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

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


## 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 $\dot{s} = -7.6 \times 10^{-13}$ 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 $+0^{\circ}4900$ 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:

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

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:

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

*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:

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

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:

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

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 obser-

vations 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.

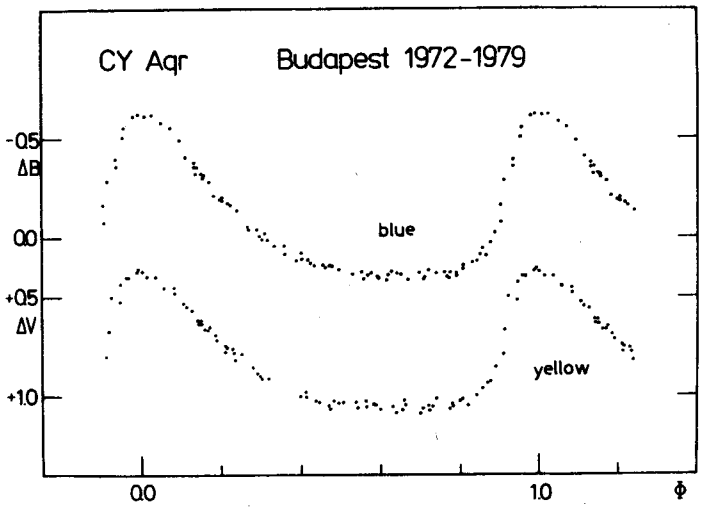


Figure 1: B and V light curves of CY Aqr

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:

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

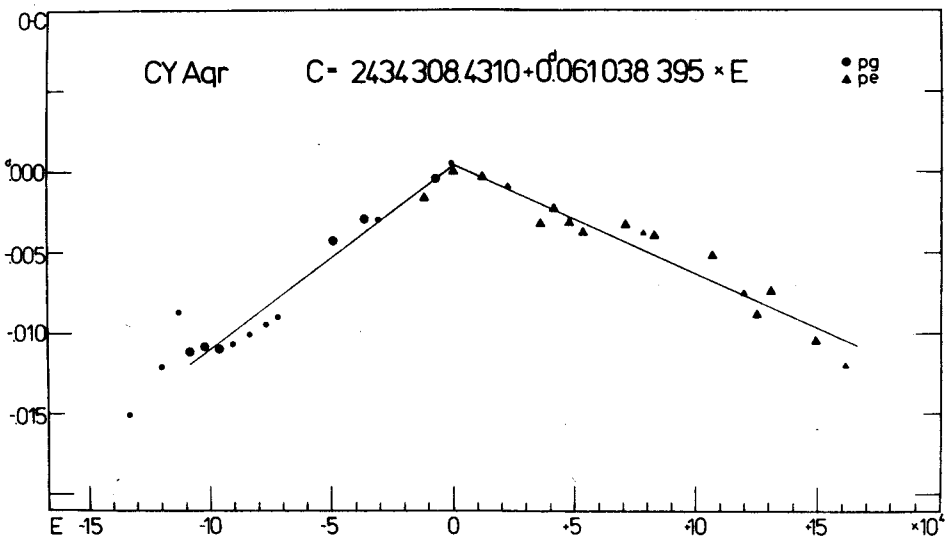


Figure 2: O-C diagram of CY Aqr

Table 3

Photographic and photoelectric maxima of CY Aqr

| year | Hel.Max.J.D. | Remarks | E | O-C | $\bar{E}$ | $\overline{O-C}$ | 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[2] | + 78330 | -0.0038 | + 78330 | -0.0038 | 1 |
| 1966 | 350.6861 | pe Zi[s] | + 82608 | -0.0046 | + 83001 | -0.0040 | 22 |
| | .7490 | pe Zi[s] | + 82609 | -0.0028 | | | |
| | .8087 | pe Zi[s] | + 82610 | -0.0041 | | | |
| | .8692 | pe Zi[s] | + 82611 | -0.0046 | | | |
| | 351.7253 | pe Zi[s] | + 82625 | -0.0031 | | | |
| | .8460 | pe Zi[s] | + 82627 | -0.0045 | | | |
| | 355.6920 | pe Zi[s] | + 82690 | -0.0039 | | | |
| | .7546 | pe Zi[s] | + 82691 | -0.0023 | | | |
| | .8145 | pe Zi[s] | + 82692 | -0.0035 | | | |
| | .8763 | pe Zi[s] | + 82693 | -0.0027 | | | |
| | 356.7300 | pe Zi[s] | + 82707 | -0.0035 | | | |
| | .7908 | pe Zi[s] | + 82708 | -0.0038 | | | |
| | .8527 | pe Zi[s] | + 82709 | -0.0029 | | | |
| | 401.5920 | pe Zi[s] | + 83442 | -0.0048 | | | |
| | .6527 | pe Zi[s] | + 83443 | -0.0051 | | | |
| | .7139 | pe Zi[s] | + 83444 | -0.0049 | | | |
| | 405.6204 | pe Zi[s] | + 83508 | -0.0049 | | | |
| | .6822 | pe Zi[s] | + 83509 | -0.0041 | | | |
| | .7428 | pe Zi[s] | + 83510 | -0.0046 | | | |
| | 406.5980 | pe Zi[s] | + 83524 | -0.0039 | | | |
| | .6578 | pe Zi[s] | + 83525 | -0.0051 | | | |
| | .7196 | pe Zi[s] | + 83526 | -0.0044 | | | |
| 1970 | 40779.7783 | pe El[2] | +106021 | -0.0044 | +106768 | -0.0052 | 5 |
| 1973 | .8390 | pe El[2] | +106022 | -0.0047 | | | |
| | .9005 | pe El[2] | +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:

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

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 |

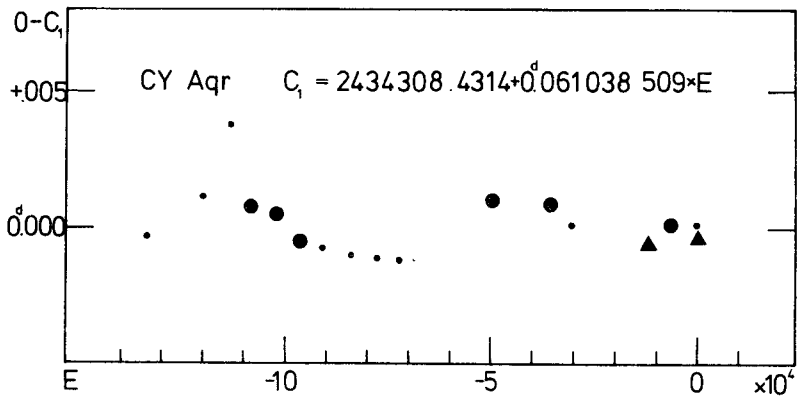


Figure 3: O-$C_1$ diagram of CY Aqr

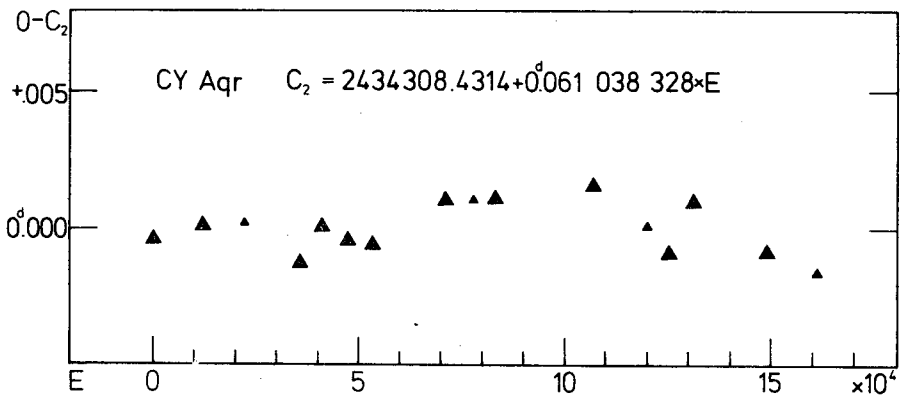


Figure 4: O-$C_2$ diagram of CY Aqr

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 ($1.81 \times 10^{-7}$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 $-0^{\circ}2911$ ($8^{m}.9$) = 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:

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

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 observ-

ing 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:

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

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:

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

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:

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

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 | $\bar{E}$ | $\overline{O-C}$ | 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:

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

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.

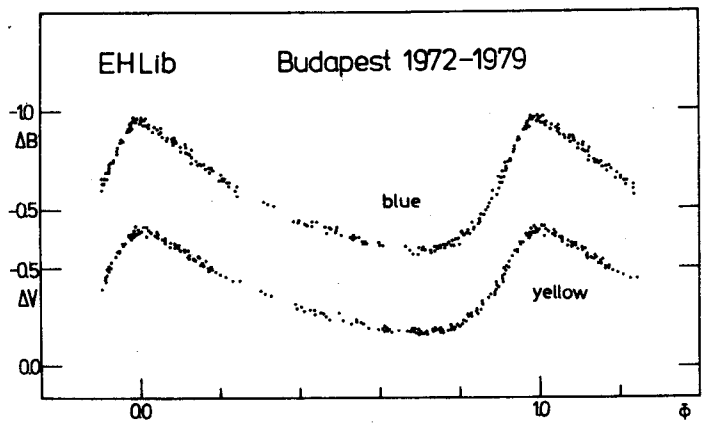


Figure 5: B and V light curves of EH Lib

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:

Max.hel. = J.D. 2433438.6078 + $0^d.088413243 \cdot E$.

