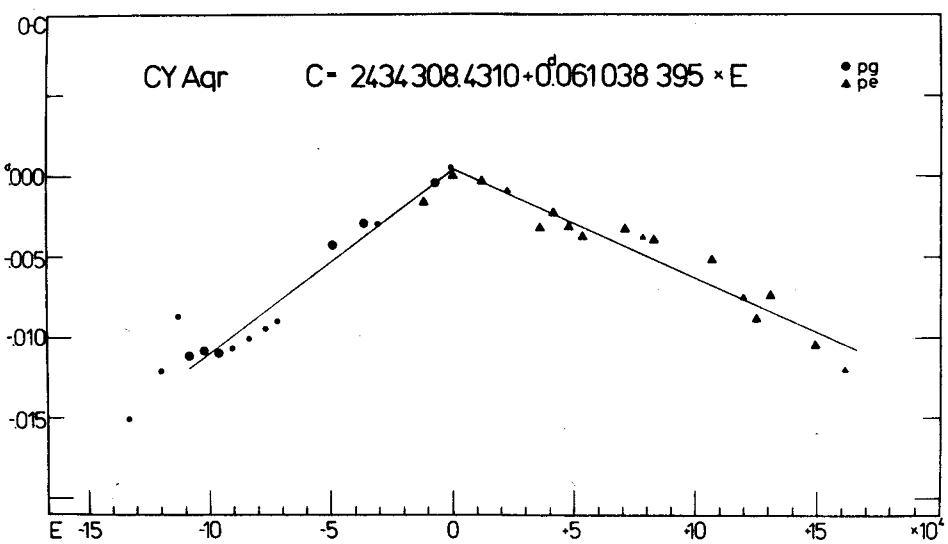

Figure 2: O-C diagram of CY Aqr

Table 3

Photographic and photoelectric maxima of CY Aqr

year	Hel.Max.J.D.	Remarks	E	O-C	$\overline{E}$	$\overline{O-C}$	n
1930	2426159.485	pg Je[1]	-133505	-0.0151	-133505	-0.0151	1
1932	27013.293	pg Je[1]	-119517	-0.0121	-119517	-0.0121	1
1933	413.220	pg Je[1]	-112965	-0.0087	-112965	-0.0087	1
1934	671.5317	pg BD	-108733	-0.0115	-108294	-0.0112	19
	.5922	pg BD	-108732	-0.0120			
	684.4712	pg Wa	-108521	-0.0121			
	685.3875	pg Wa	-108506	-0.0114			
	688.3780	pg Wa	-108457	-0.0118			
	.5010	pg BD	-108455	-0.0109			
	690.3940	pg BD	-108424	-0.0101			
	692.5287	pg Wa	-108389	-0.0117			
	.652	pg Ga	-108387	-0.0105			
	693.3829	pg We[2]	-108375	-0.0120			
	.4462	pg BD	-108374	-0.0098			
	694.3590	pg Wa	-108359	-0.0126			
	695.4600	pg BD	-108341	-0.0102			
	697.4721	pg We[2]	-108308	-0.0124			
	710.5949	pg Da	-108093	-0.0129			
	712.3069	pg BD	-108065	-0.0099			
	717.4332	pg Wa	-107981	-0.0109			
	744.2302	pg BD	-107542	-0.0097			
	.2909	pg BD	-107541	-0.0101			
1935	28045.3924	pg Pp	-102608	-0.0110	-102360	-0.0108	14
	046.3071	pg Ku[2]	-102593	-0.0118			
	.4901	pg Ku[2]	-102590	-0.0120			
	047.2826	pg Ku[2]	-102577	-0.0130			
	.3464	pg Ku[2]	-102576	-0.0102			
	.4064	pg Ku[2]	-102575	-0.0112			
	.4065	pg Mü	-102575	-0.0111			
	.4668	pg Ku[2]	-102574	-0.0119			
	048.3823	pg Ku[2]	-102559	-0.0119			
	074.3254	pg Pp	-102134	-0.0102			
	.3860	pg Pp	-102133	-0.0106			
	090.3189	pg Sc[2]	-101872	-0.0087			
	.3800	pg Sc[2]	-101871	-0.0087			
	094.2860	pg Sc[2]	-101807	-0.0091			
1936	397.5233	pg Pp	- 96839	-0.0106	- 96184	-0.0110	11
	422.4259	pg We[2]	- 96431	-0.0116			
	.4874	pg We[2]	- 96430	-0.0112			
	.5490	pg We[2]	- 96429	-0.0106			
	423.3418	pg We[2]	- 96416	-0.0113			
	.4027	pg We[2]	- 96415	-0.0114			
	.4650	pg We[2]	- 96414	-0.0102			
	.5251	pg We[2]	- 96413	-0.0111			
	451.4802	pg We[2]	- 95955	-0.0116			
	501.2275	pg We[2]	- 95140	-0.0106			
	.2878	pg We[2]	- 95139	-0.0113			
1937	782.5534	pg We[2]	- 90531	-0.0107	- 90531	-0.0107	1
1938	29195.3568	pg We[2]	- 83768	-0.0099	- 83719	-0.0101	2
	201.3382	pg We[2]	- 83670	-0.0103			
1939	568.3020	pg We[2]	- 77658	-0.0093	- 77486	-0.0095	2
	589.2989	pg We[2]	- 77314	-0.0096			

Table 3 (cont.)

year	Hel.Max.J.D.	Remarks	E	O-C	$\overline{E}$	$\overline{O-C}$	n
1940	2429880.4529	pg We[2]	- 72544	-0.0088	- 72144	-0.0090	2
	929.2833	pg We[2]	- 71744	-0.0091			
1944	31268.8978	pg GA	- 49797	-0.0042	- 49486	-0.0043	3
	296.9139	pg GA	- 49338	-0.0048			
	297.8304	pg GA	- 49323	-0.0038			
1946	32091.3914	pg LM[2]	- 36322	-0.0030	- 36310	-0.0029	4
	.4532	pg LM[2]	- 36321	-0.0023			
	092.3680	pg LM[2]	- 36306	-0.0030			
	093.4056	pg Pp	- 36289	-0.0031			
1947	440.4700	pg Pp	- 30603	-0.0030	- 30603	-0.0030	1
1950	33560.4638	pe De	- 12254	-0.0027	- 12219	-0.0016	4
	563.2728	pe De	- 12208	-0.0015			
	.3350	pe De	- 12207	-0.0003			
	.3947	pe De	- 12206	-0.0017			
1951	860.5310	pg Pp	- 7338	-0.0003	- 7281	-0.0004	4
	861.5070	pg Pp	- 7322	-0.0009			
	.5679	pg Pp	- 7321	-0.0010			
	(867.452	pg Al	- 7224	-0.0376)			
	872.5565	pg Pp	- 7141	+0.0007			
1952	34253.5575	pg Pp	- 899	0.0000	- 762	+0.0005	2
	270.3440	pg Pp	- 624	+0.0010			
	308.4310	pe Sm[3]	0	0.0000	0	0.0000	1
1954	35032.4075	pe De	+ 11861	+0.0001	+ 12071	-0.0003	4
	036.3750	pe De	+ 11926	+0.0001			
	.4353	pe De	+ 11927	-0.0006			
	075.6218	pe HT[4]	+ 12569	-0.0008			
1955	(337.422	pg Al	+ 16858	+0.0057)			
1956	689.9121	pe HT[4]	+ 22633	-0.0009	+ 22633	-0.0009	1
1958	36487.1936	pe Sa	+ 35695	-0.0029	+ 36292	-0.0033	18
	490.1231	pe Sa	+ 35743	-0.0033			
	.1837	pe Sa	+ 35744	-0.0037			
	.3068	pe Sa	+ 35746	-0.0027			
	491.2216	pe Sa	+ 35761	-0.0034			
	.2831	pe Sa	+ 35762	-0.0030			
	492.1979	pe Sa	+ 35777	-0.0038			
	.2595	pe Sa	+ 35778	-0.0032			
	.3201	pe Sa	+ 35779	-0.0036			
	541.2740	pe Ge	+ 36581	-0.0025			
	546.0949	pe Sa	+ 36660	-0.0037			
	.1555	pe Sa	+ 36661	-0.0041			
	549.0860	pe Sa	+ 36709	-0.0034			
	.1472	pe Sa	+ 36710	-0.0033			
	568.0690	pe Sa	+ 37020	-0.0034			
	569.0457	pe Sa	+ 37036	-0.0033			
	.1069	pe Sa	+ 37037	-0.0031			
	570.0834	pe Sa	+ 37053	-0.0032			
1959	735.8044	pe HT[2]	+ 39768	-0.0015	+ 41546	-0.0023	26
	.8654	pe HT[2]	+ 39769	-0.0015			
	749.7819	pe HT[2]	+ 39997	-0.0018			
	.8432	pe HT[2]	+ 39998	-0.0015			
	792.6920	pe HT[2]	+ 40700	-0.0017			
	.7528	pe HT[2]	+ 40701	-0.0019			
	.8750	pe HT[2]	+ 40703	-0.0018			
	803.8012	pe HT[2]	+ 40882	-0.0015			

Table 3 (cont.)

year	Hel.Max.J.D.	Remarks	E	O-C	$\overline{E}$	$\overline{O-C}$	n
1959	2436803.8617	pe HT[2]	+ 40883	-0.0020			
	832.6114	pe HT[2]	+ 41354	-0.0014			
	.7330	pe HT[2]	+ 41356	-0.0019			
	835.6017	pe HT[2]	+ 41403	-0.0020			
	.6624	pe HT[2]	+ 41404	-0.0023			
	842.6818	pe HT[2]	+ 41519	-0.0023			
	.7430	pe HT[2]	+ 41520	-0.0022			
	845.7345	pe HT[2]	+ 41569	-0.0015			
	871.1246	pe Sa	+ 41985	-0.0034			
	902.0108	pe DC[2]	+ 42491	-0.0026			
	.0716	pe DC[2]	+ 42492	-0.0029			
	903.0490	pe DC	+ 42508	-0.0021			
	906.0397	pe DC	+ 42557	-0.0023			
	928.0728	pe Sa	+ 42918	-0.0040			
	.1343	pe Sa	+ 42919	-0.0036			
	.9895	pe DC[2]	+ 42933	-0.0029			
	929.0511	pe Sa	+ 42934	-0.0024			
	.1105	pe Sa	+ 42935	-0.0040			
1960	37195.7276	pe HT[2]	+ 47303	-0.0026	+ 47759	-0.0032	21
	.7894	pe HT[2]	+ 47304	-0.0018			
	196.6437	pe HT[2]	+ 47318	-0.0021			
	.7054	pe HT[2]	+ 47319	-0.0014			
	.7658	pe HT[2]	+ 47320	-0.0021			
	198.2906	pe Sa	+ 47345	-0.0032			
	202.1968	pe Sa	+ 47409	-0.0035			
	204.1506	pe Sa	+ 47441	-0.0029			
	222.1557	pe Sa	+ 47736	-0.0041			
	.2165	pe Sa	+ 47737	-0.0044			
	224.2303	pe Sa	+ 47770	-0.0048			
	225.6365	pe HT[2]	+ 47793	-0.0025			
	.6978	pe HT[2]	+ 47794	-0.0023			
	226.1231	pe Sa	+ 47801	-0.0042			
	233.6340	pe Mc	+ 47924	-0.0010			
	.6940	pe Mc[2]	+ 47925	-0.0021			
	250.1112	pe Sa	+ 48194	-0.0042			
	253.1013	pe Sa	+ 48243	-0.0050			
	255.1161	pe Sa	+ 48276	-0.0045			
	257.1307	pe Sa	+ 48309	-0.0041			
	279.1041	pe Sa	+ 48669	-0.0045			
1961	524.5425	pe PO[2]	+ 52690	-0.0015	+ 53450	-0.0038	6
	578.1311	pe Sa	+ 53568	-0.0046			
	.1930	pe Sa	+ 53569	-0.0038			
	.2539	pe Sa	+ 53570	-0.0039			
	583.1360	pe Sa	+ 53650	-0.0049			
	.1980	pe Sa	+ 53651	-0.0039			
1964	38643.4958	pe KM	+ 71022	-0.0041	+ 71292	-0.0033	13
	644.4117	pe KM	+ 71037	-0.0038			
	645.3895	pe KM	+ 71053	-0.0026			
	.4508	pe KM	+ 71054	-0.0023			
	652.4082	pe KM	+ 71168	-0.0033			
	.4693	pe KM	+ 71169	-0.0032			
	653.4454	pe KM	+ 71185	-0.0037			
	654.4835	pe KM	+ 71202	-0.0033			
	675.2981	pe KM	+ 71543	-0.0028			

