ASTRONOMY & ASTROPHYSICS
SUPPLEMENT SERIES

FEBRUARY **1987,** PAGE 483

Astron. Astrophys. Suppl. Ser. **67,** 483-506 (1987)

VBLUW observations of Pleiades G and K dwarfs (*)

F. Van Leeuwen ([1,2]), P. Alphenaar ([2]) and J. J. M. Meys ([2])

([1]) Royal Greenwich Observatory, Hertsmonceux Castle, Hailsham, East Sussex, BN27 1RP, U.K.
([2]) Sterrewacht Leiden, The Netherlands

Received April 10, accepted May 20, 1985

Summary. — We present the individual photometric measurements for 45 G and K dwarfs in the Pleiades cluster, many of which are variable. The measurements were obtained during 1980 and 1981 at the European Southern Observatory, La Silla, using the Dutch 91 cm light-collector and the *VBLUW* photometer. Sufficient data have been obtained to determine periods and lightcurves for 11 stars. The lightcurves are typical for stars with non-axially symmetric surface flux distributions. Rotation causes light received from these stars to vary, which phenomenon is known as the BY Draconis syndrome. This type of lightcurve has often been observed to be unstable over periods of weeks to years. We therefore decided to present all our individual measurements, so that they can be incorporated to their full extent in future observations. Data on four variable F type cluster members that were discovered during the same period are also presented here. A thorough check on periodicity led to the revision of four periods presented earlier and brings all photometric periods in agreement with estimates of rotational periods derived from measurements of the projected rotational velocities. As a result, however, a pronounced gap in the distribution of photometric periods between 0.6 and 6.0 days shows up. The current data set shows some of the fascinating details of what is probably the last stage in the pre-main-sequence evolution of a solar-type star.

Key words : Pleiades — G and K dwarfs — BY Dra syndrome — photometry-*VBLUW*.

1. Introduction.

The lower end of the colour-magnitude diagram of the Pleiades cluster shows its K- and early M-dwarf members to lie very close to the main sequence. If these stars follow the theoretically predicted pre-main-sequence evolutionary tracks, they are 200 to 800 million years old (see e.g. Stauffer, 1982). This is considerably older than the age of 100 million years indicated by the B and A stars of this cluster (see e.g. Maeder and Mermilliod, 1981). A wide spread in ages among the G-dwarfs in the Pleiades appears to be indicated by considerable differences in their Lithium abundances (Duncan and Jones, 1983). In contrast, numerical simulations by Terlevich (1984, 1985) of open clusters like the Pleiades show that the chance of survival for an open cluster over some 400 million years is very small if it is necessary to encounter large amounts of matter to create the massive stars in a later stage. Large age differences between light and massive stars appear to be very unlikely from these models.

The turn-on point of hydrogen-burning of the Pleiades at an age of 100 million years would be expected near to the early K dwarfs (Endal and Sofia, 1981). This is in many ways a transition region in the Pleiades : this is where its brightest flare stars are found, and beyond which stars show circumstellar polarization (Coyne, 1975) and emission lines in their spectra (McCarthy, 1974). Observations by Robinson and Kraft (1974) and Van Leeuwen, Alphenaar and Brand (1986) (LAB from here on) showed a marked increase in variability beyond spectral type K1. Kunkel (1975) suggested that the BY Draconis syndrome (variability due to rotational modulation) was likely to be present among the Pleiades flare stars. If the transition region represents the turn-on point in the Pleiades, then core contraction times of low mass stars and post main sequence isochrones of massive stars agree upon the cluster age. A major adjustment of the pre-main-sequence tracks for low mass stars would in that case be warranted. More detailed studies of the Pleiades G and K dwarfs were obviously very much needed in order to clarify the cluster-age ambiguity.

Of the phenomena noted for the Pleiades K-dwarfs before 1980, the variability was the least investigated. Considering the additional information contained in variable objects, we thought a pilot study on this subject was justifiable and could possibly help clarifying the status of the Pleiades G- and K-dwarfs. Two series of observations were carried out, aiming at lightcurves for a limited sample of stars and statistical information on a wider sample. The first results of this survey have been presented by Van Leeuwen and Alphenaar (1982) and Van Leeuwen (1983). Some of the data presented here have been described in connection with follow-up observations by Stauffer *et al.* (1984), Stauffer *et al.* (1985), Marcy *et al.* (1985), Micela *et al.* (1985), Van Leeuwen

---

(*) based on observations obtained at the European Southern Observatory, La Silla, Chile.

(1985, 1986). The present paper is a detailed account of the photometric observations.

The paper has been organized as follows. Section 2 describes the instrument, observations and their reduction. The third section gives a description of lightcurves and periods, and the fourth section provides information on the colour indices. Stars were selected from the Catalogue of the Pleiades by Hertzsprung (1947), numbers indicated by « HII », or from LAB, numbers indicated by « P » (Pels selection). All stars selected from the Hertzsprung catalogue, including the local standard and comparison stars have well determined proper motions and are very probable members (apart from HII 81 and HII 659). Finding charts for stars selected from the Hertzsprung catalogue can be obtained from the first mentioned author, those with Pels numbers were presented by LAB.

2. The photometric measurements.

The aim of the current pilot study has been the verification of variability among the Pleiades G and K-dwarfs, a determination of its extent over spectral types, and possibly the determination of periodicity and lightcurves for a limited number of stars. Eight stars in the magnitude range $11.3 < V < 13.6$ were initially selected for the detailed study, while all other stars in this interval were candidates for a single measurement, to be compared with the 1979 survey by LAB. The eight selected stars were chosen from near to the lower envelope of the V - V-B distribution for the Pleiades stars in this temperature region. It was thought that in this way a possible interference with variability related to duplicity could be avoided. It was later realized, however, that the distribution of the Pleiades K-dwarfs in the V *versus* V-B diagram is too noisy to make any distinction between single and multiple stars. Selecting from the lower envelope of the V - V-B distribution introduced a bias towards rapidly rotating stars. This was found, however, only after follow-up observations on rotational velocities were presented by Stauffer *et al.* (1984). No account was taken of either flare activity or indications of variability detected among the 1979 measurements. This was done in order to see how wide-spread was the variability among the Pleiades G and K dwarfs.

The first measurements were performed during 1980 October and November by FvL and PA. They led to the discovery of five periodic variables with amplitudes from 0.05 to 0.2 magnitudes. These five stars, plus a new selection of eleven stars, were measured again during 1981 October and November by PA and JJMM. Nine stars of the new selection showed clear signs of variability during 1979 and 1980, while the other two seemed not to be variable. They were included to check on the occurrence of non-variability among the Pleiades K-stars. Table I presents a list of all stars measured, their positions and the relative position of the sky measurement.

The photometric measurements were performed using the *VBLUW* photometer on the Dutch 91 cm telescope on La Silla, ESO. A 16.5 arcsec diaphragm was used throughout. The telescope and photometer are described by Walraven and Walraven (1960), the data-acquisition system by Rijf *et al.* (1969), the system calibration by Lub and Pel (1977) and the installation of the telescope and the photometer on La Silla by Lub (1979). The incoming light is recorded by this photometer simultaneously in five channels, called *VBLUW*, ranging from visual to near ultra-violet. All data obtained with this photometer will be expressed in log (I) units, as is the custom in the *VBLUW* system. Multiplying by -2.5 gives a relative scale in magnitudes. The current data are all in the LS2 system of the *VBLUW* photometry (see LAB).

During 1980 we initially used a set of 7 nearby F type members of the Pleiades as comparison stars. Two of these were found to be variable and are described in the next section, while the others did not improve upon the quality of the data either. Table II summarizes the data obtained for the seven comparison stars. Instead, the local sub-standard HII 804 (HD 23409, $m_V = 7.86$, spectral type A3V) has been used for all the determinations of the atmospheric extinctions. This star had proven to be sufficiently stable in 1979, when it was used for the same purpose. Further checks on its stability were made by means of direct comparisons with a very similar and nearby cluster member, HII 652 (HD 23361, $m_V = 8.05$, spectral type A3V). In 1980, we measured during four successive nights 26 pairs, and similarly 25 pairs were measured in 1981. The results of these checks are summarized in table III. The bands of the *VBLUW* system are sufficiently narrow to ensure the safe use of an extinction determination by means of an A3 star over a spectral range covering K stars.

Several standard-stars of the *VBLUW* system were measured before and after the five hours spent each night on measuring Pleiades stars. In addition, during some very good nights, some standards were measured during the culmination of the Pleiades. The latter were used to calibrate HII 804 to the standard system. The others were used mainly as a check on the stability of the atmospheric extinction and the instrument. The mean values after calibrations for HII 804 are also presented in table III. Standard deviations are with respect to the calibration to the *VBLUW* system.

We measured the local standard HII 804 seven times each night, at intervals of half an hour to one hour, such that an even distribution of sec (z) values between 1.6 and 2.3 was obtained. The extinction determination consisted of a least squares fit to the measurements of HII 804 with a zero point, sec (z) and the time as variables. Most of the nights had well determined extinctions, while they showed only small variations from one night to the other. Usually a small time dependence of the zeropoint during the night was detected, possibly due to the influence of temperature changes on the high voltage supply. The extinction determinations showed that during good nights on La Silla differential photometry is possible over a field of 2 degrees up to 65 degrees away from the zenith. This provided a maximum of five hours of observing on the Pleiades each night.

1987A&AS...67..483V

Preliminary reductions of the V channel were performed during the observing runs. This allowed us to work interactively with our own data set, and to plan subsequent observations according to their need. As a result, we could obtain in a three weeks interval fully covered lightcurves for stars of which at the start of the observing runs we had at most the suspicion that they could be variable.

3. The periods and lightcurves.

A detailed periodicity analysis has been performed for those stars that had sufficient data points. First, power spectra were obtained using the PERIOD subroutines developed by K. F. Hartley on the STARLINK VAX 11/780 at the Royal Greenwich Observatory. Data from both the 1980 and the 1981 data-sets were incorporated if available. At the period(s) which showed the most pronounced peaks in the power spectrum, we fitted the data-points with a simple model, containing Fourier components up to the second order. The remaining standard deviation served as a further criterion for the goodness of fit of a period.