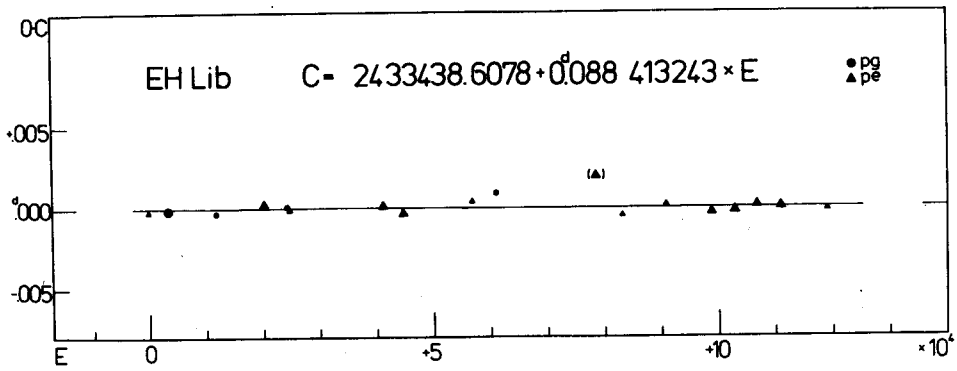


Figure 6: O-C diagram of EH Lib

*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 $+16^\circ 4877$ ($9^m.3$) = 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:

Max.hel. = J.D. 2429169.1664 + $0^d.0729256 \cdot E$.

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:

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

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 $4529 \cdot P = 330.28$ 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

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

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:

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

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:

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

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 $+0^{d}.0005$. 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 ($\beta$) of change of the period assuming that the O-Cs had a quadratic dependence on cycle numbers. They ob-

tained 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°4878 | 9.80 | +0.59 | +0.10 |
| check | +16°4876 | 10.94 | +0.53 | +0.06 |

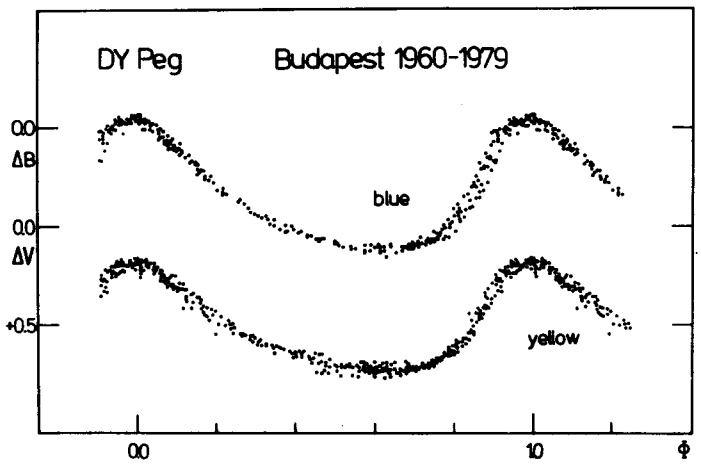


Figure 7: B and V light curves of DY Peg

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)

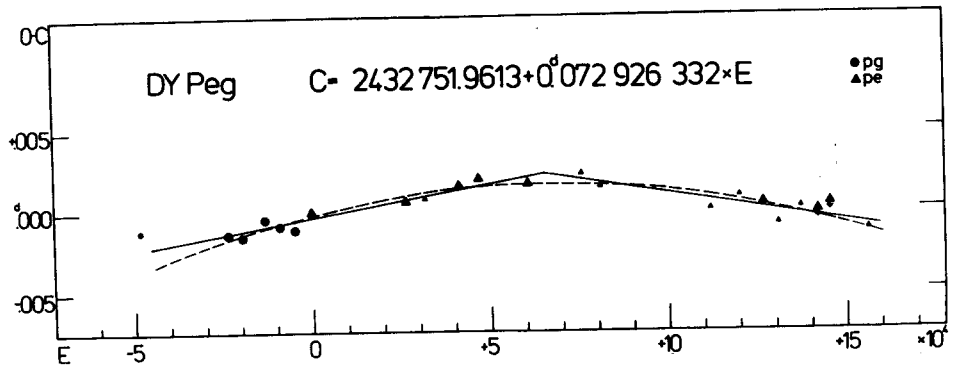


Figure 8: O-C diagram of DY Peg

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:

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

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:

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

before J.D. 2437500; E<65000 and

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

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