Table 3 (cont.)

year	Hel.Max.J.D.	Remarks	E	O-C	$\overline{E}$	$\overline{O-C}$	n
1964	2438675.3592	pe KM	+ 71544	-0.0027			
	676.3344	pe KM	+ 71560	-0.0041			
	680.730	pe Fi	+ 71632	-0.0033			
	.791	pe Fi	+ 71633	-0.0033			
1965	39089.5647	pe Zi[a]	+ 78330	-0.0038	+ 78330	-0.0038	1
1966	350.6861	pe Zi[b]	+ 82608	-0.0046	+ 83001	-0.0040	22
	.7490	pe Zi[b]	+ 82609	-0.0028			
	.8087	pe Zi[b]	+ 82610	-0.0041			
	.8692	pe Zi[b]	+ 82611	-0.0046			
	351.7253	pe Zi[b]	+ 82625	-0.0031			
	.8460	pe Zi[b]	+ 82627	-0.0045			
	355.6920	pe Zi[b]	+ 82690	-0.0039			
	.7546	pe Zi[b]	+ 82691	-0.0023			
	.8145	pe Zi[b]	+ 82692	-0.0035			
	.8763	pe Zi[b]	+ 82693	-0.0027			
	356.7300	pe Zi[b]	+ 82707	-0.0035			
	.7908	pe Zi[b]	+ 82708	-0.0038			
	.8527	pe Zi[b]	+ 82709	-0.0029			
	401.5920	pe Zi[b]	+ 83442	-0.0048			
	.6527	pe Zi[b]	+ 83443	-0.0051			
	.7139	pe Zi[b]	+ 83444	-0.0049			
	405.6204	pe Zi[b]	+ 83508	-0.0049			
	.6822	pe Zi[b]	+ 83509	-0.0041			
	.7428	pe Zi[b]	+ 83510	-0.0046			
	406.5980	pe Zi[b]	+ 83524	-0.0039			
	.6578	pe Zi[b]	+ 83525	-0.0051			
	.7196	pe Zi[b]	+ 83526	-0.0044			
1970	40779.7783	pe El[a]	+106021	-0.0044	+106768	-0.0052	5
1973	.8390	pe El[a]	+106022	-0.0047			
	.9005	pe El[a]	+106023	-0.0043			
	892.6364	pe NW	+107870	-0.0063			
	894.6507	pe NW	+107903	-0.0062			
1972	41623.2647	pe Pp	+119840	-0.0076	+119840	-0.0076	1
	958.3639	pe GH	+125330	-0.0091	+125344	-0.0089	6
	959.2799	pe GH	+125345	-0.0087			
	.3405	pe GH	+125346	-0.0092			
	.4018	pe GH	+125347	-0.0089			
	.4634	pe GH	+125348	-0.0083			
	.5234	pe GH	+125349	-0.0094			
1974	42302.5015	pe FR	+130968	-0.0060	+130987	-0.0074	7
	.5607	pe FR	+130969	-0.0079			
	303.4778	pe FR	+130984	-0.0063			
	.5371	pe FR	+130985	-0.0081			
	304.3927	pe FR	+130999	-0.0070			
	.4533	pe FR	+131000	-0.0074			
	.5126	pe FR	+131001	-0.0092			
1977	43401.3706	pe FR	+148971	-0.0111	+148981	-0.0105	7
	.4327	pe FR	+148972	-0.0101			
	.4937	pe FR	+148973	-0.0101			
	402.3478	pe FR	+148987	-0.0106			
	.4086	pe FR	+148988	-0.0108			
	.4699	pe FR	+148989	-0.0105			
	.5311	pe FR	+148990	-0.0104			
1979	44158.3069	pe Pp	+161372	-0.0120	+161372	-0.0120	1

Remarks to Table 3: Je = Jensch (1934b), BD = Balazs and Detre (1935), Wa = Wachmann (1935), Ga = Gaposchkin (1935), We = Wesselink (1941), Da = Dawson (1934), Ku = Kulikovsky (1937), Mü = Müller (1935), Sc = Schneller (1936), GA = Gossner and Ashbrook (1946), LM = Lohmann and Miczaika (1947), De = Detre (unpubl.), Al = Alania (1954, 1956), Sm = Smith (1955), HT = Hardie and Tolbert (1961), Sa = Sanwal (1962), Ge = Geyer (1961), DC = Detre and Chang (1960), Mc = McNamara et al. (1961), PO = Ponsen and Oosterhoff (1966), KM = Karetnikov and Medvedev (1966), Fi= Fitch et al. (1966), Zi = Zissell (1968), El = Elst (1972), NW = Nather and Warner (1972), GH = Geyer and Hoffmann (1974), FR= Ficarrotta and Romoli (1979), Pp = present paper
pg = photographic, pe = photoelectric, [1]= normal maxima, [2]= maximum time determined by us, [3]= as quoted by Sanwal (1962), [4]= observed by Fitch, [5]= maximum time determined by Fitch (1973)

We are convinced, from the O-C diagram, that the period change of CY Aqr cannot be described by a quadratic term. Our results are in agreement with *Percy*'s (*Percy*, 1975): the period of CY Aqr remained more or less constant until 1952, at that time it changed abruptly and became shorter after which it again remained constant.

Using the yearly means of the O-C values in Table 3 we formed yearly mean epochs of maximum light. These mean photographic and photoelectric maxima of CY Aqr are given in Table 4. The data of this table were used to carry out a least-squares solution for the period before 1952 (C_1) and after it (C_2). The resulting ephemerides are:

$$C_1(\text{Max.hel.}) = \text{J.D. } 2434308.4314 + 0\overset{d}{.}061038509 \cdot E$$
$$C_2(\text{Max.hel.}) = \text{J.D. } 2434308.4314 + 0\overset{d}{.}061038328 \cdot E$$

Table 4

Mean photographic and photoelectric maxima of CY Aqr

year	Mean Hel. Max.		W	E	$O-C_1$	$O-C_2$
1930	J.D.2426159.485	pg	0	-133505	-0.0003	--
1932	27013.293	pg	0	-119517	+0.0011	--
1933	27413.220	pg	0	-112965	+0.0038	--
1934	27698.3279	pg	2	-108294	+0.0008	--
1935	28060.5301	pg	2	-102360	+0.0005	--
1936	28437.5030	pg	2	- 96184	-0.0005	--
1937	28782.5534	pg	1	- 90531	-0.0007	--
1938	29198.3475	pg	1	- 83719	-0.0010	--
1939	29578.8004	pg	1	- 77486	-0.0011	--
1940	29904.8680	pg	1	- 72144	-0.0012	--
1944	31287.8807	pg	2	- 49486	+0.0010	--
1946	32092.1240	pg	2	- 36310	+0.0009	--
1947	32440.4700	pg	1	- 30603	+0.0001	--
1950	33562.6013	pe	2	- 12219	-0.0006	--
1951	33864.0101	pg	2	- 7281	+0.0001	--
1952	34261.9202	pg	1	- 762	+0.0001	--

Table 4 (cont.)

year	Mean Hel. Max.	W	E	$O-C_1$	$O-C_2$
1952	J.D 2434308.4310	pe 2	0	-0.0004	-0.0004
1954	35045.2252	pe 2	+ 12071	--	+0.0001
1956	35689.9121	pe 1	+ 22633	--	+0.0002
1958	36523.6331	pe 2	+ 36292	--	-0.0013
1959	36844.3299	pe 2	+ 41546	--	+0.0001
1960	37223.5605	pe 2	+ 47759	--	-0.0004
1961	37570.9294	pe 2	+ 53450	--	-0.0006
1964	38659.9770	pe 2	+ 71292	--	+0.0011
1965	39089.5647	pe 1	+ 78330	--	+0.0011
1966	39374.6748	pe 2	+ 83001	--	+0.0011
1970	40825.3732	pe 2	+106768	--	+0.0016
1972	41623.2647	pe 1	+119840	--	+0.0001
1973	41959.2187	pe 2	+125344	--	-0.0009
1974	42303.6599	pe 2	+130987	--	+0.0010
1977	43401.9816	pe 2	+148981	--	-0.0009
1979	44158.3069	pe 1	+161372	--	-0.0016

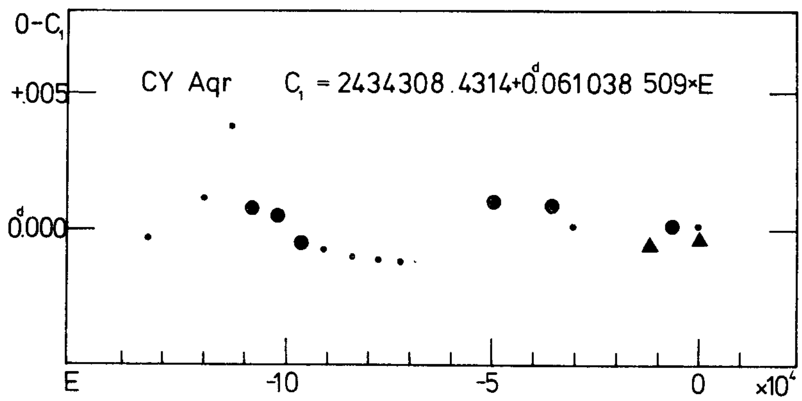

Figure 3: $O-C_1$ diagram of CY Aqr

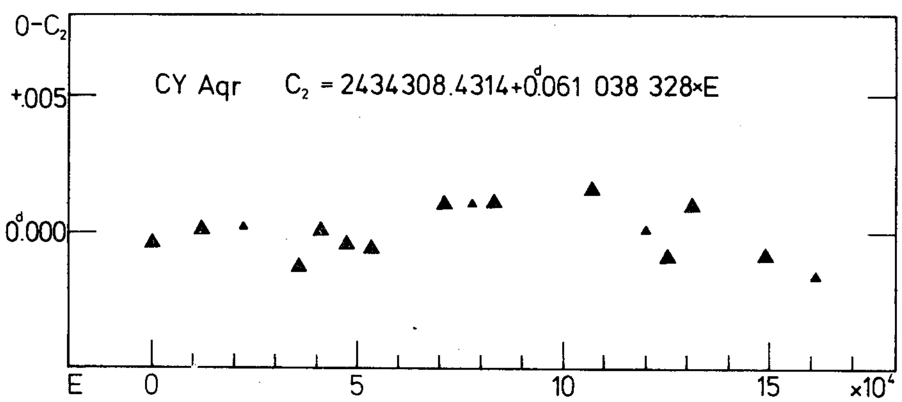

Figure 4: $O-C_2$ diagram of CY Aqr

The corresponding $O-C_1$ and $O-C_2$ diagrams are plotted in Figures 3 and 4, respectively. Some fluctuations with an amplitude of 0.002 day ≈ 3 minutes are clearly seen, but these do not appear to be periodic. Obviously the reality of these fluctuations can be questioned. They may be caused by systematic differences between the results of different authors. But the phase shift around E = -60000 was already noticed by *Ashbrook* (1954). His result also supports the idea that the period of CY Aqr before and after the large period jump (1.81×10^{-7}day ≈ 0.016sec) has not been strictly constant, it has always been subject to small random variations (in this context see *Balázs-Detre* and *Detre*, 1965).

EH LIBRAE

The star BD $-0^{o}2911$ ($8\overset{m}{.}9$) = EH Lib was found to be variable in light by *A.N. Vyssotsky* on an objective prism plate. He took note of the variation in density across the width of its spectrum. *Code* (1950) observed the star photoelectrically on three successive nights, June 4 through June 6, 1950. He determined the type of variability and gave a preliminary period of the star as 0.08842 day.

In the following year *Ashbrook* (1952) made 83 photographic observations which yielded three heliocentric Julian dates of maximum light and which resulted in the accurate new elements:

$$\text{Max.hel.} = \text{J.D. } 2433673.1688 + 0\overset{d}{.}08841381 \cdot E$$

Since *Code*'s photoelectric and *Ashbrook*'s photographic observations a great number of visual observations have been collected. *Batyrev* (1951, 1953a, 1957, 1964) observed the star visually between 1951 and 1963 and, utilizing his some 560 observations, he gave the time of 23 individual light maxima. He stated that light curve variation was present but he could not determine the secondary period. *Tsesevich* (1956) also gave a visual normal maximum.