The second order harmonic model is justified by the very good fit that our best determined lightcurves make to it. The same good fit has been observed for AU Mic by Van Leeuwen *et al.* (in preparation) and for FK Com by Morris and Milone (1983). The goodness of these fits is related to the fact that all these stars are variable due to rotational modulation. Their lightcurves are reflections of the non-axial symmetry of their surface fluxes. Between the actual surface flux distribution and the lightcurve, however, the flux is twice integrated : first over stellar latitude, and then over stellar longitude. Both integrations depress the higher harmonics from the surface flux distribution, and leave only the first and second harmonics in the lightcurve. An inclination of the stellar rotation axis depresses the higher harmonics still further. The plots of residuals given with each lightcurve in figure 1 to 12 show how well the second harmonic « model » fits to these lightcurves.

It is important to realize that the light variations at the current measuring accuracy of approximately 0.005 mag can be represented by no more than 4 parameters : the mean appearent brightness, the amplitudes of the first and second harmonics and their phase difference. The spot models which are often applied to explain these lightcurves need at least two spots (see e.g. Torres *et al.*, 1972). This is the reflection of the two harmonics found in the Fourier analysis. However, a spot model with two spots is based upon at least 9 free parameters : the mean stellar brightness, the sizes and temperatures of the two spots, their latitudes and difference in longitude, and the inclination of the stellar rotation axis. Considering the very limited amount of information contained in the lightcurves, we could not see a justification for applying such a model.

The stars for which multiple measurements were obtained will now be described individually. Periodicity has been detected from the power spectra, but the actual periods (expressed in days) were determined by means of the model fits, from the minimum of a second order polynomial through the remaining standard deviations at different periods. A measure for the accuracy of the periods has been included, given by the offset in period at which the standard deviation increases by 10 percent. All periods are given in days. The actual standard deviations are also given, and are expressed in log (I). The accuracy of a standard deviation equals this standard deviation divided by the square root of twice the number of observations, which means that most accuracies are between 8 and 12 percent.

HII 34, a late G dwarf. Three alternative periods appear from the power spectrum, at 0.867, 1.176 and 6.5 days. The model fit provides the following periods, accuracies and standard deviations : 0.86553±0.00016, sd 0.0031 ; 1.1764±0.0003, sd 0.0034 ; 6.553±0.006, sd 0.0025. This excludes the second period, and leaves the first and the third with the third as the more likely one, contrary to the earlier findings by Van Leeuwen and Alphenaar (1982) (LA from here on). Figure 1 shows the data folded with the 6.553 days period.

HII 129, a late G dwarf. This star shows a spread in magnitudes of at least 0.026 magnitudes, but not enough data have been gathered for a period determination.

HII 451, an intermediate K dwarf. The spread in magnitudes shown by this star is rather large, possibly up to 0.3 magnitudes. If it is periodic, its period is likely to be much less than one day : variations of up to 0.15 magnitudes were observed within three hours. No significant indications of periodicity were extracted from the present data-set.

HII 625, an intermediate K dwarf. Two alternative periods were detected in the power spectrum, 0.75 and 0.428 days. The model fit provided the following periods, accuracies and standard deviations : 0.748±0.003, sd 0.006 ; 0.4282±0.0008, sd 0.005. As in the visual inspection by LA, the shorter period appears the most likely one. The lightcurve at this period is shown in figure 2.

HII 659, an early K dwarf, shows some signs of variability, but no periodicity could be detected. This star does not look very much like a cluster member from the proper motions. In the V - V-B diagram, however, it is well situated between the more obvious cluster members. The proper-motion shows signs of non linearity (Van Leeuwen, in progress). It was indicated as a possible escaping member by LAB.

HII 686, an intermediate K dwarf. Two alternative periods were detected from the power spectrum, 0.284 and 0.397 days. The model fit for the 1980 observations gives the following periods, accuracies and standard deviations : 0.2838±0.0007, sd 0.0081 ; 0.3965±0.0010, sd 0.0074. Similarly for 1981 observations : 0.2844±0.0005, sd 0.0072 ; 0.3974±0.0007, sd 0.0063. Both sets of observations show the longer period as the more likely one. A combination of the two data-sets provided two possible periods with equal standard deviations : 0.39697±0.00004, sd 0.00718 ; 0.39653±0.00004, sd 0.00715. Figure 3 shows the second of these periods.

HII 727, an F8 dwarf. The power spectrum indicates a period of 8.15 days, with a secondary peak at 0.90 days.

The model fit gives the following periods, accuracies and standard deviations : 0.894±0.006, sd 0.0045 ; 8.07±0.25, sd 0.0030. The longer period is thus clearly the more likely one, contrary to the short period used before by Van Leeuwen (1983). The nature of the light variations is still unknown. The period may be double (16.2 ± 0.9 days), as in that case the present data only provide coverage of one minimum. This star is also an X-ray source (Micela *et al.*, 1985) and has very broad absorption lines (Mermilliod, private communication). It could therefore be a close binary. Figure 4 shows the lightcurves at single and double period.

HII 739, an F9 star, indicated by Binnendijk (1946) as peculiar. It shows a few hundreds of a magnitude variations in *V*, but insufficient data were gathered for a periodicity search.

HII 746, a late G dwarf, showing a few hundredths of a magnitude variations on a time-scale of days. Insufficient data for a periodicity search.

HII 879, an early K dwarf. Two possible periods were found from the power spectrum : 0.885 and 7.38 days. The model fit to the 1980 measurements gives the following periods, accuracies and standard deviations : 0.883±0.004, sd 0.0034 ; 7.4±0.2, sd 0.0031. Similarly for the 1981 observations : 0.877±0.004, sd 0.0044 ; 7.10±0.09, sd 0.0024. Both sets of observations indicate the longer period as the more likely one. The larger difference in standard deviation between the two periods for the 1981 observations is the result of obtaining observations spread through the five hours of observing. The combined data-sets give the following period, accuracy and standard deviation : 7.386±0.009, sd 0.0034. The observations folded with the latter period are shown in figure 5.

HII 882, an early K dwarf. Two possible periods are indicated by the power spectrum, 0.58 and 1.37 days. The model fit gives the following periods, accuracies and standard deviations : 0.5798±0.0014, sd 0.0033 ; 1.378±0.018, sd 0.0057. The first period provides clearly a better fit and is shown in figure 6.

HII 883, an intermediate K dwarf. Only small variations have been observed for this star, up to 0.03 magnitudes. No periodicity has been detected. This is so far the only K-dwarf in the Pleiades that does not appear to be variable.

HII 1039, an intermediate K dwarf. The power spectrum shows two families of periods. The first family is based on a phase shift of ± 0.20 per day, giving the following periods : 0.85, 1.20 and 6.2 days. These periods coincide with peaks in the power-spectrum of the distribution of observations. The second family is based on a shift in phase of ± 0.30 per day, giving the following periods : 0.59, 1.43 and 3.37 days. The model fit gives the following periods, accuracies and standard deviations : 0.848±0.017, sd 0.0021 ; 1.200±0.021, sd 0.017 ; 6.2±0.7, sd 0.0018 ; 0.59±0.02, sd 0.025 ; 1.428±0.024, sd 0.0018 ; 3.37±0.12, sd 0.0022. This star is obviously in need of many more observations before anything further can be said about its periodicity.

HII 1124, an early K dwarf. The power spectrum indicates two periods, 0.86 and 6.0 days. The model fit for the 1980 observations gives the following periods, accuracies and standard deviations : 0.856±0.007, sd 0.0058 ; 5.97±0.19, sd 0.0052. Similarly for the 1981 observations : 0.855±0.004, sd 0.0043 ; 6.03±0.11, sd 0.0028. Both data-sets thus indicate the longer period as the more likely. The higher level of distinction in the 1981 data-set was obtained with the better spread of data-points through the nights. In addition, the 1980 observations showed a considerably less stable lightcurve than the 1981 observations. The model fit for the combined data-sets gives the following periods, accuracies and standard deviations : 5.950±0.009, sd 0.0049 ; 6.051±0.009, sd 0.0049. The data folded with the second of these periods are shown in figure 7.

HII 1220, a late G type star. This star showed some indications of slow variations with an amplitude in excess of 0.04 magnitudes. The current data-set does not allow for any periodicity check.

HII 1332, an intermediate K dwarf. The power spectrum of this star shows two possible periods : 1.13 and 8.3 days. The model fit gives the following periods, accuracies and standard deviations : 1.135±0.008, sd 0.0023 ; 8.3±0.3, sd 0.0021. The latter period seems more likely for this star, contrary to the earlier report by Van Leeuwen and Alphenaar. Figure 8 shows the data-points folded with the 8.3 days period.

HII 1531, an intermediate K dwarf. The power spectrum indicates two possible periods, at 0.325 and 0.483 days. The model fit gives the following values for periods, accuracies and standard deviations : 0.3254±0.0006, sd 0.0058 ; 0.4830±0.0010, sd 0.0041. The latter period clearly provides a better fit to the data-points. Figure 9 shows the data points folded with this period.

HII 1797, an F star. This star is definitely variable, but despite quite regular observing no periodicity could be detected. The frequency distribution is irregular and might as best indicate two periods, 1.73 and 0.17 days, with amplitudes of 0.008 and 0.006 magnitudes. The nature of these variations is completely unclear. This star is well outside the Delta Scuti range.

HII 1883, an early K dwarf. The power spectrum clearly shows a period of 0.2354 days. The model fit gives for the 1980 observations the following period, accuracy and standard deviation : 0.23538±0.00006, sd 0.0029. Similarly, for the 1981 observations : 0.23540±0.00007, sd 0.0031. The combined observations give the following values : 0.235405±0.000003, sd 0.0030. The observations folded with this period are shown in figure 10. Observations by Stauffer *et al.* (1986) confirm both the period and lightcurve up to January 1983. After that date and before December 1983 a phase shift of 0.38 periods has taken place. In November 1985 the lightcurve virtually disappeared, to reappear in quite a different shape in January 1986 (Stauffer, private communication, March 1986). A large flare has been observed for this star in October 1983 by Dr. H. S. Chavushian of Byurakan Observatory, using a new stellar track technique. The flare lasted for well over two hours. Marcy *et al.* (1985) discovered a periodic modulation of the broad component of the Hα emission, which has the same period as the photometric variations. They attribute this modulation to a modulated stellar wind.

HII 2034, an early K-dwarf. The power spectrum of this star shows two possible periods, 0.355 and 0.551 days. The model fit gives the following periods, accuracies and standard deviations : 0.3554±0.0008, sd 0.0056 ; 0.5516±0.0017, sd 0.0044. The latter is clearly better, and is shown in figure 11.

HII 2786, and F9 dwarf. The few measurements obtained for this star indicate variations of more than 0.03 magnitudes in V within a day.

HII 3019, an intermediate K dwarf. This star is variable with an amplitude of at least 0.04 magnitudes over a day. Not enough data were gathered to determine a period.

HII 3163, an early K dwarf. The power spectrum of this star shows a period of 0.418 days. The model fit gives the following period, accuracy and standard deviation : 0.4178±0.0006, 0.0040. The data-points folded with this period are shown in figure 12.

The individual measurements in V and the colour indices for each of the above mentioned stars are presented in table IV. Table V presents the individual measurements of 24 other cluster members in the same spectral region, as obtained in 1980. Table VI summarizes the Fourier components obtained in the model fit with their accuracies. It gives in column 3 the period in days, and in the next two columns the mean apparent brightness in 1980 and 1981 respectively. Columns 6 and 7 provide the amplitudes of the first and second harmonics, followed by their phase difference and ratio. The remaining standard deviation and the total number of observations used are given in the last two columns. Below each entry the accuracy is given. Table VII gives the phases of the lightcurves at HJD=2444550.0 and HJD=2444900.0 days. They can serve as the phase reference points of the current data set.

As was mentioned before by Van Leeuwen and Alphenaar (1983), there exists a clear relation between photometric periods and amplitudes for the Pleiades K-dwarfs. Figure 13 shows this relation between the amplitude of the first harmonic and period. What is also clear is the lack of periods between 0.6 and 6.0 days. This has been the reason why all periods between 6 and 10 days were originally put at their *alias* around one day. Comparing the residuals for the four stars concerned shows, however, clearly that in all cases the longer period is the more likely one.

Figure 14 shows the remaining standard deviations as a function of mean brightness. We would expect that the remaining standard deviations are roughly the same for stars of similar brightness. They should also slowly increase towards fainter stars. Figure 14 shows, however, that in three cases (HII 625, HII 686, and HII 1124) there is still additional variation which has not been accounted for. The nature of these variations is still unknown.

A comparison between mean brightness in 1980 and in 1981 shows significant changes for three of the five stars measured in both seasons. It also shows the remarkable stability of the most rapidly varying star HII 1883. The differences are as follows (1980-1981) : HII 34 −0.0087±0.0007 ; HII 686 +0.0050±0.0015 ; HII 879 +0.0026±0.0011 ; HII 1124 +0.0109±0.0012 ; HII 1883 +0.0003±0.0007. An overall variation in brightness appears to be a normal feature for this type of star. The differences in amplitude for the first harmonic are (1980-1981) : HII 34 −0.0012±0.0009 ; HII 686 −0.0001±0.0020 ; HII 879 −0.0023±0.0013 ; HII 1124 −0.0047±0.0015 ; HII 1883 −0.0009±0.0009. All results are again expressed in log (I). The mean appearent brightness can thus change by almost as much as the amplitude of the light variations without a significant change in the lightcurve.

Stauffer *et al.* (1984) measured projected angular velocities for all stars presented above as periodic. Figure 15 compares their « $v \sin i$ » values with inverse photometric periods on a logarithmic scale relative to the rotation period and the rotation velocity of the Sun (24 days and 2 km/sec). The linear relation is a clear indication that these stars are variable due to rotational modulation. The average radius of these stars derived from the offset of this relation is thus approximately 0.8 R (Sun), or 4.8 * 10 ** 5 km. This is a perfectly reasonable value for K0 to K5 dwarfs.

4. The colour indices.

The simultaneous recording of light in five channels by the *VBLUW* photometer permits a description of the colour indices (V-B, B-U, U-W and B-L) on the same basis as the description of the V observations. The information recorded in the near ultra-violet channels is, however, rather noisy for K-type stars due to the lack of photons. In this section we will first describe the general properties of the colour indices of the Pleiades G and K dwarfs, followed by a description of the variations in the colour indices.

The mean colour indices of 17 of the stars presented above have been compared with those of 22 G and K dwarfs, all of which are within 10 pc from the Sun and therefore unlikely to be affected by interstellar reddening. Figures 16, 17 and 18 show the two-colour diagrams for both groups of stars. The B-U and B-L values for some of the Pleiades K-dwarfs with V-$B >$ 0.43 are clearly lower (more blue) than those of the nearby K-dwarfs. The U-W values are very similar in both groups. The blue-excess of the Pleiades K-dwarfs starts at the Balmer jump, and is, considering the fact that many of these stars have active chromospheres producing Hα and Hβ emission, probably due to Balmer-continuum radiation. There is some indication from figures 16-18 that the fast rotating stars are more active than the slow rotating ones, as would be expected and as was also observed by Stauffer *et al.* (1984). The maximum in the excess blue-radiation appears to be between the U and W channels, leading to little or no change in the U-W colour indices of the Pleiades K-dwarfs. This would mean a temperature of 15000 to 20000 K for the radiating medium.

In order to check on variability in the colour indices, we first had a look at the most prominent variable, HII 1883. Figure 19 shows the lightcurves of HII 1883 in *V* and the colour indices. The variations in *V* are reflected in (*V*-*B*) but not in the other indices. A similar colour dependence of photometric amplitudes has been observed for stars in the solar neighbourhood by Vrba and Rydgren (1983). The relation between *V* and (*V*-*B*) is linear as can be seen in figure 20. There are no differences found in this relation between the rising and descending branches of the lightcurve. Figure 21 shows the size and direction of the variations of HII 1883 in a *V* - (*V*-*B*) diagram, together with the data of other cluster members of that spectral region.

Considering the results found for HII 1883, a simultaneous least squares solution was made for all K-dwarfs presented in the previous section, and for which periods had been determined. In this solution, we assumed fixed ratios between the variations in the colour indices and those in *V*. The zero points in these relations were free parameters for each individual star. Thus, the results presented in table VIII were obtained. The variations in *B*-*V* are obvious, and close to what was observed for HII 1883. In *B*-*U* and *U*-*W* there could be some variation present too, while in *B*-*L* no variations are found. The variations in *B*-*V* and *B*-*U* are quite close to a blackbody approximation, which would be observed if these stars as a whole are slightly cooler on one side compared to the other. However, as was described above, the *BLUW* channels most likely also receive a significant flux from another, much hotter component next to the flux received from the stellar atmosphere. As it is difficult to quantify the contribution from the stellar atmosphere, it is not possible to reconstruct the flux variations in these channels as received from the stellar atmosphere only. Thus, the *VBLUW* colour indices may tell us something about the stellar activity, but are not very suitable for a detailed discussion of the stellar surface phenomena.

5. Conclusions.

The current data set together with the follow-up work by Stauffer and his colleagues have revealed a large number of new aspects to the physics of the very young Pleiades G and K dwarfs. One of the most striking is perhaps the sharpness as a function of *V*-*I* of the transition shown by several different aspects (see Stauffer *et al.*, 1984), such as the rapid rotation, the flare activity and chromospheric activity. Even where the rotation and the flare activity are not closely linked, they both start at the same value of $V\text{-}I > 0.95$ magnitudes. At *V*-*I* values between 0.95 and 1.4 the flare statistics as derived from Haro *et al.* (1982) show that 85 percent of these stars (22 out of 26) are flare stars with an average frequence of 2 flares in approximately 3000 hours of observing (Mirzoyan, 1981). Of the same stars 14 are slow and 12 rapid rotators. The most actively flaring is a slow rotator, HII 357, while two rapid rotators, HII 625 and HII 738, have sofar not been observed to flare. At *V*-*I* values less than 0.95 no flare stars and no rapid rotators are found. Thus, as figure 22 shows, the two phenomena are linked in occurrence as a function of spectral type and thus as a function of evolutionary status, but are not directly linked as physical processes.

In X-rays (see Micela *et al.*, 1984), the opposite seems to happen : here the main activity is for the slow rotating late G-dwarfs, which no longer show flare activity. Micela *et al.* attribute the X-ray activity to the braking of angular momentum inside these stars.

Given the age of the cluster of approximately 10 ** 8 years and the Helmholtz-Kelvin contraction times of stars of 0.70 $M_{\odot}$ (spectral type K5), which is approximately 10 ** 8 years, it seems very likely that the transition observed is a reflection of the turn-on point of hydrogen-burning of the Pleiades.

Acknowledgements.

Since we first discovered these stars in 1980, we have enjoyed many discussions on their characteristics with Prof. C. Zwaan. We also enjoyed the immediate enthusiasm shown by Merle F. Walker from Lick Observatory, who was first to show the rapid rotation and thus the rotational modulation of these stars. Mr. Norman Walker of the RGO assisted in the analysis of the power spectra.