The German amateurs (*Pohl*, 1954; *Braune* and *Hübscher*, 1967; *Braune*, *Hübscher* and *Mundry*, 1970, 1972, 1977, 1979; *Braune* and *Mundry*, 1973; *Berthold*, 1976) have been particularly busy in obtaining visual observations. Between 1951 and 1977 they determined 68 dates of visual maximum.

Berdnikov (1972, 1975, 1977) also put EH Lib on his observing programme of dwarf cepheids. Between 1972 and 1975 he made nearly 700 visual estimations, determined more than 30 maxima, and gave four normal maxima; one for each year from 1972 to 1975. Mostly discussing the visual observations he suggested that the period of the star varied with a period of about 1800 days ≈ 20400 cycles and the form of the light curve changed. As we shall see later on these statements are completely erroneous.

Because the observational errors of visual light estimation are always large and, in consequence, the errors in dates of visual light maxima are considerable, we have ignored all the observed visual maxima and have not listed them in Table 5. In a scrupulous period analysis they are of no value.

Some photographic observations were also made on the star.

Alania (1954), using only a few observations, gave a poorly determined time of photographic maximum. Although this is given in the table of maxima (Table 5), it has been disregarded in constructing the O-C diagram of EH Lib (Figure 6).

Burnicki and *Krygier* (1958) photographically investigated the colour variation of the variable during its light variation. From May 1954 to May 1956, 66 exposures were made: 41 in the pg and 25 in the pv spectral region. Even though *Burnicki* and *Krygier* gave no epochs of maximum light, we were able to determine one normal maximum from their accurate measurements.

The last observers to report on photographic observations were *Harding* and *Penston* (1966). Curiously enough their photographic photometry definitely indicated a period of less than 2 hours in 1965, and over a period of a year they deduced a period of 0.082478 day. In view of this, it is rather surprising that the maximum time given by them fits very well in the O-C diagram (Figure 6) calculated using our elements. We are convinced that the period was around $2^h07^m18^s.9$ in 1965. *Harding* and *Penston*'s observations were somewhat poorer, but unfortunately they did not publish their measurements and it is thus hard to judge their mistake.

Fitch (1957) observed EH Lib photoelectrically in three colours of the UBV system, his observations totalled 6.1 cycles on 4 nights in 1955 and 1956. In a result inconsistent with the poor visual observations, he found that the light curve of the variable is quite regular and the height of maximum varies by less than ±0.015 mag. From a very accurate analysis of his photoelectric light curves of high precision he found a mean difference maximum minus median = +0.0086 ±0.0003 m.e. Using this value we converted his 8 epochs of median magnitude to the epochs of maximum light (6 in 1955 and 2 in 1956) and these dates are given in Table 5. He also noted that "maximum brightness in blue and yellow occurs at the same phase, within the limits of error of the observations". *Fitch*'s comparison star was BD $-0^{\circ}2909$ with its magnitude and colours as follows: V = 10.26, B-V = +0.44 and U-B = -0.03. Using the observations from 1950 to 1956 *Fitch* gave the highly accurate ephemeris:

$$\text{Max.hel.} = \text{J.D. } \underset{\pm .0003}{2433438.6078} + \underset{\pm .00000002}{0\overset{d}{.}08841325} \cdot E$$

In 1960 and 1961 *Sanwal* and *Pande* (1961) carried out photoelectric observations in blue and yellow lights on ten nights covering 15 cycles. They also found the light curve of this variable star quite regular and did not detect any differences between times of maximum brightness in blue and yellow light. They listed 9 epochs of maximum light for the year 1960 and 5 epochs for 1961. Their least-squares solution yielded the following very good elements:

$$\text{Max.hel.} = \text{J.D. } \underset{\pm .0003}{2433438.6079} + \underset{\pm .00000001}{0\overset{d}{.}08841324} \cdot E$$

In 1960 *Oosterhoff* and *Walraven* (1966) obtained more than 400 five-colour measurements of EH Librae, that unambiguously show the strictly repetitive nature of the light variation. They published three new epochs of light maximum. Because *Oosterhoff* and *Walraven* took into account the visual observations of low weight, as well, their elements:

$$\text{Max.hel.} = \text{J.D. } 2433438.6090 + 0\overset{d}{.}088413216 \cdot E$$

are less accurate than the elements determined by *Fitch* and by *Sanwal* and *Pande*.

Fitch et al. (1966) made 120 photoelectric observations in UBV on three nights in 1964, and gave two dates of maximum. Using *Fitch*'s (1957) old mean light curves we redetermined the two dates from their new observations. We have already listed these new epochs in Table 5.

Among other variable stars *Epstein* (1969) observed EH Lib in 1966 in the four-colour system of *Strömgren* and *Perry*. Unfor-

Table 5

Photographic and photoelectric maxima of EH Lib

year	Hel.Max.J.D.	Remarks	E	O-C	$\overline{E}$	$\overline{O-C}$	n
1950	2433438.6076	pe Co	0	-0.0002	0	-0.0002	1
1951	711.7165	pg As	+ 3089	+0.0002	3308	-0.0002	3
	737.709	pg As	3383	-0.0008			
	743.722	pg As	3451	+0.0001			
1953	(34485.518	pg Al	11841	+0.0090)	11868	-0.0003	2
	487.454	pg Pp	11863	-0.0001			
	488.426	pg Pp	11874	-0.0006			
1955	35223.7596	pe Fi	20191	0.0000	20271	+0.0002	6
	.8478	pe Fi	20192	-0.0002			
	.9372	pe Fi	20193	+0.0008			
	225.7932	pe Fi	20214	+0.0001			
	243.7414	pe Fi	20417	+0.0004			
	.8298	pe Fi	20418	+0.0004			
1956	599.958	pg BK[1]	24446	+0.0001	24446	+0.0001	1
	622.6799	pe Fi	24703	-0.0002	24704	-0.0001	2
	.7686	pe Fi	24704	0.0000			
1960	36996.4443	pe SP	40241	-0.0008	41170	+0.0001	12
	37054.2674	pe SP	40895	0.0000			
	.3552	pe SP	40896	-0.0006			
	075.2222	pe SP	41132	+0.0009			
	.3109	pe SP	41133	+0.0012			
	.3982	pe SP	41134	+0.0001			
	077.1670	pe SP	41154	+0.0006			
	082.2054	pe SP	41211	-0.0006			
	105.1927	pe SP	41471	-0.0007			
	114.301	pe OW	41574	+0.0010			
	116.245	pe OW	41596	-0.0001			
	.334	pe OW	41597	+0.0005			
1961	403.3217	pe SP	44843	-0.0012	44891	-0.0004	5
	.4115	pe SP	44844	+0.0002			
	408.3624	pe SP	44900	0.0000			
	410.3074	pe SP	44922	-0.0001			
	412.3402	pe SP	44945	-0.0008			
1964	38441.0300	pe FE[1]	56580	+0.0009	56727	+0.0004	2
	467.0225	pe FE[1]	56874	-0.0001			
1965	822.710	pg HP	60897	+0.0009	60897	+0.0009	1
1969	40365.6104	pe TR	78348	+0.0018	78515	+0.0021	8
	368.6169	pe TR	78382	+0.0023			
	.7054	pe TR	78383	+0.0024			
	387.5371	pe TR	78596	+0.0021			
	.6253	pe TR	78597	+0.0018			
	.7142	pe TR	78598	+0.0023			
	388.5100	pe TR	78607	+0.0024			
	.5978	pe TR	78608	+0.0018			
1970	794.6775	pe BH[1,2]	83201	-0.0005	83201	-0.0005	1
1972	41476.4327	pe Pp	90912	+0.0002	90912	+0.0002	1
1974	42159.5129	pe Pp	98638	-0.0004	98766	-0.0003	4
	162.5181	pe KM	98672	-0.0012			
	178.7868	pe MF	98856	-0.0005			
	182.4133	pe KM	98897	+0.0010			
1975	515.5531	pe BC	102665	-0.0003	102940	-0.0002	15

Table 5 (cont.)

year	Hel.Max.J.D.	Remarks	E	O-C	$\bar{E}$	$\overline{O-C}$	n
1975	2442515.6410	pe BC	+102666	-0.0008			
	519.5314	pe BC	102710	-0.0006			
	.6201	pe BC	102711	-0.0003			
	521.5654	pe BC	102733	-0.0001			
	541.4588	pe KM	102958	+0.0003			
	544.3758	pe KM	102991	-0.0003			
	.4653	pe KM	102992	+0.0008			
	547.3819	pe BC	103025	-0.0003			
	548.4427	pe Pp	103037	-0.0004			
	549.4154	pe BC	103048	-0.0003			
	.5032	pe BC	103049	-0.0009			
	551.4492	pe BC	103071	0.0000			
	.5375	pe BC	103072	-0.0001			
	577.4437	pe KM	103365	+0.0010			
1976	871.5051	pe Pp	106691	0.0000	106701	+0.0001	6
	.5069	pe KM	106691	+0.0018			
	.5933	pe KM	106692	-0.0002			
	872.4773	pe KM	106702	-0.0004			
	.5658	pe KM	106703	-0.0003			
	874.5107	pe KM	106725	-0.0005			
1977	43249.6478	pe GE	110968	-0.0008	111108	-0.0001	7
	254.5996	pe GE	111024	-0.0001			
	255.5728	pe GE	111035	+0.0006			
	.6613	pe GE	111036	+0.0007			
	256.6329	pe GE	111047	-0.0003			
	274.5807	pe GE	111250	-0.0004			
	287.5778	pe GE	111397	0.0000			
1979	957.5732	pe Pp	118975	-0.0002	118975	-0.0002	1

Remarks to Table 5: Co = Code (1951), As = Ashbrook (1952), Al = Alania (1954), Fi =Fitch (1957), BK =Burnicki and Krygier (1958), Sp =Sanwal and Pande (1961), OW =Oosterhoff and Walraven (1966), FE = Fitch et al. (1966), HP = Harding and Penston (1966), TR = Terzan and Rutily (1974), BH = Boardman and Heiser (1972), KM = Karetnikov and Medvedev (1977), MF = McNamara and Feltz (1976), BC = Broglia and Conconi (1977), GE = Garrido et al. (1979), Pp = present paper
pg = photographic, pe = photoelectric, [1]= maximum time determined by us, [2]= normal maximum

tunately the 7 published observations in V light are not sufficient to determine an epoch of maximum light.

Terzan and *Rutily* (1974) obtained 453 photoelectric observations in the UBV system on four nights in 1969. As a comparison star they used HD 132092 = BD $-0^{\circ}2906$ whose magnitude and colours are: V = 9.27, B-V = +0.32 and U-B = +0.13. They gave eight dates of maximum light. The O-C deviations of these epochs are surprisingly high, the cause of this is not clear and has no explanation; it is most likely that these epochs are due to systematic error. Because of this their period (0.088413276) is slightly longer than the correct one.

In 1970 *Boardman* and *Heiser* (1972) carried out uvby photometry of this star. They obtained 144 differential photoelectric observations on four nights. These observations enabled us to determine an accurate normal maximum.

In their paper *McNamara* and *Feltz* (1976) made a detailed study of the radial velocity variations of EH Librae. In order to be able to calculate the correct phase of the measured radial velocities, they secured a maximum light observation in 1974 which is well-represented by our elements.

Karetnikov and *Medvedev* (1977) obtained over 500 photoelectric observations close to B and V on 13 nights in the years 1974-1976. They determined 22 epochs of light maximum, 11 maxima in each colour. Since the earlier observations also showed that there was no systematic difference between the times of maximum in different colours, we formed mean values of the epochs determined from the blue and yellow observations. In this way 11 times of maximum are added to the list of epochs of EH Lib (Table 5) from *Karetnikov* and *Medvedev*'s observations. *Broglia* and *Conconi* (1977) made more than 900 photoelectric B and V observations (443 in B and 462 in V). They detected small variations in the height of the maxima, but they did not find any variations in the minima. They failed, however, to see any evidence of periodic oscillation in the O-C residuals, in particular with a period near 1800 days (*Berdnikov*, 1975). Their measurements indicate some cycle-to-cycle variations, and if this phenomenon is periodic they propose a period of about 300 cycles (≈27 day). Taking into account the visual observations, too, but with low weight, they found the elements:

$$\text{Max.hel.} = \text{J.D.}\ \underset{\pm.0002}{2433438.6082} + \underset{\pm.0000000020}{0^{d}.0884132445} \cdot E$$

On discussing the period changes they arrived at the conclusion that the period changed abruptly on two occasions. This conclusion is, however, based only on *Terzan* and *Rutily*'s (1974) observations. *Garrido* et al. (1979) observed EH Lib in B and V on six nights. They collected 146 photoelectric observations and determined 7 times of maximum light. We rediscussed these observations and by fitting *Fitch*'s (1957) mean B and V light curves to their observations we redetermined the maximum times. In Table 5 these newly determined maxima are given. *Garrido* et al. (1979) made an effort to find secondary periodicities of EH Lib. Their power spectrum, however, showed "no features which could be regarded as certainly significant".

The reality of all periods other than the fundamental one is questioned.

This variable star has long been on the programme at the Konkoly Observatory. It was observed photographically in 1953 and two times of light maximum could be determined for that year. Our 65 photographic observations made on three nights are given in Table 12. We observed the star photoelectrically on five nights in 1972, 1974, 1975, 1976 and 1979 and collected 322 observations in B and V. BD $-0^{\circ}2909$ was used as a comparison star, its magnitude and colours were adopted from *Fitch* (1957) (Tables 13-14). These observations yielded five times of maximum light which are included in the table of epochs of maximum of EH Librae (Table 5).

Our photoelectric observations also clearly show that EH Lib is a dwarf cepheid with a stable light curve of strictly repetitive character.

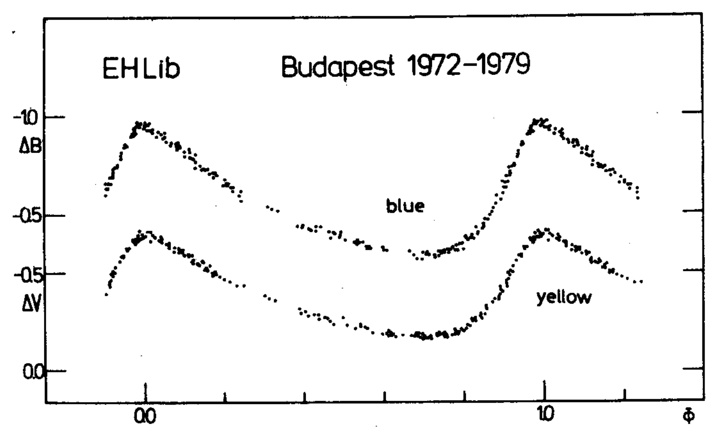

Figure 5: B and V light curves of EH Lib

Since the visual observations are of such low weight relative to the photoelectric observations it did not seem worthwhile to include them in a new solution. Using only the photoelectric maxima we cannot detect any change in the period of EH Lib in the past almost 30 years (2433400-2444000). A least-squares solution yields the following elements:

$$\text{Max.hel.} = \text{J.D. } 2433438.6078 + 0\overset{d}{.}088413243 \cdot E.$$

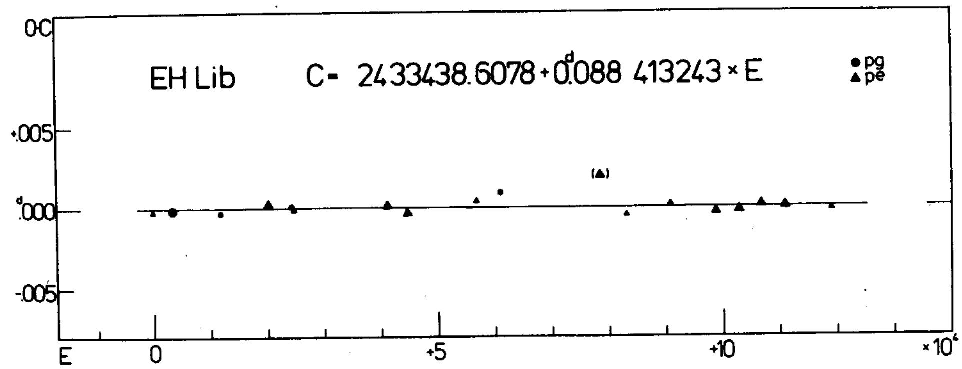

Figure 6: O-C diagram of EH Lib

Berdnikov (1977) believed that a periodic change with a cycle length of 1800 days in the period of EH Lib is present. Our O-C diagram does not show this phenomenon. Obviously the visual observations of poor quality led him to the erroneous interpretation.

DY PEGASI

The variability of DY Peg = BD +16°4877 ($9\overset{m}{.}3$) = HD 218549 (F5) = 112.1934 = P 5726 was discovered by *Morgenroth* (1934) on the Babelsberg survey plates.

First *Soloviev* (1938) made a series of visual observations of this star in August and September 1938 and he determined the type and period of the light variability. His 14 visual maxima enabled him to give:

$$\text{Max.hel.} = \text{J.D. } 2429169.1664 + 0\overset{d}{.}0729256 \cdot E.$$

Of course, the very short period attracted the attention of many visual observers to this star. The accuracy of visual observations is usually far too low so we have simply listed the references to these observations without giving full particulars. *Ahnert* (1938, 1939) observed the star back in October 1938 and confirmed *Soloviev*'s elements. *Bancilhon* and *Schmitt* (1940), *Batyrev* (1953b, 1955, 1962), *Kühn* (1951), *Lange* (1944, 1959), *Mandell* (1958a, b), *Mandell* and *Grigorevsky* (1959), *Satanova* and

Grigorevsky (1957), *Soloviev* (1940a, b, 1952) and *Steinman* (1958) made roughly 5000 further visual estimates. In particular, the German amateurs (*Braune* and *Hübscher*, 1967; *Braune, Hübscher* and *Mundry*, 1970, 1972, 1977, 1979; *Braune* and *Mundry*, 1973; *Busch*, 1973, 1975, 1976, 1977, 1978; *Domke* and *Pohl*, 1952; *Dueball* and *Lehmann*, 1964; and *Pohl*, 1954) were busy in obtaining visual observations. The most thorough investigation of visual observations was that of *Grigorevsky* and *Mandell* (1960). They made use of their own 3061 visual observations, too. From more than 500 maxima (observed up to 1958) they deduced the following elements:

$$\text{Max.hel.} = \text{J.D.}2436071.42469 + 0^{d}.0729263727 \cdot E$$
$$\pm.00028 \quad \pm.0000000076$$

According to their visual observations the star shows fairly strong light curve variations, especially in heights of maximum (0.3 mag.). *Soloviev* (1938) was the first to refer to this effect, but *Lange* (1944) soon questioned it. *Grigorevsky* and *Mandell* suggested a period of 0.2554 day for this secondary variation. These results are, however, hardly acceptable. As we will see later on, modern photoelectric observations show only a fluctuation of 0.04 mag. in the heights of the maxima. Obviously the visual observations have errors in the order of 0.3 mag., and no finer results can be deduced from them. *Grigorevsky* and *Mandell* claimed that they had found a long term variation in the phase of the light maxima of DY Peg. They gave a period of 4529·P = 330.28 days and an amplitude of 10 minutes for this long-term variation.

The first valuable photographic observations of this star were obtained by *Schneller* (1938) and he gave two epochs of light maximum.

In his two papers *Steinmetz* (1946, 1948) published 1874 photographic and 419 photovisual exposures. The observations span an interval from 28 July 1943 to 12 September 1947. He determined a revised value of the period, equal to 0.072926355 day from the complete photographic material and found this period to be constant during the whole interval of more than 20000 periods covered by his observations. In his discussions *Steinmetz* used the point on the rising branch at brightness $\Delta m = -0.46$ mag. and listed 46 epochs of that particular point. Unfortunately he did not give the epochs of observed maxima. We used the mean light curve of *Steinmetz* and have derived a phase difference of

$$\Delta\varphi = \varphi(\max) - \varphi(\Delta m = -0.46) = 0\overset{p}{.}088 = 0\overset{d}{.}0064$$

between the time of maximum light and *Steinmetz*'s favoured point. Adding this value $\Delta\varphi$ to the epochs given by *Steinmetz* we were able to determine the times of his photographic maxima. We then formed means of these times for the years 1943 (n=6), 1944 (n=10), 1945 (n=3), 1946 (n=3) and 1947 (n=24), these are given in Table 7. We should like to mention here that *Quigley* and *Africano* (1979) followed another procedure. They determined the times of maxima observed by *Steinmetz* by fitting his original data to a parabola. Obviously in this way they obtained maxima which were systematically delayed.

Alania (1954, 1956) also observed the star photographically and gave an epoch of maximum light. His observation can, however, be accepted only with reserve.

The very first photoelectric observations were made by *Hiltner* (*Iriarte*, 1952). On two nights, 19 and 20 July 1948, *Hiltner* obtained 301 observations in one colour which enable us to determine three times of maximum light. The light curve did not seem to repeat in all details, especially near minimum light.

Masani and *Broglia* (1954) obtained 573 photoelectric observations in blue and 523 in yellow light between 10 October and 14 November, 1953. Their light curve shows some non-repetitive character from cycle to cycle and the deviations are certainly larger than the observational errors. *Masani* and *Broglia* determined 28 epochs of maximum light based on their own observations but three were in fairly large error (they gave their epochs with an accuracy of 0.001 day only) and we have therefore omitted the three erroneous epochs from our table of maximum times (Table 7).

Hardie and *Geilker* (1958) obtained the first complete light curves in the UBV system for DY Peg in 1956. They published 1633 photoelectric observations (500 in V, 614 in B and 519 in U). Having analysed tha data they found the general character of the light curves to be repetitive, however, no two cycles were alike in detail. The irregularities did not appear to reveal any systematic trend during the time covered by their observations. It was found that there was a variation of 0.04 mag. at maximum in V. *Hardie* and *Geilker* did not give their observed times of maxima. Using their original published magnitude data we were able to determine 18 epochs of light maximum (6 in V, 7 in B and 5 in U). These times are given in Table 7.

In 1957 and 1960 *Broglia* (1961) secured 170 yellow photoelectric observations and gave five further epochs of maximum light. From his observations he found the amplitude of DY Peg to be slightly variable (some hundredths in magnitude). The new elements derived by him are:

$$\text{Max.hel.} = \text{J.D. } \underset{\pm.00009}{2434696.39682} + \underset{\pm.000000002}{0^{d}.072926371} \cdot E$$

From 23 July to 16 October 1963 *Karetnikov* and *Medvedev* (1964) observed the star photoelectrically at the Odessa Observatory with an 8-inch refractor. Oddly enough they found that the form of the light curve changed significantly and very rapidly. The variations in the amplitude of DY Peg exceeded $\Delta A \approx 0.4$ mag. Unusual humps occurred on both the ascending and descending branches of its light curve. *Karetnikov* and *Medvedev* investigated the phase of these humps and thought to find a correlation with a secondary period. They proposed $P_s = 0.255413$ day for its value. In that all other photoelectric observations before and after 1963 have not shown any evidence for the strong light curve variation we have to accept *Karetnikov* and *Medvedev*'s results, but we do so with reserve. We tend to believe that these irregular variations are an artifact of their observing technique rather than intrinsic to DY Peg. Because of this we have given only the mean moment of their maxima in Table 7.

A further 54 UBV observations were published by *Fitch* et al. (1966). They also gave an epoch of maximum light which was determined as the time of the brightest observed point in V light. Using our mean photoelectric light curves we redetermined the time of maximum light from *Fitch* et al.'s data.

In order to demonstrate the usefulness of their technique of sequential photoelectric photometry *Warner* and *Nather* (1972) observed DY Peg on two nights in November 1970. They have not published the observations, but only the graphs of the two observed light curves. From their figures we could read off two epochs of light maximum. We must, however, admit that the captions of their figures are inconsistent with the time scales on the horisontal axis. This ambiguity should be kept in mind. The most important conclusion of *Warner* and *Nather*'s observation is that the light variation with phase in each colour is smooth but small changes may occur from cycle to cycle.