References

BINNENDIJK, L. : 1946, *Ann. Sterrew. Leiden* XIX, second part.
COYNE, G. V. : 1975, in Proceedings of the Second European Regional Meeting in Astronomy, *Mem. Soc. Astron. Ital.* **45,** 445.
DUNCAN, K. D., JONES, B. F. : 1983, *Astrophys. J.* **271,** 663.
ENDAL, A. S., SOFIA, S. : 1981, *Astrophys. J.* **243,** 625.
HARO, G., CHAVIRA, E., GONZALEZ, G. : 1982, *Ton. Obs. Bull.* **3,** 1.
HERTZSPRUNG, E. : 1947, *Ann. Sterrew. Leiden XIX,* **I** A.
KUNKEL, W. E. : 1975, in *IAU Symp.* **67,** Eds. V. E. Sherwood and L. Plaut, p. 15.
LUB, J., PEL, J. W. : 1977, *Astron. Astrophys.* **54,** 137.
LUB, J. : 1979, *ESO Messenger* **19,** 1.
MAEDER, A., MERMILLIOD, J. C. : 1981, *Astron. Astrophys.* **93,** 136.
MARCY, G. W., DUNCAN, D. K., COHEN, R. D. : 1985, *Astrophys. J.* **288,** 259.
MCCARTHY, M. F. : 1974, *Cont. Oss. Astrofis. Asiago* No. 300-bis **87.**
MICELA, G., SCIORTINO, S., SERIO, S., VAIANA, G. S., GOLUB, L., HARNDEN, F. R., ROSNER, R. : 1985, preprint.
MIRZOYAN, L. V. : 1981 : Instationarity and Evolution of Stars, *Akad. Nauk Armyanskaj* SSR.
MORRIS, S. L., MILONE, E. F. : 1983, *Publ. Astron. Soc. Pac.* **95,** 376.
RIJF, R., TINBERGEN, J., WALRAVEN, Th. : 1969, *Bull. Astron. Inst. Neth.* **20,** 279.
ROBINSON, E. L., KRAFT, R. P. : 1974, *Astron. J.* **79,** 698.
STAUFFER, J. R., 1982 : *Astron. J.* **87,** 899.
STAUFFER, J. R., HARTMANN, L. W., SODERBLOM, D. R., BURNHAM, N. J., 1984 : *Astrophys. J.* **280,** 202.
STAUFFER, J. R., HARTMANN, L. W., BURNHAM, N. J., JONES, B. F., 1985 : *Astrophys. J.,* **289,** 247.
STAUFFER, J. R., DORREN, J. D., AFRICANO, J. L., 1985 : *Astrophys. J.,* in press.
TERLEVICH, E., 1984 : *Evolution of Open Clusters,* Ph. D thesis Cambridge, U. K.
TERLEVICH, E., 1985 : in Dynamics of Star Clusters, *IAU Symp.* **113,** J. Goodman and P. Hut Eds. (D. Reidel, Dordrecht, Holland).
TORRES, C. A. O., FERRAZ MELLO, S., QUAST, G. R., 1972 : *Astrophys. Lett.* **11,** 13.
VAN LEEUWEN, F., ALPHENAAR, P., 1982 : *ESO Messenger* **28,** 15.
VAN LEEUWEN, F., 1983 : *The Pleiades,* Ph. D thesis, Leiden.
VAN LEEUWEN, F., 1985 : in *Birth and Evolution of Massive Stars and Stellar Groups,* W. Boland and H. van Woerden Eds. (D. Reidel, Dordrecht, Holland), p. 55.
VAN LEEUWEN, F., 1986 : in *Flare Stars and Related Objects,* symp. held in Byurakan, USSR, Oct. 1984, p. 289.
VAN LEEUWEN, F., ALPHENAAR, P., BRAND, J., 1986 : *Astron. Astrophys. Suppl. Ser., 65,* 309.
VRBA, F. J., RYDGREN, A. E., 1983 : in Activity in Red Dwarf Stars, *IAU coll.* **71.**
WALRAVEN, Th. WALRAVEN, J. H., 1960 : *Bull. Astron. Inst. Neth.* **15,** 67.

1987A&AS...67..483V

TABLE I. — *Summary of the stars with multiple measurements.*

HII	RA (2000)	DEC	m	V-B	sky
			V	log(I)	pos
	h m s	° ′ ″			
25	3 42 55	+24 29 41	9.49	0.208	30" S
34	3 43 03	+24 40 17	12.06	0.429	30" S
129	3 43 34	+23 45 49	11.45	0.372	30" S
164	3 43 42	+23 35 47	9.55	0.214	30" N
451	3 44 50	+24 54 46	13.43	0.570	30" N
625	3 45 21	+23 43 45	12.66	0.526	30" S
659	3 45 26	+23 25 55	12.02	0.413	30" N
686	3 45 33	+24 18 17	13.44	0.520	30" W
727	3 45 40	+24 37 44	9.73	0.236	30" S
745	3 45 41	+24 17 25	9.47	0.221	30" N
746	3 45 41	+24 25 59	11.28	0.351	30" S
879	3 46 06	+24 34 08	12.83	0.499	30" N
882	3 46 04	+23 24 26	12.90	0.487	30" S
883	3 46 07	+24 33 52	13.05	0.534	30" N
1039	3 46 27	+23 35 40	13.05	0.572	30" S
1122	3 46 39	+24 06 18	9.31	0.199	30" S
1124	3 46 39	+24 01 53	12.32	0.441	30" N
1220	3 46 53	+22 52 58	11.84	0.372	30" S
1332	3 47 13	+23 42 58	12.52	0.474	30" S
1531	3 47 41	+23 58 25	13.58	0.563	30" N
1797	3 48 17	+23 38 18	10.12	0.243	30" S
1883	3 48 28	+23 18 09	12.61	0.477	30" S
2034	3 48 49	+23 58 44	12.65	0.447	30" S
3019	3 51 24	+24 05 20	13.49	0.567	30" S
3163	3 51 53	+24 23 19	12.73	0.457	30" S

TABLE II. — *Mean values and standard deviations for 7 F-type Pleiades, initially used as comparison stars.*

star nr	V	V-B	B-U	U-W	B-L	N
		... log(I) ...				
HII 25	-1.0490 ±0.0014	0.2127 ±0.0008	0.3057 ±0.0012	0.1888 ±0.0046	0.2073 ±0.0012	25
HII 164	-1.0759 ±0.0011	0.2207 ±0.0017	0.2961 ±0.0020	0.1902 ±0.0041	0.2078 ±0.0021	9
HII 727	-1.1538 ±0.0053	0.2417 ±0.0017	0.2926 ±0.0028	0.1970 ±0.0039	0.2226 ±0.0023	30
HII 745	-1.0432 ±0.0015	0.2295 ±0.0011	0.3258 ±0.0021	0.1986 ±0.0034	0.2184 ±0.0020	60
HII 1122	-0.9783 ±0.0009	0.2040 ±0.0010	0.2980 ±0.0021	0.1854 ±0.0032	0.2066 ±0.0012	22
HII 1132	-1.0333 ±0.0010	0.2145 ±0.0011	0.3069 ±0.0019	0.1932 ±0.0026	0.2104 ±0.0015	11
HII 1797	-1.3105 ±0.0034	0.2496 ±0.0014	0.2902 ±0.0035	0.2019 ±0.0073	0.2272 ±0.0026	41

TABLE III. — *Differences between HII 652 and HII 804 (the local standard) as measured in 1980 and 1981 and the calibration values for HII 804.*

	V	V-B	B-U	U-W	B-L	N	
652-804	-0.0790	0.0124	-0.0008	0.0078	0.0036	26	(1980)
s.d.	±0.0017	±0.0010	±0.0015	±0.0026	±0.0009		
652-804	-0.0788	0.0125	-0.0005	0.0083	0.0036	25	(1981)
s.d.	±0.0030	±0.0010	±0.0017	±0.0027	±0.0010		
804 cal.	-0.3948	0.0855	0.4435	0.1432	0.2104	9	(1980)
s.d.	±0.0013	±0.0019	±0.0012	±0.0033	±0.0030		

1987A&AS...67..483V

TABLE IV. — *Individual photometric data obtained in 1980 and 1981 for Pleiades F, G and K dwarfs.*