Geyer and *Hoffmann* (1974, 1975b) carried out photoelectric photometry of this star in B and V with a double-beam photometer. They observed six cycles on two nights and gave six epochs of maxima. One of them (J.D. 2441957.5998) is somewhat uncertain but it does not significantly affect the average O-C value of the six maxima. *Geyer* and *Hoffmann* concluded that a short period beat phenomenon was not present in this variable and the light curve was smooth without anomalies.

While testing an amateur photoelectric photometer *Heiser* (1976) observed DY Peg on 22 November 1975. He gave two times of light maxima (*Braune, Hübscher* and *Mundry*, 1979), one of which could be determined more accurately using the graph in his paper (*Heiser*, 1976).

Recently *Quigley* and *Africano* (1979) carried out a high-speed photometry of this variable at the McDonald Observatory in order to update the star's ephemeris. The times of 19 maxima were recorded between November 1976 and 1977. Combining these with more than one hundred selected times of maxima they arrived at a revised ephemeris:

$$\text{Max.hel.} = \text{J.D. } 2432751.96195 + 0\overset{d}{.}072926332 \cdot E$$

Most of the selected times of maxima were calculated by *Quigley* and *Africano* using a least-squares fit of the light curve data near the maximum to a parabola. Since the maximum of short periodic variables is asymmetric this fit obviously results in an epoch which may give rise to a systematic delay of 0.001 day. Therefore, *Pogson*'s or any other "classical" method certainly give a better estimation of epoch of maximum light. Comparing the times of maximum light determined by us with those calculated by *Quigley* and *Africano* we came to the conclusion that their epochs of maxima have a lag of $+0\overset{d}{.}0005$. The corrected value of $\overline{O-C}$ is also given in Table 7 and in calculating the mean maximum of *Quigley* and *Africano* we have already taken this correction into consideration (Table 8).

Using the 122 entries of their Table I and Table II they also estimated the rate (β) of change of the period assuming that the O-Cs had a quadratic dependence on cycle numbers. They obtained the value $\beta=-6\times10^{-12}$ days·day^{-1}=-0.02 sec·century^{-1} for the rate of change.

The photoelectric observations of this star were commenced at the Konkoly Observatory in 1954. The 1954 observations were carried out without using any filter but the 1960 observations were already made in the BV system. *Detre*'s observations of 1954 enabled us to determine one time of maximum light. Between August 1960 and August 1979 some 615 photoelectric BV observations were obtained. The 1974 observations were made with the 20 inch reflector of our Mountain Station; the others were carried out with the 24 inch telescope at Budapest. The two colour observations are given in Tables 15-16 and are plotted against phase in Figure 7. The comparison and check stars are given in Table 6. Their magnitudes and colours are adopted from *Hardie* and *Geilker* (1958).

Table 6

star	BD	V	B-V	U-B
comparison	$+16^\circ4878$	9.80	+0.59	+0.10
check	$+16^\circ4876$	10.94	+0.53	+0.06

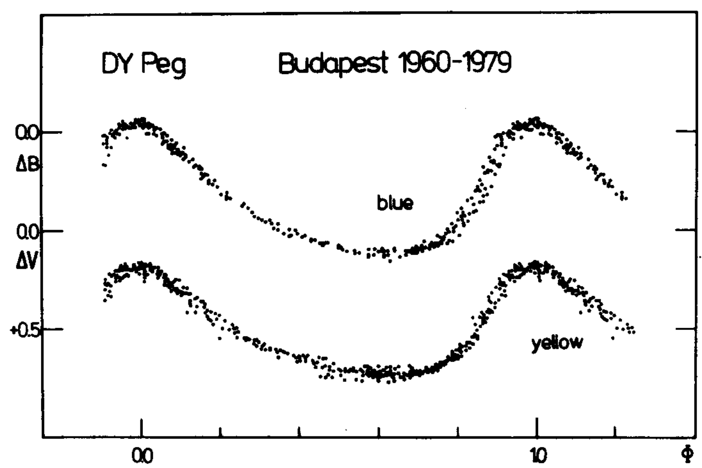

Figure 7: B and V light curves of DY Peg

We have not found any significant shift in time between the blue and yellow maxima. Some small changes of the light curve (e.g. in maximum about 0.05 mag.) have, however, been recorded. Whether these minute changes are periodic or not is open to fur-

Table 7

Photographic and photoelectric maxima of DY Peg

year	Hel.Max.J.D.	Remarks	E	O-C	$\overline{E}$	$\overline{O-C}$	n
1938	2429193.4456	pg Sc	- 48796	-0.0024	- 48789	-0.0012	2
	194.4691	pg Sc	- 48782	+0.0001			
1943	31022.0744	pg St[1,2]	- 23721	-0.0014	- 23721	-0.0014	1
1944	310.4978	pg St[1,2]	- 19766	-0.0016	- 19766	-0.0016	1
1945	764.3924	pg St[1,2]	- 13542	-0.0005	- 13542	-0.0005	1
1946	32092.4147	pg St[1,2]	- 9044	-0.0009	- 9044	-0.0009	1
1947	408.0396	pg St[1,2]	- 4716	-0.0011	- 4716	-0.0011	1
1948	751.8884	pe Ir[1]	- 1	0.0000	+ 4	0.0000	3
	.9613	pe Ir[1]	- 0	0.0000			
	752.9093	pe Ir[1]	+ 13	0.0000			
1953	(34626.462	pg Al	+ 25704	+0.0023)	+ 26533	+0.0005	25
	661.3915	pe MB	+ 26183	0.0000			
	.4644	pe MB	+ 26184	0.0000			
	662.3403	pe MB	+ 26196	+0.0008			
	.4857	pe MB	+ 26198	+0.0004			
	.5589	pe MB	+ 26199	+0.0006			
	689.3228	pe MB	+ 26566	+0.0006			
	690.3437	pe MB	+ 26580	+0.0005			
	.4165	pe MB	+ 26581	+0.0004			
	691.2919	pe MB	+ 26593	+0.0007			
	.3646	pe MB	+ 26594	+0.0004			
	.4376	pe MB	+ 26595	+0.0005			
	692.2401	pe MB	+ 26606	+0.0008			
	.3138	pe MB	+ 26607	+0.0016			
	.3858	pe MB	+ 26608	+0.0007			
	.4585	pe MB	+ 26609	+0.0004			
	693.2613	pe MB	+ 26620	+0.0010			
	.3338	pe MB	+ 26621	+0.0006			
	.4057	pe MB	+ 26622	-0.0004			
	.4789	pe MB	+ 26623	-0.0001			
	695.3021	pe MB	+ 26648	-0.0001			
	.3756	pe MB	+ 26649	+0.0005			
	.4487	pe MB	+ 26650	+0.0007			
	696.2515	pe MB	+ 26661	+0.0013			
	.3242	pe MB	+ 26662	+0.0010			
	.3966	pe MB	+ 26663	+0.0005			
1954	35070.2901	pe De	+ 31790	+0.0007	+ 31790	+0.0007	1
1956	745.5885	pe HG[1]	+ 41050	+0.0013	+ 41292	+0.0015	18
	.6611	pe HG[1]	+ 41051	+0.0009			
	.7343	pe HG[1]	+ 41052	+0.0012			
	.8069	pe HG[1]	+ 41053	+0.0009			
	760.6847	pe HG[1]	+ 41257	+0.0017			
	.7576	pe HG[1]	+ 41258	+0.0017			
	762.5808	pe HG[1]	+ 41283	+0.0017			
	.6536	pe HG[1]	+ 41284	+0.0016			
	.7266	pe HG[1]	+ 41285	+0.0017			
	.8003	pe HG[1]	+ 41286	+0.0025			
	770.6031	pe HG[1]	+ 41393	+0.0021			
	.6753	pe HG[1]	+ 41394	+0.0014			
	.7488	pe HG[1]	+ 41395	+0.0020			
	771.6229	pe HG[1]	+ 41407	+0.0010			

Table 7 (cont.)

year	Hel.Max.J.D.	Remarks	E	O-C	$\bar{E}$	$\overline{O-C}$	n
1956	2435771.6958	pe HG[1]	+ 41408	+0.0009			
	773.6654	pe HG[1]	+ 41435	+0.0015			
	.7375	pe HG[1]	+ 41436	+0.0007			
	780.6664	pe HG[1]	+ 41531	+0.0016			
1957	36155.3623	pe Br	+ 46669	+0.0020	+ 46715	+0.0019	3
	160.3214	pe Br	+ 46737	+0.0021			
	.3939	pe Br	+ 46738	+0.0017			
1960	37164.5170	pe Pp	+ 60507	+0.0021	+ 60596	+0.0016	7
	165.5375	pe Pp	+ 60521	+0.0017			
	167.4320	pe Pp	+ 60547	+0.0001			
	168.5276	pe Br	+ 60562	+0.0018			
	174.4348	pe Br	+ 60643	+0.0019			
	178.3734	pe Pp	+ 60697	+0.0025			
	.4451	pe Pp	+ 60698	+0.0013			
1963	38276.8624	pe KM[2]	+ 75760	+0.0022	+ 75760	+0.0022	1
1964	655.8598	pe Fi[1]	+ 80957	+0.0014	+ 80957	+0.0014	1
1970	40895.6447	pe WN[3]	+111670	-0.0001	+111684	0.0000	2
	897.6138	pe WN[3]	+111697	0.0000			
1972	41535.5012	pe Pp	+120444	+0.0008	+120444	+0.0008	1
1973	937.4701	pe GH	+125956	-0.0003	+126218	+0.0003	8
	.5444	pe GH	+125957	+0.0011			
	957.3785	pe GH	+126229	-0.0008			
	.4535	pe GH	+126230	+0.0013			
	.5243	pe GH	+126231	-0.0008			
	.5998	pe GH	+126232	+0.0018			
	963.4324	pe Pp	+126312	+0.0003			
	984.3615	pe Pp	+126599	-0.0005			
1974	42279.4210	pe Pp	+130645	-0.0009	+130645	-0.0009	1
1975	739.2955	pe He[4]	+136951	+0.0001	+136951	+0.0001	1
1976	43085.6951	pe QA	+141701	-0.0004	+141725	-0.0002*	6
	.7684	pe QA	+141702	0.0000		(-0.0007)	
	.8403	pe QA	+141703	-0.0010			
	088.6860	pe QA	+141742	+0.0005			
	.7582	pe QA	+141743	-0.0002			
	089.7064	pe QA	+141756	0.0000			
1977	305.9329	pe QA	+144721	-0.0001	+145201	+0.0003*	13
	307.8308	pe QA	+144747	+0.0017		(-0.0002)	
	.9023	pe QA	+144748	+0.0003			
	348.8143	pe QA	+145309	+0.0006			
	.8867	pe QA	+145310	+0.0001			
	.9598	pe QA	+145311	+0.0003			
	350.7833	pe QA	+145336	+0.0006			
	.8554	pe QA	+145337	-0.0002			
	.9288	pe QA	+145338	+0.0003			
	351.8042	pe QA	+145350	+0.0005			
	.8765	pe QA	+145351	-0.0001			
	353.7728	pe QA	+145377	+0.0001			
	.8459	pe QA	+145378	+0.0003			
1979	44113.5179	pe Pp	+155795	-0.0013	+155795	-0.0013	1

Remarks to Table 7: Sc = Schneller (1938), St = Steinmetz (1946, 1948), Ir = Iriarte (1952), Al = Alania (1956), MB = Masani and Broglia (1954), De = Detre (unpubl.), HG = Hardie and Geilker (1958), Br = Broglia (1961), KM = Karetnikov and Medvedev (1964), Fi = Fitch et al. (1966), WN = Warner and Nather (1972), GH = Geyer and Hoffmann (1974), He = Heiser (1976), QA = Quigley and Africano (1979), Pp = present paper

pg = photographic, pe = photoelectric, [1]= determined by us, [2]= mean epoch, [3]= read from Warner and Nather's figures, [4]=read from Heiser's figure, *= the mean value has been decreased by 0.0005 day (see text)

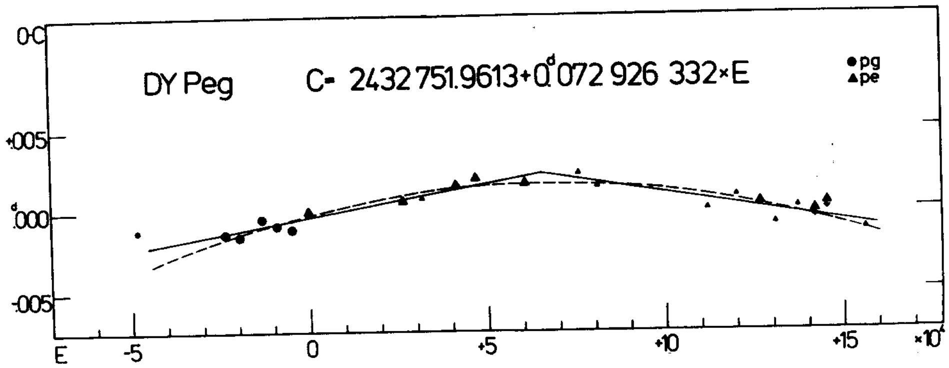

Figure 8: O-C diagram of DY Peg

ther investigation. Our observations do not confirm the 0.255 day secondary period and definitely contradict the 330 day long-term variation stated by *Grigorevsky* and *Mandell* (1960). Obviously they simply underestimated the errors of visual recordings and identified the observational scatter with real changes.