NUMBER HII	HELIOC. JULIAN DATE	m V	V	V-B	B-U	U-W	B-L	SEC(Z)
					....log(I).....			
34	534.73987	11.981	-2.0755	.428	.445		.447	1.7
	534.74442	11.967	-2.0698	.412	.465	.24	.458	1.7
	534.82733	11.977	-2.0737	.427	.498	.44	.451	1.9
	534.83197	11.981	-2.0753	.430	.480		.454	1.9
	542.74903	11.941	-2.0592	.424	.481	.24	.468	1.7
	542.75349	11.946	-2.0611	.423	.469	.27	.470	1.7
	544.71847	11.969	-2.0706	.426	.476	.30	.462	1.7
	544.72657	11.968	-2.0700	.430	.472	.35	.453	1.7
	544.81248	11.970	-2.0708	.422	.490	.24	.464	1.9
	545.72950	11.990	-2.0790	.429	.485	.31	.474	1.7
	545.73962	11.990	-2.0792	.430	.488	.26	.466	1.7
	546.67446	12.000	-2.0832	.427	.487	.29	.464	1.9
	546.68356	12.003	-2.0845	.428	.481	.26	.465	1.8
	549.70179	11.935	-2.0568	.425	.469	.27	.454	1.7
	549.71069	11.940	-2.0588	.424	.462	.29	.457	1.7
	550.65407	11.955	-2.0647	.426	.481	.28	.450	2.0
	550.66258	11.953	-2.0639	.428	.475	.27	.449	1.9
	553.65692	11.988	-2.0781	.429	.483	.29	.457	1.9
	553.66567	11.994	-2.0806	.432	.481	.32	.451	1.8
	553.68964	11.995	-2.0812	.433	.474	.28	.451	1.7
	553.69858	11.998	-2.0823	.434	.486	.26	.450	1.7
	553.73498	12.004	-2.0846	.432	.468	.34	.455	1.7
	553.74416	11.999	-2.0827	.433	.476	.31	.455	1.7
	553.78072	11.994	-2.0805	.425	.486	.30	.449	1.9
	553.78923	11.977	-2.0737	.433	.491	.33	.450	1.9
	553.79088	11.988	-2.0784	.424	.481	.30	.452	2.0
	554.70696	11.974	-2.0726	.429	.482	.26	.468	1.7
	554.71641	11.974	-2.0724	.427	.471	.29	.457	1.7
	555.67380	11.950	-2.0628	.424	.474	.26	.461	1.8
	555.68294	11.948	-2.0622	.423	.487	.21	.461	1.7
	556.68268	11.947	-2.0618	.423	.492	.26	.445	1.7
	556.69143	11.941	-2.0593	.422	.468	.29	.464	1.7
	557.66797	11.960	-2.0670	.433	.477	.30	.472	1.8
	557.67683	11.962	-2.0677	.428	.487	.26	.470	1.7
	559.73880	11.979	-2.0747	.426	.454	.28	.449	1.8
	559.74742	11.993	-2.0801	.427	.479	.30	.471	1.8
	561.72632	11.984	-2.0767	.424	.483	.29	.458	1.7
	561.73754	11.977	-2.0738	.424	.483	.26	.451	1.8
	562.67383	11.950	-2.0629	.422	.492	.21	.483	1.7
	562.68426	11.952	-2.0638	.424	.500	.27	.431	1.7
	571.63280	11.982	-2.0759	.429	.480	.26	.461	1.8
	571.64199	11.985	-2.0771	.426	.490	.28	.460	1.7
	571.71436	11.994	-2.0808	.434	.497	.29	.464	1.8
	571.72400	11.996	-2.0813	.424	.493	.29	.464	1.8
	895.71311	11.953	-2.0642	.427	.461	.30	.486	1.9
	896.74892	11.926	-2.0530	.420	.479	.29	.461	1.7
	896.77270	11.921	-2.0513	.422	.495	.29	.451	1.7
	896.80524	11.922	-2.0514	.422	.474	.31	.458	1.7
	898.73637	11.951	-2.0632	.421	.476	.32	.455	1.8
	898.79399	11.951	-2.0631	.427	.481	.30	.467	1.7
	898.83980	11.955	-2.0647	.420	.480	.27	.465	1.9
	899.75227	11.979	-2.0748	.427	.459	.28	.459	1.7
	899.83388	11.978	-2.0741	.427	.498	.30	.471	1.9
	900.69974	11.969	-2.0705	.427	.493	.26	.451	1.9
	900.75697	11.972	-2.0717	.426	.492	.25	.460	1.7
	900.83615	11.970	-2.0710	.428	.485	.27	.485	1.9
	901.75528	11.965	-2.0691	.423	.490	.28	.479	1.7
	901.81482	11.963	-2.0682	.425	.482	.25	.453	1.8
	905.70207	11.960	-2.0671	.423	.479	.25	.459	1.8
	905.76054	11.958	-2.0662	.424	.467	.33	.462	1.7
	905.83266	11.978	-2.0742	.436	.494	.29	.498	2.0
	906.70684	11.974	-2.0726	.427	.479	.27	.454	1.8
	906.78497	11.970	-2.0708	.426	.485	.24	.457	1.7
129	534.70368	11.406	-1.8428	.365	.423	.25	.393	1.9
	534.70835	11.408	-1.8436	.369	.430	.25	.389	1.8
	534.79288	11.411	-1.8445	.378	.432	.20	.370	1.7
	534.79757	11.408	-1.8435	.378	.404	.26	.363	1.7
	542.78306	11.431	-1.8526	.376	.410	.28	.378	1.7
	542.78750	11.429	-1.8520	.382	.397	.28	.373	1.7
	544.68062	11.420	-1.8482	.375	.406	.27	.389	1.8
	544.68912	11.421	-1.8485	.371	.416	.24	.391	1.8
	545.66456	11.426	-1.8508	.374	.403	.26	.387	2.0
	545.67380	11.421	-1.8485	.376	.414	.27	.370	1.9
	555.80306	11.433	-1.8536	.376	.413	.27	.378	2.1
451	555.61997	13.519	-2.6981	.584	.825		.642	2.2
	557.62470	13.437	-2.6648	.584	.550	.25	.552	2.1
	557.79201	13.420	-2.6579	.584	.552	.65	.535	2.1
	558.61823	13.406	-2.6523	.611	.848		.621	2.1
	559.61976	13.396	-2.6485	.560	.573	.62	.616	2.1
	559.79174	13.256	-2.5918	.545	.313	.04	.456	2.1
	897.75920	13.426	-2.6603	.613	.581	1.06	.653	1.7
	897.81298	13.417	-2.6567	.588	.800	.29	.612	1.8
	897.85664	13.409	-2.6536	.605	.499	.91	.650	2.0
	898.68676	13.417	-2.6567	.562	.810	.06	.563	2.1
	898.71535	13.389	-2.6453	.574	.612	.46	.605	1.9
	898.76067	13.405	-2.6520	.579	.657	.32	.556	1.7
	898.82834	13.426	-2.6605	.569	.663	1.06	.726	1.8
	899.68614	13.382	-2.6426	.561	.618	.33	.573	2.1
	899.74084	13.394	-2.6475	.580	.731	.21	.597	1.8
	899.79259	13.402	-2.6506	.579	.628	.37	.560	1.7
	899.83965	13.405	-2.6521	.574	.681	.72	.599	1.9
	900.69389	13.524	-2.7003	.348	.420	.19	.300	2.0
	900.73797	13.409	-2.6534	.577	.560	.35	.532	1.8
	900.78359	13.407	-2.6526	.575	.666	.36	.521	1.7
	900.82983	13.377	-2.6407	.565	.698	.13	.560	1.9
625	556.61062	12.611	-2.3306	.527	.550	.47	.458	2.2
	901.70707	12.676	-2.3570	.530	.510	.42	.418	1.8
	901.74966	12.703	-2.3676	.542	.544	.40	.433	1.7
	901.80377	12.728	-2.3778	.541	.520	.30	.438	1.7
	905.68370	12.730	-2.3786	.540	.502	.27	.405	1.9
	905.72961	12.729	-2.3783	.543	.567	1.21	.414	1.7
	905.77213	12.721	-2.3750	.539	.537	.35	.431	1.7
	905.81549	12.705	-2.3685	.544	.505	.40	.428	1.8
	906.67036	12.707	-2.3692	.540	.533	.32	.420	2.0
	906.71465	12.686	-2.3610	.543	.503	.32	.434	1.7
	906.74863	12.654	-2.3479	.537	.522	.34	.436	1.7
	907.67848	12.663	-2.3515	.542	.498	.39	.418	1.9
	907.74345	12.731	-2.3789	.539	.503	.37	.418	1.7
	908.69891	12.726	-2.3771	.546	.515	.48	.430	1.8
	908.75708	12.729	-2.3782	.540	.537	.32	.454	1.7
	908.78584	12.722	-2.3753	.535	.465	.42	.460	1.7
	909.67879	12.709	-2.3703	.545	.509	.40	.424	1.9
	909.70991	12.673	-2.3558	.530	.541	.24	.423	1.7
	909.75737	12.639	-2.3419	.541	.515	.33	.393	1.7
	909.81752	12.666	-2.3529	.532	.509	.42	.421	1.9
	910.72318	12.712	-2.3713	.535	.503	.41	.443	1.7
	910.77688	12.716	-2.3729	.549	.470	.39	.405	1.7
	910.80771	12.738	-2.3821	.543	.517	.38	.417	1.9
	911.69039	12.744	-2.3844	.538	.492	.28	.429	1.8
	911.73833	12.742	-2.3834	.536	.545	.35	.431	1.7
	911.78106	12.732	-2.3796	.543	.561	.23	.450	1.7
	911.81843	12.724	-2.3761	.535	.532	.22	.443	2.0
	912.76187	12.633	-2.3396	.539	.513	.35	.444	1.7
	912.79903	12.648	-2.3455	.537	.510	.41	.451	1.8
	914.71429	12.747	-2.3857	.540	.513	.27	.422	1.7

1987A&AS...67..483V

TABLE IV *(continued)*.