In order to analyse the period changes of this variable star we have collected all the available times of photographic and photoelectric maxima in Table 7. Again we left the visual observations out of consideration because they proved to be of no value.

The O-C values have been computed with the linear formula:

$$C(\text{Max.hel.}) = \text{J.D. } 2432751.9613 + 0\overset{d}{.}072926332 \cdot E .$$

For each year a mean O-C value ($\overline{O-C}$) and a mean epoch number ($\overline{E}$) were formed and then a yearly mean epoch of the observed light maxima was calculated. These epochs are given in Table 8. The data of this table were used to carry out least-squares solutions.

First we tried to make an approximation with two straight lines and obtained the linear ephemerides:

$$C_1(\text{Max.hel.}) = \text{J.D. } 2432751.9609 + 0\overset{d}{.}072926372 \cdot E$$

before J.D. 2437500; E<65000 and

$$C_2(\text{Max.hel.}) = \text{J.D. } 2432751.9658 + 0\overset{d}{.}072926297 \cdot E$$

after J.D. 2437500; E>65000.

Table 8

Mean photographic and photoelectric maxima of DY Peg

year	Mean Hel. Max.		W	E	$O-C_1$	$O-C_2$	$O-C_3$
1938	J.D.2429193.9573	pg	0	- 48789	+0.0012	--	+0.0025
1943	31022.0744	pg	1	- 23721	0.0000	--	+0.0003
1944	31310.4978	pg	1	- 19766	-0.0004	--	-0.0002
1945	31764.3924	pg	1	- 13542	+0.0004	--	+0.0005
1946	32092.4147	pg	1	- 9044	-0.0001	--	-0.0002
1947	32408.0396	pg	1	- 4716	-0.0005	--	-0.0007
1948	32752.2530	pe	2	+ 4	+0.0004	--	+0.0002
1953	34686.9162	pe	2	+ 26533	-0.0001	--	-0.0004
1954	35070.2901	pe	1	+ 31790	-0.0002	--	-0.0004
1956	35763.2369	pe	2	+ 41292	+0.0002	--	+0.0002
1957	36158.7168	pe	2	+ 46715	+0.0004	--	+0.0005
1960	37171.0069	pe	2	+ 60596	-0.0004	--	0.0000
1963	38276.8624	pe	1	+ 75760	--	+0.0003	+0.0006
1964	38655.8598	pe	1	+ 80957	--	-0.0002	-0.0001
1970	40896.6658	pe	1	+111684	--	-0.0006	-0.0008
1972	41535.5012	pe	1	+120444	--	+0.0005	+0.0002
1973	41956.5774	pe	2	+126218	--	+0.0002	0.0000
1974	42279.4210	pe	1	+130645	--	-0.0009	-0.0010
1975	42739.2955	pe	1	+136951	--	+0.0004	+0.0003
1976	43087.4450*	pe	2	+141725	--	-0.0002	-0.0002
1977	43340.9374*	pe	2	+145201	--	+0.0004	+0.0005
1979	44113.5179	pe	1	+155795	--	-0.0003	0.0000

*The mean epoch has been decreased by 0.0005 day (see text).

The corresponding O-C values are given in Table 8 under the headings $O-C_1$ and $O-C_2$. If the period had really a sudden change around J.D. 2437500, and before and after it the period was constant, the value of the period change was

$$\Delta P = -6.5 \times 10^{-8} \text{ day.}$$

The second order fit yielded the following formula:

$$C_3(\text{Max.hel.}) = \text{J.D. } 2432751.9611 + 0^d.072926384 \cdot E - 3.813 \times 10^{-13} \cdot E^2.$$

(C_3 was calculated in such a way that all the mean epochs -except *Schneller*'s- were given equal weight.) In this case

$$\beta = -7.6 \times 10^{-13} \text{ day} \cdot \text{cycle}^{-1} = -10.4 \times 10^{-12} \text{ days.day}^{-1} =$$
$$= -0.03 \text{ sec} \cdot \text{century}^{-1}$$

in rough agreement with the estimates of *Quigley* and *Africano* (1979).

At present, no difference can be made between the two approximations because

$$\frac{1}{n^2}\Sigma\{(O-C_1)^2 + (O-C_2)^2\} \text{ and } \frac{1}{n^2}\Sigma(O-C_3)^2$$

are in the same order. Further observations can only settle which approximation is the correct one.

GENERAL REMARKS

The number of dwarf cepheids investigated here is insufficient for making any definite conclusion on the possible evolutionary changes of the periods. Nevertheless, some comments can be made. CY Aqr and DY Peg can definitely be identified with the low-metal Population II (Breger, 1980) and both variable stars show decreasing periods; in contrast, EH Lib exhibits a normal Population I nature and has a very stable, constant period. The periods of both CY Aqr and DY Peg show some small random fluctuations, too, which are reflected in their O-C diagrams.

The light curve of EH Lib is also stable whereas the light curves of CY Aqr and DY Peg show small cycle-to-cycle changes the character of which are still obscure. Further high speed photoelectric observations are needed in order to disentangle this problem.

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Table 9

Photographic observations of CY Aqr

J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}
2428045		2428074		2432440		2433860	
.3832	11.06	.3798	11.01	.4647	10.86	.5409	10.53
.3853	10.90	.3818	10.69	.4668	10.56	.5430	10.59
.3874	10.73	.3839	10.45	.4689	10.36	.5450	10.56
.3895	10.45	.3867	10.30	.4709	10.32	.5471	10.71
.3916	10.37	.3888	10.36	.4730	10.41	.5492	10.84
.3937	10.39			.4751	10.64	.5534	11.00
.3978	10.43	2428397		.4772	10.75	.5555	10.86
.3999	10.63	.5100	11.03	.4793	10.81	.5596	11.07
.4020	10.62	.5122	10.90	.4814	10.86	.5638	11.06
.4041	10.80	.5143	10.92	.4834	10.87	.5680	11.15
.4062	10.88	.5163	10.93	.4855	10.96	.5700	11.14
.4103	10.93	.5184	10.70	.4876	10.99	.5721	11.23
.4207	11.19	.5205	10.53	.4897	11.00	.5742	11.17
.4228	11.18	.5226	10.14	.4980	11.29	.5763	11.18
.4242	11.18	.5247	10.17	.5001	11.35		
.4284	11.20	.5267	10.32	.5022	11.23	2433861	
.4346	11.35	.5289	10.44	.5043	11.28	.4722	10.95
.4367	11.25	.5330	10.56	.5064	11.28	.4741	10.96
.4388	11.24	.5350	10.61	.5105	11.16	.4762	10.98
.4410	11.15	.5412	10.93	.5147	11.28	.4783	11.04
.4430	11.11	.5433	11.01	.5168	11.16	.4804	11.05
.4450	10.98	.5476	10.98	.5189	11.10	.4845	11.14
		.5496	11.03	.5209	11.03	.4866	11.20
2428074		.5517	11.13	.5230	10.94	.4887	11.18
.3214	10.40	.5538	11.19			.4908	11.03
.3235	10.37	.5559	11.23	2433860		.4929	11.00
.3257	10.28			.4825	10.59	.4970	10.94
.3277	10.22	2432093		.4846	10.83	.4991	10.90
.3298	10.42	.3938	11.12	.4867	10.91	.5012	10.66
.3318	10.62	.3958	11.10	.4888	11.02	.5054	10.30
.3339	10.62	.3979	11.18	.4930	11.04	.5074	10.17
.3360	10.72	.4021	10.58	.4950	11.16	.5095	10.24
.3381	10.73	.4042	10.32	.4972	11.17	.5595	11.06
.3402	10.90	.4063	10.24	.5034	11.17	.5616	10.84
.3423	10.92	.4083	10.34	.5055	11.18	.5637	10.78
.3443	11.13	.4104	10.46	.5075	11.22	.5658	10.40
.3464	10.99	.4125	10.60	.5096	11.24	.5679	10.10
.3485	11.14	.4146	10.66	.5117	11.32	.5699	10.20
.3506	11.18	.4167	10.69	.5138	11.16	.5720	10.22
.3527	11.25	.4188	10.76	.5159	11.22	.5741	10.48
.3548	11.22	.4208	10.88	.5180	11.12	.5762	10.60
.3568	11.28	.4271	10.88	.5200	11.14	.5783	10.75
.3589	11.32	.4292	10.90	.5222	10.98	.5804	10.78
.3610	11.33	.4313	11.07	.5242	10.80		
.3631	11.33	.4333	11.02	.5263	10.44	2433872	
.3673	11.22	.4354	11.08	.5284	10.37	.5079	10.96
.3693	11.23			.5305	10.32	.5100	10.99
.3714	11.26	2432440		.5325	10.22	.5121	11.14
.3735	11.26	.4564	11.04	.5346	10.40	.5142	11.05
.3756	11.06	.4605	11.17	.5367	10.40	.5163	11.23
.3777	11.15	.4626	10.98	.5388	10.46	.5184	11.21

Table 9 (cont.)

Photographic observations of CY Aqr

J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}
2433872		2433872		2434253		2434270	
.5204	11.24	.5704	11.09	.5539	10.89	.3031	11.24
.5225	11.21	.5746	11.15	.5560	10.72	.3052	11.09
.5246	11.32	.5767	11.08	.5580	10.46	.3072	11.16
.5267	11.38	.5809	11.28	.5622	10.90	.3093	11.24
.5309	11.34	.5829	11.20	.5643	10.83	.3114	11.32
.5329	11.37	.5871	11.34	.5664	11.08	.3135	11.24
.5350	11.44	.5890	11.35	.5705	11.29	.3156	11.38
.5371	11.33			.5726	11.29	.3218	11.37
.5392	11.39	2434253		.5747	11.36	.3239	11.49
.5413	11.42	.5205	11.42	.5768	11.44	.3260	11.27
.5434	11.32	.5247	11.38	.5810	11.48	.3281	11.42
.5454	11.31	.5268	11.48	.5851	11.52	.3302	11.36
.5475	11.33	.5351	11.50	.5872	11.53	.3343	11.10
.5496	11.11	.5372	11.40	.5893	11.54	.3364	11.08
.5538	10.81	.5398	11.50	.5914	11.40	.3385	10.99
.5559	10.74	.5414	11.38			.3427	10.60
.5579	10.62	.5435	11.42	2434270		.3447	10.36
.5600	10.68	.5455	11.37	.2947	10.81	.3468	10.46
.5621	10.75	.5497	10.93	.2968	10.98	.3489	10.68
.5642	10.82	.5518	10.76	.2989	11.11	.3510	10.66
.5684	11.06						