NUMBER HII	HELIOC. JULIAN DATE	m V	V	V-B	B-U	U-W	B-L	SEC(Z)
				....log(I).....				
625	914.75163	12.746	-2.3850	.518	.482	.30	.417	1.7
	914.77499	12.737	-2.3815	.535	.468	.44	.457	1.7
	914.80098	12.746	-2.3850	.536	.565	.39	.429	1.9
	915.66267	12.714	-2.3723	.534	.519	.34	.367	1.9
	915.69386	12.662	-2.3510	.535	.491	.33	.377	1.7
	915.73791	12.644	-2.3440	.533	.522	.20	.386	1.7
	915.77281	12.626	-2.3367	.512	.460	.36	.394	1.7
	915.79785	12.644	-2.3438	.523	.476	.55	.417	1.9
	915.80994	12.665	-2.3525	.531	.507	.21	.427	2.0
	926.69521	12.776	-2.3974	.541	.527	.39	.428	1.7
	926.73283	12.775	-2.3969	.558	.553	.33	.438	1.7
	926.76461	12.734	-2.3803	.558	.534	.55	.416	1.9
659	556.61861	11.943	-2.0602	.409	.428	.22	.350	2.1
	896.76106	11.947	-2.0615	.413	.394	.34	.366	1.7
	896.79373	11.939	-2.0583	.411	.416	.31	.353	1.7
	896.81689	11.944	-2.0606	.409	.423	.32	.366	1.7
	898.72107	11.961	-2.0675	.412	.413	.27	.359	1.8
	898.76632	11.961	-2.0674	.409	.414	.27	.352	1.7
	898.83408	11.958	-2.0663	.412	.416	.29	.359	1.8
	899.75797	11.940	-2.0588	.413	.417	.32	.357	1.7
	900.70602	11.981	-2.0754	.417	.411	.30	.355	1.8
	900.76267	11.981	-2.0755	.410	.414	.30	.374	1.6
	900.84196	11.970	-2.0710	.413	.418	.28	.365	1.9
	901.68926	11.951	-2.0634	.410	.415	.30	.358	1.9
	901.80924	11.951	-2.0634	.407	.428	.31	.354	1.7
	905.73528	11.970	-2.0711	.414	.403	.27	.358	1.7
	905.79831	11.974	-2.0724	.412	.417	.30	.363	1.7
686	542.67091	13.389	-2.6456	.576	.749	.93	.612	2.0
	542.67628	13.377	-2.6407	.551	.530	.48	.572	2.0
	543.74254	13.452	-2.6712	.587	.729	.39	.800	1.7
	543.74717	13.440	-2.6662	.561	.567	.07	.699	1.7
	544.77631	13.419	-2.6575	.541	.492	.66	.565	1.7
	544.78528	13.480	-2.6823	.558	.624	.05	.533	1.8
	545.79517	13.354	-2.6314	.539	.474	.30	.580	1.8
	545.80404	13.386	-2.6442	.542	.632	.48	.486	1.9
	546.75122	13.459	-2.6738	.545	.604	.23	.532	1.7
	546.75988	13.416	-2.6566	.555	.506	.33	.654	1.7
	549.66801	13.455	-2.6722	.573	.602	1.20	.642	1.9
	549.67770	13.470	-2.6784	.573	.578		.610	1.8
	549.73292	13.393	-2.6471	.568	.663	.26	.487	1.7
	549.74169	13.397	-2.6486	.561	.696	.53	.691	1.7
	549.79426	13.365	-2.6356	.559	.616	.08	.536	1.9
	549.80291	13.385	-2.6440	.545	.661	.34	.508	1.9
	550.66814	13.410	-2.6539	.565	.626	.33	.543	1.9
	550.67746	13.407	-2.6527	.571	.711		.600	1.8
	550.71569	13.433	-2.6632	.559	.602	.21	.562	1.7
	550.72448	13.440	-2.6662	.555	.669	.89	.566	1.7
	553.64276	13.457	-2.6731	.563	.587	.77	.604	2.0
	553.65135	13.430	-2.6620	.564	.575	.30	.536	1.9
	553.67464	13.445	-2.6680	.581	.801		.488	1.8
	553.68394	13.429	-2.6616	.567	.620	.19	.629	1.7
	553.72052	13.413	-2.6553	.575	.546	.73	.482	1.7
	553.72822	13.413	-2.6551	.568	.607	.08	.434	1.7
	553.73002	13.398	-2.6491	.559	.676	.02	.455	1.7
	553.76666	13.369	-2.6375	.528	.533	.19	.539	1.8
	553.77492	13.367	-2.6365	.533	.533	.18	.476	1.8
	554.64502	13.390	-2.6459	.565	.530	.26	.472	1.9
686	554.65397	13.402	-2.6509	.557	.515	.37	.629	1.9
	554.67613	13.426	-2.6605	.562	.719	.15	.508	1.8
	554.68482	13.398	-2.6493	.580	.611	.31	.501	1.7
	554.72440	13.443	-2.6675	.573	.600	.21	.456	1.7
	554.73375	13.438	-2.6654	.571	.541	.37	.557	1.7
	554.77177	13.457	-2.6731	.589	.633	.36	.522	1.8
	554.78064	13.467	-2.6772	.573	.705	.49	.566	1.9
	555.64396	13.436	-2.6644	.563	.511	.37	.627	1.9
	555.65090	13.434	-2.6638	.564	.577	.36	.552	1.9
	555.68824	13.415	-2.6560	.560	.605	.73	.544	1.7
	555.69563	13.393	-2.6471	.554	.550	.16	.551	1.7
	555.73129	13.359	-2.6332	.566	.573	.20	.520	1.7
	555.73950	13.386	-2.6444	.552	.587	.43	.484	1.7
	555.77692	13.382	-2.6428	.546	.578	.17	.477	1.9
	555.78582	13.384	-2.6434	.534	.591	.37	.642	1.9
	556.63631	13.392	-2.6466	.551	.426	.53	.556	2.0
	556.64490	13.394	-2.6476	.557	.563	.54	.547	1.9
	556.66817	13.420	-2.6580	.539	.598	.15	.567	1.8
	556.67705	13.412	-2.6549	.567	.499	.24	.513	1.7
	556.69716	13.426	-2.6604	.559	.535		.628	1.7
	556.70592	13.456	-2.6728	.559	.712	.05	.504	1.7
	556.73060	13.438	-2.6652	.541	.544	.59	.546	1.7
	556.73920	13.436	-2.6645	.588	.562	.41	.623	1.7
	556.77554	13.463	-2.6754	.566	.489	.40	.536	1.9
	556.78429	13.490	-2.6862	.555	.487	.62	.495	1.9
	556.80459	13.506	-2.6929	.515	.551	.86	.475	2.2
	556.81345	13.436	-2.6645	.548	.453	.60	.467	2.3
	557.64978	13.414	-2.6557	.547	.526	.39	.568	1.9
	557.65802	13.394	-2.6477	.543	.582	.24	.562	1.8
	557.68242	13.399	-2.6494	.551	.596	.34	.537	1.7
	557.69090	13.374	-2.6396	.558	.545	.28	.617	1.7
	557.71526	13.368	-2.6370	.538	.632	.35	.453	1.7
	557.72428	13.381	-2.6421	.566	.621	.80	.491	1.7
	557.76164	13.382	-2.6428	.553	.637	.13	.527	1.8
	557.76891	13.373	-2.6389	.552	.586	.33	.510	1.9
	557.79908	13.379	-2.6413	.557	.643	.15	.530	2.1
	557.80641	13.366	-2.6360	.535	.374	.39	.405	2.2
	558.62952	13.394	-2.6474	.530	.448	.39	.432	2.0
	558.63893	13.405	-2.6518	.532	.510	.49	.591	1.9
	559.64475	13.417	-2.6570	.546	.486	.60	.608	1.9
	559.65325	13.409	-2.6537	.566	.504	.31	.510	1.8
	559.66397	13.390	-2.6459	.564	.725		.588	1.8
	559.67309	13.382	-2.6426	.559	.482	.08	.606	1.7
	559.69406	13.390	-2.6457	.545	.542	.24	.540	1.7
	559.70212	13.376	-2.6404	.539	.542	.20	.501	1.7
	559.72495	13.344	-2.6274	.522	.580	.37	.473	1.7
	559.73321	13.347	-2.6286	.533	.605	.16	.466	1.7
	559.75840	13.391	-2.6465	.556	.635	.32	.553	1.8
	559.76670	13.419	-2.6578	.543	.505	.38	.474	1.9
	571.61243	13.410	-2.6540	.546	.609	.58	.645	1.8
	571.62131	13.401	-2.6503	.559	.512	.34	.668	1.8
	571.64800	13.383	-2.6432	.555	.522	.33	.549	1.7
	571.65687	13.392	-2.6467	.556	.625	.18	.508	1.7
	571.69946	13.405	-2.6521	.584	.517	.25	.495	1.7
	571.70854	13.435	-2.6640	.603	.538	.37	.574	1.7
	571.75059	13.434	-2.6639	.562	.638	.59	.656	2.0
	571.75966	13.429	-2.6618	.588	.691	.62	.445	2.1
	571.77069	13.444	-2.6679	.608	.780	.45	.769	2.3
	571.77900	13.505	-2.6924	.558			.753	2.4
	907.66472	13.480	-2.6823	.566	.732	.39	.545	2.1
	907.73202	13.494	-2.6879	.550	.629	.36	.489	1.7
	908.66971	13.414	-2.6557	.550	.688	.15	.527	2.0
	908.73005	13.405	-2.6519	.541	.495	.34	.515	1.7
	908.79363	13.434	-2.6638	.549	.598	.24	.469	1.8
	909.65938	13.481	-2.6827	.569	.640	.35	.469	2.1
	909.70414	13.489	-2.6861	.559	.576	.15	.513	1.8
	909.75175	13.440	-2.6660	.553	.623	.34	.585	1.7
	909.79420	13.415	-2.6559	.553	.578	.17	.472	1.8
	909.82332	13.408	-2.6532	.534	.635	.34	.552	2.0
	910.66886	13.415	-2.6561	.551	.612	.14	.502	2.0

TABLE IV *(continued)*.

NUMBER HII	HELIOC. JULIAN DATE	m V	V	V-B	B-U	U-W	B-L	SEC(Z)
					....log(I).....			
686	910.70561	13.393	-2.6471	.557	.575	.28	.438	1.7
	910.73455	13.429	-2.6618	.536	.612	.71	.518	1.7
	910.77122	13.438	-2.6653	.558	.636	.24	.577	1.7
	910.80205	13.466	-2.6768	.551	.743	.01	.460	1.9
	911.67283	13.496	-2.6887	.542	.549	1.01	.418	1.9
	911.72685	13.443	-2.6675	.540	.458	.36	.459	1.7
	911.76971	13.416	-2.6565	.549	.510	.40	.503	1.7
	911.80652	13.410	-2.6538	.541	.581	.44	.579	1.9
	912.76778	13.448	-2.6694	.541	.547	.45	.510	1.7
	912.80491	13.480	-2.6823	.553	.608	.32	.454	1.9
	914.72018	13.399	-2.6497	.531	.527	.21	.469	1.7
	914.75747	13.423	-2.6591	.509	.576	.43	.444	1.7
	914.78914	13.476	-2.6806	.538	.565		.541	1.8
	915.66836	13.450	-2.6701	.553	.474	.17	.508	1.9
	915.69977	13.459	-2.6740	.573	.544	.33	.452	1.7
	915.75538	13.399	-2.6494	.529	.442	.16	.427	1.7
	915.78645	13.354	-2.6313	.486	.551	.26	.497	1.8
	926.68920	13.439	-2.6658	.536	.597	.63	.471	1.7
	926.72087	13.476	-2.6808	.567	.639	.34	.542	1.7
	926.75291	13.495	-2.6885	.595	.662	.07	.620	1.8
	926.77612	13.503	-2.6917	.549	.629	.56	.634	2.0
727	542.68384	9.715	-1.1578	.239	.304	.21	.239	1.9
	542.69626	9.710	-1.1560	.237	.307	.20	.239	1.8
	542.83052	9.719	-1.1597	.239	.306	.20	.242	2.0
	543.71947	9.713	-1.1572	.238	.305	.21	.239	1.7
	543.73496	9.708	-1.1552	.236	.305	.21	.240	1.7
	544.76714	9.699	-1.1514	.236	.301	.20	.236	1.7
	545.76802	9.691	-1.1481	.235	.305	.21	.238	1.7
	546.71020	9.684	-1.1454	.236	.307	.20	.235	1.7
	549.81034	9.720	-1.1602	.237	.304	.20	.241	2.0
	554.80031	9.695	-1.1500	.234	.306	.20	.240	2.1
	555.63618	9.708	-1.1550	.239	.301	.21	.238	2.0
	555.79429	9.694	-1.1496	.238	.298	.21	.235	2.0
	556.63005	9.722	-1.1608	.238	.307	.20	.238	2.1
	556.79086	9.735	-1.1662	.239	.296	.21	.237	2.0
	556.79228	9.721	-1.1604	.236	.308	.20	.240	2.0
	557.62955	9.713	-1.1571	.238	.306	.20	.240	2.0
	557.79549	9.715	-1.1579	.240	.301	.20	.237	2.1
	558.62241	9.706	-1.1543	.238	.304	.20	.239	2.1
	559.62445	9.703	-1.1530	.238	.301	.21	.234	2.0
	559.78760	9.710	-1.1558	.237	.303	.19	.240	2.1
	561.60032	9.690	-1.1479	.233	.301	.20	.238	2.3
	561.77891	9.692	-1.1485	.236	.301	.20	.236	2.0
	562.61295	9.684	-1.1453	.235	.303	.21	.240	2.1
	562.69852	9.681	-1.1442	.235	.303	.21	.236	1.7
	571.57212	9.713	-1.1571	.237	.305	.20	.239	2.3
	571.59327	9.706	-1.1545	.240	.302	.20	.242	2.0
	571.62853	9.701	-1.1525	.239	.304	.20	.238	1.8
	571.67918	9.694	-1.1496	.236	.308	.20	.235	1.7
	571.73182	9.693	-1.1490	.236	.303	.21	.239	1.9
	571.76660	9.690	-1.1478	.236	.308	.20	.244	2.2
739	542.83990	9.543	-1.0883	.280	.318	.22	.268	2.2
	555.64077	9.553	-1.0924	.280	.317	.22	.270	2.0
	555.71427	9.549	-1.0906	.280	.322	.21	.272	1.7
	555.79000	9.551	-1.0915	.280	.322	.21	.273	2.0
	556.66448	9.549	-1.0907	.280	.314	.23	.269	1.8
	557.71126	9.536	-1.0857	.279	.316	.22	.266	1.7
	559.65996	9.543	-1.0885	.281	.321	.21	.265	1.8
746	534.68676	11.269	-1.7872	.356	.376	.24	.381	2.1
	534.69133	11.268	-1.7866	.361	.373	.32	.351	2.0
	534.77498	11.276	-1.7901	.361	.389	.25	.380	1.7
	534.77989	11.279	-1.7914	.356	.397	.27	.380	1.7
	542.79927	11.264	-1.7850	.360	.398	.22	.367	1.8
	542.80371	11.265	-1.7855	.362	.397	.24	.368	1.8
	544.66589	11.271	-1.7880	.363	.394	.25	.366	2.0
	544.67433	11.270	-1.7876	.363	.390	.24	.375	1.9
	546.78180	11.288	-1.7949	.363	.394	.26	.377	1.8
	546.79221	11.284	-1.7933	.361	.395	.25	.374	1.8
879	542.68777	12.739	-2.3824	.508	.554	.25	.505	1.9
	542.69248	12.753	-2.3881	.502	.556	.26	.532	1.9
	543.72411	12.766	-2.3932	.497	.539	.35	.531	1.7
	543.72990	12.786	-2.4012	.496	.544	.37	.563	1.7
	544.76309	12.776	-2.3974	.507	.629	.41	.563	1.7
	544.77108	12.774	-2.3966	.503	.601	.42	.533	1.7
	545.76295	12.788	-2.4020	.502	.586	.33	.532	1.7
	545.77223	12.774	-2.3965	.507	.581	.24	.484	1.7
	546.70556	12.760	-2.3909	.499	.555	.33	.530	1.7
	546.71490	12.759	-2.3905	.508	.610	.19	.518	1.7
	550.70024	12.762	-2.3916	.501	.611	.22	.526	1.7
	550.70973	12.765	-2.3928	.507	.568	.26	.520	1.7
	554.75444	12.728	-2.3777	.497	.570	.30	.538	1.8
	554.76368	12.729	-2.3782	.499	.579	.36	.533	1.8
	555.74498	12.717	-2.3734	.498	.544	.28	.541	1.7
	555.75319	12.728	-2.3777	.502	.578	.40	.525	1.8
	556.74475	12.724	-2.3764	.496	.609	.17	.519	1.7
	556.75352	12.728	-2.3777	.498	.551	.40	.540	1.8
	557.69639	12.744	-2.3844	.506	.584	.34	.507	1.7
	557.70468	12.754	-2.3882	.500	.596	.20	.522	1.7
	559.79736	12.787	-2.4019	.488	.569	.22	.488	2.2
	897.72382	12.755	-2.3890	.504	.592	.29	.543	1.8
	897.79552	12.762	-2.3917	.510	.569	.36	.561	1.7
	897.84522	12.759	-2.3903	.504	.613	.26	.541	1.9
	898.69855	12.800	-2.4072	.511	.562	.45	.550	2.0
	898.74373	12.799	-2.4066	.502	.553	.45	.546	1.7
	898.80133	12.797	-2.4060	.505	.618	.25	.558	1.7
	898.84725	12.793	-2.4041	.513	.582	.37	.562	2.0
	899.71453	12.790	-2.4028	.502	.587	.30	.550	1.9
	899.80591	12.781	-2.3995	.508	.534	.31	.518	1.7
	900.74552	12.768	-2.3940	.503	.606	.04	.573	1.7
	900.80310	12.775	-2.3967	.496	.549	.25	.549	1.7
	905.71815	12.784	-2.4005	.507	.572	.42	.574	1.8
	906.73748	12.789	-2.4027	.506	.584	.35	.536	1.7
	907.72618	12.780	-2.3989	.503	.553	.33	.571	1.7
	908.71861	12.779	-2.3986	.495	.552	.37	.534	1.7
	909.74423	12.723	-2.3757	.494	.582	.20	.549	1.7
	910.71725	12.714	-2.3722	.504	.534	.41	.501	1.7
	911.71526	12.742	-2.3834	.499	.600	.31	.556	1.7
	911.76389	12.746	-2.3851	.503	.632	.20	.535	1.7
	912.81740	12.792	-2.4036	.501	.641	.13	.549	2.0
	914.70300	12.782	-2.3996	.501	.529	.28	.506	1.7
	915.71110	12.768	-2.3941	.500	.596	.25	.489	1.7
882	556.79584	12.879	-2.4392	.503	.474	.48	.450	2.0
	906.67800	12.722	-2.3754	.475	.502	.28	.461	1.9
	906.77920	12.718	-2.3739	.484	.531	.31	.445	1.7
	906.81640	12.731	-2.3789	.480	.477	.30	.466	1.8
	907.70903	12.807	-2.4099	.481	.466	.30	.435	1.7
	907.78867	12.737	-2.3817	.485	.486	.31	.447	1.7
	908.69311	12.814	-2.4127	.491	.462	.32	.442	1.8
	908.77444	12.842	-2.4240	.488	.484	.33	.454	1.7
	908.81637	12.819	-2.4149	.490	.451	.32	.439	1.9
	909.66746	12.711	-2.3708	.480	.494	.34	.481	2.0

TABLE IV *(continued)*.