Table 10

Photoelectric yellow observations of CY Aqr

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2441623		2441623		2441651		2444158	
.2511	+1.067	.3053	+1.047	.2500	+1.024	.2792	+1.060
.2539	1.057	.3081	1.067	.2514	1.037	.2804	1.027
.2553	1.000	.3095	1.057	.2549	1.052	.2863	1.028
.2596	0.668	.3185	0.931	.2563	1.048	.2899	1.050
.2629	0.397	.3213	0.495	.2590	1.059	.2912	1.018
.2643	0.364	.3227	0.427	.2604	1.073	.2937	1.044
.2671	0.395	.3254	0.353	.2632	1.090	.2949	1.029
.2719	0.545	.3310	0.474	.2646	1.073	.2984	0.964
.2747	0.662	.3324	0.527	.2681	1.058	.3005	0.856
.2761	0.692	.3351	0.634	.2695	1.021	.3016	0.793
.2789	0.762	.3365	+0.650	.2736	0.937	.3037	0.516
.2803	0.788			.2903	0.635	.3047	0.392
.2831	0.905	2441651		.2945	0.752	.3071	0.368
.2845	0.915	.2292	+0.615	.2959	0.819	.3080	0.391
.2893	1.001	.2306	0.664	.2993	+0.888	.3105	0.443
.2921	1.035	.2333	0.743			.3121	0.451
.2935	1.052	.2347	0.780	2444158		.3148	0.560
.2977	1.036	.2375	0.854	.2711	+0.985	.3162	0.617
.3004	1.043	.2389	0.912	.2749	1.066	.3187	0.715
.3015	1.069	.2458	1.005	.2763	+1.040	.3200	+0.773
.3039	+1.089	.2472	+1.028				

Table 11

Photoelectric blue observations of CY Aqr

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2441623		2441623		2441651		2444158	
.2490	+0.185	.3074	+0.180	.2507	+0.168	.2742	+0.152
.2504	0.178	.3089	0.170	.2542	0.178	.2756	0.150
.2532	0.160	.3122	0.179	.2556	0.181	.2784	0.192
.2546	0.123	.3164	0.119	.2583	0.190	.2800	0.214
.2574	+0.029	.3178	+0.096	.2597	0.184	.2823	0.209
.2589	−0.165	.3206	−0.287	.2639	0.204	.2835	0.219
.2622	0.555	.3220	0.398	.2674	0.200	.2869	0.214
.2636	0.615	.3303	0.559	.2688	0.198	.2893	0.206
.2664	0.621	.3317	0.491	.2729	+0.053	.2930	0.210
.2679	0.584	.3344	−0.358	.2896	−0.357	.2943	0.181
.2740	0.323			.2910	0.317	.2955	0.147
.2754	0.285	2441651		.2938	0.188	.2980	+0.089
.2782	0.174	.2285	−0.380	.2952	0.165	.3003	−0.024
.2796	0.136	.2299	0.306	.2979	−0.037	.3012	0.077
.2838	−0.015	.2326	0.190	.3000	+0.015	.3032	0.359
.2886	+0.120	.2368	0.051			.3042	0.506
.2914	0.149	.2382	−0.037	2444158		.3065	0.623
.2928	0.146	.2410	+0.049	.2641	−0.004	.3075	0.618
.2997	0.193	.2424	0.084	.2653	+0.019	.3141	0.415
.3011	0.202	.2451	0.112	.2680	0.047	.3155	0.319
.3032	0.173	.2465	0.136	.2704	0.084	.3180	0.210
.3046	+0.189	.2493	+0.144	.2716	+0.120	.3194	−0.196

Table 12

Photographic observations of EH Lib

J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}	J.D.	m_{pg}
2434487		2434488		2434516		2434516	
.4294	10.14	.4294	9.44	.4013	10.09	.4534	9.45
.4349	9.94	.4349	9.52	.4034	9.94	.4555	9.44
.4405	9.89	.4377	9.60	.4055	10.00	.4576	9.54
.4433	9.75	.4405	9.67	.4075	10.01	.4596	9.57
.4460	9.73	.4433	9.73	.4096	9.94	.4617	9.54
.4488	9.53	.4460	9.77	.4117	9.98	.4638	9.63
.4516	9.44	.4488	9.84	.4159	9.99	.4659	9.62
.4544	9.42	.4516	9.80	.4180	10.07	.4680	9.70
.4572	9.42	.4544	9.85	.4305	10.11	.4700	9.76
.4599	9.56	.4572	9.97	.4346	10.02	.4770	9.81
.4627	9.63	.4627	9.94	.4388	10.00	.4791	9.80
		.4655	9.95	.4409	9.98	.4812	9.86
2434488		.4683	10.07	.4430	9.78	.4832	9.86
.4127	9.99	.4710	10.02	.4450	9.70	.4853	9.89
.4155	9.81			.4471	9.61	.4895	9.99
.4210	9.59	2434516		.4492	9.48	.4916	10.05
.4238	9.37	.3992	10.00	.4513	9.48	.4999	10.09
.4266	9.35						

Table 13

Photoelectric yellow observations of EH Lib

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2441476		2442159		2442548		2442871	
.4056	−0.190	.5056	−0.484	.3942	−0.273	.4839	−0.176
.4065	0.160	.5080	0.582	.4023	0.225	.4859	0.208
.4075	0.165	.5091	0.614	.4037	0.216	.4867	0.196
.4095	0.184	.5112	0.672	.4071	0.188	.4889	0.229
.4101	0.181	.5167	0.652	.4082	0.197	.4897	0.250
.4111	0.192	.5181	0.628	.4195	0.192	.4917	0.283
.4134	0.187	.5195	0.605	.4209	0.170	.4927	0.325
.4148	0.206	.5237	0.543	.4239	0.182	.4948	0.359
.4160	0.211	.5251	0.534	.4254	0.202	.4957	0.376
.4181	0.249	.5265	0.514	.4333	0.385	.4977	0.498
.4191	0.263	.5306	0.466	.4347	0.426	.4986	0.523
.4201	0.284	.5318	0.455	.4379	0.582	.5014	0.612
.4221	0.346	.5334	0.433	.4392	0.625	.5033	0.644
.4231	0.359	.5396	0.381	.4420	0.695	.5042	0.709
.4241	0.393	.5406	0.369	.4432	0.710	.5066	0.709
.4262	0.498	.5420	0.359	.4461	0.682	.5075	0.680
.4272	0.556	.5476	0.290	.4473	0.650	.5106	0.635
.4282	0.586	.5494	0.277	.4509	0.605	.5128	0.626
.4304	0.661	.5535	0.269	.4524	0.587	.5137	0.618
.4314	0.673	.5608	0.235	.4556	0.549	.5156	0.590
.4324	0.679	.5619	0.218	.4570	0.539	.5182	0.554
.4341	0.657	.5667	0.189	.4646	−0.438	.5191	0.525
.4363	0.667	.5677	0.179			.5210	0.494
.4382	0.638	.5688	0.173	2442871		.5218	−0.480
.4394	0.628	.5730	0.173	.4514	−0.316		
.4404	0.605	.5744	0.165	.4525	0.302	2443957	
.4426	0.597	.5751	0.176	.4546	0.285	.5650	−0.439
.4436	0.553	.5799	0.170	.4556	0.264	.5660	0.501
.4446	0.545	.5813	0.179	.4579	0.251	.5709	0.671
.4468	0.509	.5824	0.198	.4588	0.237	.5719	0.673
.4478	−0.499	.5858	0.255	.4610	0.272	.5733	0.688
		.5876	0.275	.4620	0.234	.5747	0.692
2442159		.5890	0.310	.4639	0.213	.5768	0.671
.4882	−0.165	.5920	0.409	.4677	0.194	.5782	0.649
.4896	0.171	.5937	0.454	.4712	0.203	.5806	0.609
.4905	0.181	.5944	0.499	.4744	0.179	.5816	0.588
.4952	0.206	.5987	0.663	.4763	0.178	.5837	0.561
.4966	0.223	.5997	−0.692	.4773	0.188	.5851	0.539
.4980	0.265			.4794	0.167	.5879	0.498
.5035	0.425	2442548		.4804	−0.158	.5886	−0.504
.5049	−0.445	.3928	−0.286				

Table 14

Photoelectric blue observations of EH Lib

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2441476		2441476		2441476		2441476	
.4051	−0.269	.4070	−0.289	.4100	−0.305	.4127	−0.312
.4062	−0.264	.4090	−0.283	.4106	−0.304	.4141	−0.310

Table 14 (cont.)

Photoelectric blue observations of EH Lib

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2441476		2442159		2442548		2442871	
.4155	−0.315	.5174	−0.890	.4015	−0.344	.4863	−0.335
.4176	0.368	.5188	0.866	.4034	0.333	.4884	0.370
.4186	0.401	.5202	0.830	.4075	0.315	.4894	0.372
.4196	0.419	.5244	0.762	.4202	0.295	.4922	0.444
.4216	0.504	.5258	0.726	.4216	0.313	.4943	0.523
.4226	0.546	.5268	0.725	.4247	0.347	.4952	0.589
.4236	0.564	.5313	0.654	.4261	0.361	.4972	0.656
.4257	0.709	.5323	0.635	.4297	0.472	.4982	0.704
.4267	0.749	.5341	0.591	.4308	0.488	.5000	0.798
.4277	0.813	.5403	0.534	.4340	0.630	.5010	0.858
.4299	0.892	.5413	0.526	.4354	0.727	.5028	0.900
.4309	0.946	.5426	0.515	.4385	0.842	.5038	0.955
.4319	0.961	.5483	0.441	.4399	0.909	.5061	0.955
.4336	0.929	.5497	0.419	.4425	0.950	.5070	0.932
.4346	0.913	.5538	0.408	.4437	0.930	.5091	0.906
.4356	0.897	.5549	0.402	.4468	0.885	.5123	0.861
.4377	0.870	.5563	0.385	.4484	0.852	.5133	0.839
.4389	0.864	.5605	0.365	.4516	0.821	.5152	0.815
.4399	0.848	.5615	0.356	.4530	0.787	.5160	0.781
.4419	0.796	.5626	0.322	.4628	0.613	.5178	0.745
.4431	0.789	.5674	0.299	.4641	−0.617	.5205	0.709
.4441	0.736	.5681	0.285			.5214	−0.697
.4461	0.731	.5737	0.275	2442871			
.4473	0.704	.5747	0.287	.4509	−0.435	2443957	
.4483	0.686	.5758	0.292	.4520	0.429	.5643	−0.598
.4502	0.642	.5806	0.296	.4541	0.414	.5657	0.657
.4512	0.645	.5820	0.308	.4551	0.408	.5678	0.783
.4522	0.633	.5829	0.341	.4583	0.372	.5684	0.840
.4544	−0.565	.5869	0.394	.4605	0.391	.5705	0.926
		.5883	0.428	.4615	0.363	.5712	0.964
2442159		.5893	0.466	.4635	0.353	.5730	0.966
.4889	−0.278	.5930	0.630	.4643	0.348	.5740	0.960
.4901	0.278	.5940	0.690	.4662	0.320	.5761	0.920
.4910	0.306	.5951	0.742	.4672	0.322	.5775	0.916
.4959	0.372	.5994	0.908	.4698	0.329	.5803	0.861
.4973	0.389	.6000	−0.953	.4707	0.309	.5809	0.846
.4983	0.428			.4759	0.308	.5830	0.830
.5042	0.662	2442548		.4768	0.288	.5844	0.801
.5052	0.683	.3924	−0.437	.4789	0.300	.5872	0.730
.5059	0.733	.3935	0.434	.4799	0.290	.5882	0.710
.5105	0.935	.3965	0.399	.4834	0.310	.5907	0.673
.5126	−0.934	.3979	−0.404	.4854	−0.327	.5914	−0.650

Table 15

Photoelectric yellow observations of DY Peg

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2437164		2437164		2437164		2437164	
.5129	+0.259	.5216	+0.261	.5247	+0.316	.5275	+0.383

Table 15 (cont.)

Photoelectric yellow observations of DY Peg

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2437164		2437167		2437178		2437178	
.5342	+0.501	.3703	+0.371	.3696	+0.246	.4372	+0.416
.5372	0.557	.3733	0.421	.3701	0.233	.4379	0.366
.5400	0.586	.3759	0.505	.3707	0.225	.4393	0.276
.5466	0.671	.3821	0.581	.3714	0.209	.4400	0.272
.5493	0.679	.3846	0.587	.3721	0.195	.4406	0.254
.5521	0.707	.3866	0.607	.3740	0.180	.4413	0.209
.5581	0.718	.3892	0.645	.3747	0.185	.4420	0.205
.5605	0.756	.3946	0.703	.3754	0.184	.4427	0.189
.5632	0.736	.3967	0.719	.3761	0.195	.4434	0.186
.5691	0.730	.3991	0.718	.3768	0.215	.4448	0.175
.5726	0.689	.4033	0.732	.3775	0.228	.4455	0.165
.5816	0.446	.4054	0.728	.3796	0.252	.4462	0.168
.5844	0.335	.4073	0.728	.3803	0.258	.4469	0.179
.5872	+0.213	.4129	0.717	.3816	0.297	.4476	0.170
		.4140	0.710	.3835	0.346	.4483	0.190
2437165		.4151	0.698	.3842	0.362	.4490	0.203
.4964	+0.656	.4173	0.675	.3849	0.390	.4504	0.234
.4971	0.665	.4185	0.645	.3861	0.413	.4511	0.258
.4978	0.679	.4195	0.633	.3868	0.425	.4518	0.278
.4985	0.675	.4207	0.619	.3875	0.436	.4525	0.303
.4992	0.704	.4233	0.527	.4122	0.714	.4532	0.305
.4999	0.697	.4243	0.462	.4129	0.722	.4539	0.319
.5006	0.705	.4253	0.405	.4136	0.708	.4546	0.318
.5021	0.715	.4263	0.376	.4143	0.696	.4560	0.354
.5028	0.721	.4293	0.209	.4150	0.696	.4566	0.358
.5035	0.713	.4303	0.189	.4157	0.701	.4573	0.362
.5042	0.706	.4315	0.183	.4171	0.697	.4580	0.381
.5049	0.719	.4326	0.177	.4178	0.718	.4587	0.408
.5056	0.722	.4337	0.174	.4185	0.710	.4601	0.446
.5062	0.721	.4347	0.190	.4192	0.700	.4614	0.464
.5076	0.734	.4373	0.240	.4199	0.704	.4621	0.495
.5082	0.724	.4384	0.261	.4206	0.697	.4628	0.480
.5089	0.747	.4394	0.289	.4213	0.707	.4635	0.503
.5096	0.743	.4404	+0.311	.4227	0.690	.4642	0.518
.5103	0.742			.4234	0.699	.4649	0.550
.5110	0.740	2437178		.4248	0.715	.4656	0.546
.5117	0.744	.3580	+0.665	.4255	0.717	.4670	0.557
.5138	0.730	.3587	0.663	.4261	0.722	.4677	0.570
.5145	0.738	.3594	0.643	.4268	0.717	.4684	0.601
.5152	0.726	.3601	0.617	.4282	0.695	.4691	0.610
.5159	0.736	.3608	0.604	.4289	0.680	.4698	0.611
.5166	0.725	.3615	0.583	.4296	0.668	.4712	0.624
.5173	0.725	.3622	0.563	.4303	0.665	.4726	0.617
.5187	0.713	.3636	0.476	.4310	0.636	.4733	0.633
.5199	0.714	.3643	0.450	.4317	0.639	.4740	0.642
.5207	0.685	.3650	0.414	.4324	0.590	.4747	0.647
.5214	0.671	.3657	0.397	.4337	0.572	.4754	0.638
.5221	0.665	.3664	0.358	.4344	0.540	.4761	0.637
.5228	+0.640	.3669	0.329	.4351	0.505	.4768	0.636
		.3674	0.309	.4358	0.493	.4789	0.644
2437167		.3691	+0.257	.4365	+0.431	.4796	+0.648

Table 15 (cont.)

Photoelectric yellow observations of DY Peg

J.D.	ΔV	J.D.	ΔV	J.D.	ΔV	J.D.	ΔV
2437178		2441535		2441984		2442279	
.4802	+0.652	.5449	+0.734	.3623	+0.189	.4274	+0.271
.4816	0.681	.5482	0.748	.3641	0.208	.4281	0.280
		.5516	0.736	.3648	0.221	.4288	0.307
2441535		.5530	0.715	.3668	0.226	.4295	+0.314
.4850	+0.679	.5540	0.717	.3675	0.236		
.4857	0.642	.5565	0.675	.3693	0.296	2444113	
.4881	0.596	.5572	+0.667	.3700	0.317	.4685	+0.586
.4888	0.588			.3728	0.379	.4695	0.589
.4902	0.542	2441963		.3735	0.416	.4728	0.614
.4926	0.473	.4117	+0.719	.3755	0.435	.4762	0.670
.4933	0.414	.4131	0.704	.3762	+0.455	.4812	0.689
.4943	0.374	.4154	0.686			.4822	0.743
.4961	0.275	.4168	0.650	2442279		.4842	0.744
.4971	0.243	.4193	0.605	.3921	+0.729	.4851	0.762
.4978	0.237	.4228	0.540	.3930	0.720	.4871	0.756
.4998	0.196	.4238	0.440	.3939	0.734	.4881	0.771
.5002	0.192	.4262	0.330	.3946	0.720	.4900	0.750
.5016	0.182	.4269	0.301	.3955	0.731	.4910	0.760
.5040	0.205	.4293	0.230	.3993	0.741	.4929	0.775
.5051	0.220	.4307	0.201	.4001	0.720	.4939	0.767
.5061	0.241	.4328	0.199	.4008	0.728	.4958	0.758
.5093	0.326	.4338	0.200	.4016	0.730	.4968	0.746
.5107	0.360	.4367	0.222	.4024	0.718	.4987	0.742
.5144	0.452	.4415	0.314	.4057	0.677	.4997	0.717
.5169	0.497	.4439	0.388	.4077	0.619	.5017	0.695
.5183	0.512	.4453	+0.403	.4084	0.612	.5026	0.689
.5190	0.521			.4091	0.577	.5046	0.648
.5214	0.556	2441984		.4120	0.477	.5075	0.574
.5221	0.564	.3400	+0.701	.4126	0.442	.5085	0.526
.5232	0.558	.3425	0.695	.4133	0.416	.5105	0.446
.5259	0.597	.3432	0.687	.4142	0.344	.5114	0.358
.5269	0.607	.3450	0.656	.4150	0.318	.5133	0.269
.5280	0.619	.3474	0.614	.4155	0.288	.5143	0.229
.5311	0.645	.3481	0.587	.4163	0.251	.5162	0.182
.5322	0.672	.3501	0.515	.4171	0.223	.5172	0.170
.5343	0.695	.3519	0.472	.4181	0.227	.5192	0.173
.5357	0.702	.3529	0.430	.4196	0.199	.5201	0.181
.5367	0.704	.3547	0.361	.4202	0.198	.5221	0.217
.5387	0.709	.3571	0.240	.4209	0.197	.5231	0.219
.5398	0.714	.3578	0.250	.4216	0.199	.5250	0.249
.5405	0.720	.3596	0.199	.4223	0.206	.5260	0.264
.5428	0.735	.3603	0.194	.4231	0.217	.5279	0.291
.5439	+0.738	.3616	+0.188	.4238	+0.222	.5289	+0.316

Table 16

Photoelectric blue observations of DY Peg

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2437164		2437164		2437164		2437164	
.5115	−0.018	.5143	−0.072	.5198	−0.084	.5230	−0.019

Table 16 (cont.)

Photoelectric blue observations of DY Peg

J.D.	ΔB
2437164	
.5328	+0.212
.5358	0.281
.5386	0.336
.5451	0.426
.5507	0.481
.5567	0.513
.5591	0.527
.5622	0.529
.5677	0.501
.5707	0.484
.5740	0.458
.5802	0.226
.5830	+0.068
.5858	−0.055
2437165	
.5249	+0.377
.5256	0.358
.5263	0.345
.5270	0.306
.5284	0.257
.5291	0.225
.5298	0.175
.5305	0.116
.5312	0.071
.5319	+0.014
.5332	−0.069
.5339	0.089
.5346	0.110
.5353	0.129
.5360	0.137
.5367	0.155
.5374	0.147
.5381	0.133
.5395	0.138
.5402	0.133
.5409	0.121
.5416	0.099
.5423	0.094
.5430	0.085
.5437	0.059
.5444	0.038
.5450	−0.021
.5457	+0.002
.5464	0.019
.5485	0.082
.5492	0.112
.5499	0.124
.5506	0.154
.5513	0.170
.5520	+0.183
2437165	
.5527	+0.216
2437167	
.3724	+0.135
.3745	0.179
.3769	0.238
.3835	0.346
.3856	0.371
.3877	0.417
.3936	0.453
.3957	0.466
.3979	0.484
.4044	0.498
.4064	0.507
.4121	0.491
.4146	0.495
.4168	0.472
.4179	0.473
.4189	0.435
.4200	0.427
.4228	0.305
.4238	0.258
.4249	0.189
.4258	+0.102
.4279	−0.028
.4288	0.094
.4309	0.143
.4320	0.143
.4332	0.146
.4341	0.129
.4354	0.089
.4380	0.037
.4389	−0.021
.4399	+0.007
.4410	0.010
.4422	+0.035
2441535	
.4829	+0.469
.4843	0.438
.4853	0.420
.4877	0.347
.4884	0.305
.4895	0.248
.4919	0.171
.4929	0.114
.4940	+0.045
.4954	−0.038
.4968	0.078
.4975	0.086
.4995	−0.118
2441535	
.5002	−0.126
.5012	0.133
.5037	0.128
.5044	0.120
.5058	0.091
.5075	0.033
.5086	−0.005
.5100	+0.018
.5120	0.066
.5127	0.090
.5141	0.124
.5176	0.226
.5186	0.239
.5211	0.270
.5218	0.286
.5225	0.310
.5252	0.358
.5266	0.390
.5273	0.397
.5294	0.428
.5308	0.418
.5315	0.439
.5336	0.459
.5350	0.474
.5364	0.469
.5384	0.488
.5391	0.490
.5401	0.509
.5464	0.511
.5475	0.511
.5489	0.511
.5509	0.511
.5523	0.499
.5537	0.503
.5558	0.477
.5568	0.466
.5579	+0.438
2441963	
.4110	+0.518
.4151	0.466
.4161	0.457
.4186	0.381
.4200	0.334
.4221	0.265
.4255	+0.058
.4265	−0.031
.4290	0.099
.4321	0.142
.4335	0.130
.4360	−0.107
2441963	
.4374	−0.076
.4411	+0.005
.4432	0.039
.4446	0.090
.4471	+0.149
2441984	
.3397	+0.508
.3404	0.502
.3422	0.483
.3429	0.455
.3453	0.433
.3471	0.404
.3478	0.370
.3491	0.307
.3498	0.293
.3515	0.235
.3522	0.201
.3543	0.097
.3550	+0.048
.3568	−0.055
.3575	0.090
.3592	0.117
.3599	0.127
.3612	0.136
.3619	0.142
.3644	0.125
.3689	−0.011
.3696	+0.006
.3721	0.052
.3731	0.079
.3748	0.125
.3758	+0.163
2442279	
.3924	+0.503
.3942	0.512
.3950	0.501
.3959	0.525
.4004	0.520
.4012	0.502
.4028	0.489
.4061	0.451
.4073	0.412
.4081	0.391
.4088	0.350
.4095	0.330
.4123	0.197
.4129	0.148
.4137	0.081
.4147	+0.027

Table 16 (cont.)

Photoelectric blue observations of DY Peg

J.D.	ΔB	J.D.	ΔB	J.D.	ΔB	J.D.	ΔB
2442279		2442279		2444113		2444113	
.4157	−0.066	.4298	−0.005	.4895	+0.538	.5099	+0.198
.4159	0.075			.4905	0.534	.5109	+0.109
.4166	0.084	2444113		.4924	0.541	.5128	−0.014
.4174	0.109	.4680	+0.333	.4934	0.559	.5138	0.070
.4187	0.113	.4712	0.353	.4953	0.535	.5158	0.136
.4192	0.126	.4723	0.373	.4963	0.532	.5167	0.147
.4201	0.113	.4746	0.407	.4983	0.522	.5187	0.140
.4205	0.130	.4757	0.406	.4992	0.509	.5197	0.137
.4213	0.118	.4778	0.429	.5012	0.490	.5216	0.117
.4220	0.124	.4788	0.451	.5022	0.474	.5226	0.091
.4227	0.126	.4817	0.480	.5041	0.439	.5245	0.058
.4235	0.116	.4847	0.500	.5051	0.411	.5255	−0.026
.4242	0.088	.4866	0.516	.5070	0.366	.5274	+0.014
.4277	0.049	.4876	+0.522	.5080	+0.317	.5284	+0.033
.4284	−0.026						