NUMBER HII	HELIOC. JULIAN DATE	m V	V	V-B	B-U ....log(I).....	U-W	B-L	SEC(Z)
882	909.69019	12.750	-2.3866	.476	.491	.34	.475	1.8
	909.71558	12.732	-2.3796	.487	.492	.39	.443	1.7
	909.76296	12.753	-2.3880	.489	.478	.28	.483	1.7
	909.81186	12.788	-2.4022	.486	.530	.23	.444	1.9
	910.67482	12.759	-2.3903	.481	.517	.35	.470	1.9
	910.69993	12.731	-2.3790	.479	.515	.25	.475	1.7
	910.74838	12.713	-2.3716	.482	.499	.29	.471	1.6
	910.79049	12.716	-2.3729	.477	.509	.32	.474	1.7
	910.81923	12.719	-2.3743	.470	.514	.24	.477	1.9
	911.65212	12.824	-2.4166	.483	.529	.27	.493	2.1
	911.70957	12.841	-2.4237	.492	.504	.32	.464	1.7
	911.74647	12.814	-2.4126	.484	.511	.35	.461	1.6
	911.78903	12.784	-2.4004	.482	.508	.27	.470	1.8
	912.75040	12.803	-2.4084	.495	.506	.36	.470	1.7
	912.78745	12.835	-2.4210	.493	.537	.29	.471	1.8
	912.82532	12.839	-2.4229	.487	.518	.32	.489	2.0
	914.70861	12.775	-2.3970	.483	.517	.16	.441	1.7
	914.74576	12.744	-2.3842	.468	.474	.27	.460	1.7
	914.78304	12.727	-2.3773	.489	.494	.27	.465	1.8
	914.81264	12.733	-2.3798	.489	.479	.29	.454	2.0
	915.67406	12.821	-2.4157	.491	.518	.33	.436	1.8
	915.70541	12.836	-2.4216	.479	.520	.14	.459	1.7
	915.74949	12.831	-2.4197	.492	.433	.17	.429	1.7
	915.78066	12.809	-2.4108	.465	.478	.33	.431	1.8
	915.80421	12.820	-2.4153	.491	.502	.31	.452	1.9
	926.71509	12.828	-2.4183	.494	.519	.33	.455	1.7
	926.75875	12.838	-2.4223	.502	.516	.24	.443	1.8
883	897.72952	12.957	-2.4704	.535	.606	.36	.532	1.8
	897.80108	12.972	-2.4765	.532	.622	.19	.606	1.7
	897.85072	12.948	-2.4671	.524	.606	.33	.578	2.0
	898.70394	12.961	-2.4722	.530	.639	.24	.545	2.0
	898.74915	12.972	-2.4765	.517	.588	.38	.554	1.7
	898.80678	12.959	-2.4714	.530	.587	.42	.562	1.7
	898.85274	12.963	-2.4731	.526	.609	.64	.596	2.0
	899.71987	12.970	-2.4759	.519	.697	.28	.579	1.8
	899.81152	12.949	-2.4675	.528	.597	.30	.581	1.8
	900.75104	12.958	-2.4709	.528	.613	.53	.578	1.7
	900.80857	12.939	-2.4634	.518	.548	.42	.557	1.8
	905.72379	12.965	-2.4740	.526	.600	.33	.579	1.7
1039	557.60853	12.847	-2.4262	.567	.572	.52	.562	2.2
	901.70105	12.791	-2.4033	.534	.525	.27	.483	1.9
	901.74392	12.783	-2.4002	.530	.579	.11	.484	1.7
	901.79802	12.790	-2.4029	.536	.543	.29	.491	1.7
	901.83404	12.790	-2.4030	.536	.516	.44	.493	1.9
	905.67007	12.813	-2.4124	.531	.564	.38	.509	2.0
	905.74670	12.810	-2.4109	.535	.526	.28	.506	1.7
	905.80410	12.805	-2.4089	.537	.582	.31	.494	1.8
	906.68943	12.792	-2.4039	.541	.549	.38	.466	1.9
	906.79934	12.801	-2.4074	.539	.553	.46	.486	1.7
	907.68980	12.779	-2.3986	.533	.531	.41	.487	1.8
	907.77133	12.787	-2.4018	.528	.530	.32	.463	1.7
	907.82101	12.791	-2.4035	.528	.558	.28	.499	1.9
	908.68153	12.792	-2.4037	.541	.508	.28	.509	1.9
	908.74176	12.798	-2.4063	.533	.540	.31	.472	1.7
	908.81080	12.793	-2.4042	.536	.495	.29	.488	1.8
	909.69611	12.800	-2.4070	.539	.547	.28	.470	1.8
	909.76889	12.805	-2.4092	.545	.522	.31	.483	1.7
1124	542.72248	12.320	-2.2125	.455	.533	.27	.506	1.7
	542.72706	12.321	-2.2129	.452	.514	.36	.473	1.7
	543.67987	12.344	-2.2224	.458	.498	.23	.501	1.9
	543.68432	12.344	-2.2226	.457	.508	.47	.481	1.9
	544.73469	12.348	-2.2241	.459	.524	.26	.462	1.7
	544.74222	12.358	-2.2281	.457	.527	.22	.473	1.7
	545.74771	12.330	-2.2168	.450	.515	.25	.492	1.7
	545.75675	12.325	-2.2146	.450	.519	.27	.470	1.7
	549.68639	12.354	-2.2265	.454	.497	.11	.455	1.8
	549.69594	12.357	-2.2276	.458	.493	.30	.464	1.7
	549.76181	12.362	-2.2297	.453	.489	.30	.468	1.7
	549.77077	12.354	-2.2265	.458	.507	.23	.479	1.7
	554.73977	12.326	-2.2150	.454	.504	.24	.481	1.7
	554.74872	12.328	-2.2158	.455	.532	.26	.487	1.7
	555.65640	12.355	-2.2268	.458	.491	.28	.480	1.8
	555.66337	12.359	-2.2286	.462	.502	.35	.477	1.8
	556.65045	12.381	-2.2375	.456	.504	.28	.498	1.9
	556.65795	12.386	-2.2395	.456	.514	.29	.475	1.8
	556.76148	12.375	-2.2348	.458	.487	.27	.467	1.8
	556.76993	12.381	-2.2374	.460	.526	.26	.501	1.8
	557.63571	12.354	-2.2266	.469	.521	.36	.428	2.0
	557.64412	12.357	-2.2276	.455	.520	.26	.468	1.9
	557.77510	12.351	-2.2251	.455	.515	.37	.465	1.9
	557.78347	12.355	-2.2268	.455	.482	.30	.479	1.9
	558.60170	12.332	-2.2177	.454	.459	.29	.521	2.3
	559.63060	12.318	-2.2119	.452	.517	.33	.451	1.9
	559.63903	12.315	-2.2108	.448	.511	.22	.471	1.9
	559.77226	12.318	-2.2119	.452	.516	.25	.480	1.9
	559.78067	12.326	-2.2152	.448	.544	.23	.471	2.0
	561.70781	12.388	-2.2401	.458	.541	.30	.458	1.7
	561.71884	12.379	-2.2366	.458	.481	.34	.507	1.7
	562.70585	12.402	-2.2460	.459	.509	.29	.473	1.7
	571.59744	12.330	-2.2169	.460	.494	.32	.485	2.0
	571.60644	12.335	-2.2188	.453	.493	.22	.486	1.9
	571.66266	12.345	-2.2228	.451	.512	.26	.454	1.7
	571.67165	12.328	-2.2160	.454	.504	.29	.443	1.7
	571.73605	12.319	-2.2124	.453	.477	.34	.442	1.9
	571.74460	12.331	-2.2170	.454	.515	.35	.500	1.9
	895.70735	12.411	-2.2496	.465	.579	.38	.512	2.0
	896.74313	12.379	-2.2365	.457	.519	.35	.490	1.7
	896.76683	12.380	-2.2368	.457	.515	.31	.480	1.7
	896.79940	12.380	-2.2371	.457	.541	.27	.467	1.7
	898.70962	12.327	-2.2155	.447	.512	.32	.476	1.9
	898.75486	12.329	-2.2163	.445	.501	.27	.464	1.7
	898.81261	12.334	-2.2182	.448	.514	.26	.472	1.7
	899.70144	12.343	-2.2218	.455	.509	.35	.466	1.9
	899.86168	12.373	-2.2343	.458	.550	.32	.494	2.1
	900.71756	12.402	-2.2458	.458	.530	.28	.477	1.8
	900.78929	12.395	-2.2430	.451	.507	.23	.497	1.7
	901.71299	12.404	-2.2466	.452	.504	.24	.501	1.8
	901.73262	12.417	-2.2519	.456	.519	.34	.483	1.7
	905.67803	12.354	-2.2263	.446	.515	.32	.482	2.0
	905.77897	12.354	-2.2266	.445	.504	.31	.477	1.7
	906.74297	12.388	-2.2402	.454	.499	.26	.467	1.7
	907.71462	12.406	-2.2477	.458	.480	.35	.471	1.7
	908.72420	12.381	-2.2375	.451	.522	.28	.495	1.7
	909.77460	12.346	-2.2231	.453	.497	.32	.475	1.7
	910.71153	12.333	-2.2180	.447	.533	.25	.483	1.7
	910.75993	12.335	-2.2189	.447	.494	.29	.477	1.7
	911.72093	12.357	-2.2275	.449	.515	.27	.468	1.7
	912.79323	12.387	-2.2400	.454	.507	.30	.495	1.8
	914.72604	12.396	-2.2434	.449	.493	.22	.449	1.7
	914.76330	12.376	-2.2355	.450	.505	.28	.459	1.7
	915.65696	12.344	-2.2226	.444	.500	.27	.480	1.9
	915.71679	12.358	-2.2281	.442	.505	.20	.467	1.7

TABLE IV *(continued)*.

NUMBER HII	HELIOC. JULIAN DATE	m V	V	V-B	B-U	U-W	B-L	SEC(Z)
				....log(I).....				
1220	534.72232	11.767	-1.9886	.405	.363		.383	1.7
	534.72687	11.758	-1.9852	.384	.383	.01	.444	1.7
	534.81084	11.761	-1.9865	.390	.476	.18	.398	1.7
	534.81547	11.766	-1.9883	.391	.401	.24	.426	1.7
	542.76436	11.784	-1.9957	.390	.443	.25	.417	1.6
	542.76875	11.781	-1.9943	.396	.429	.23	.407	1.6
	544.70551	11.772	-1.9907	.388	.438	.30	.406	1.7
	544.71335	11.775	-1.9921	.385	.431	.21	.418	1.7
	545.71407	11.777	-1.9928	.391	.437	.25	.408	1.7
	545.72377	11.782	-1.9949	.391	.430	.29	.420	1.6
	546.81491	11.772	-1.9907	.391	.426	.26	.411	1.9
	549.74782	11.788	-1.9973	.390	.428	.25	.416	1.6
	549.75629	11.786	-1.9965	.389	.432	.26	.414	1.7
	554.69062	11.795	-2.0002	.393	.419	.26	.406	1.7
	554.70042	11.792	-1.9991	.393	.437	.25	.418	1.6
	559.80294	11.779	-1.9938	.395	.452	.24	.423	2.1
1332	558.60991	12.437	-2.2599	.471	.558	.38	.513	2.2
	906.73151	12.429	-2.2570	.467	.574	.14	.547	1.7
	906.79139	12.420	-2.2533	.474	.570	.32	.537	1.7
	907.69561	12.450	-2.2655	.476	.569	.37	.531	1.8
	907.75344	12.452	-2.2662	.474	.569	.27	.522	1.7
	908.70698	12.480	-2.2774	.471	.558	.40	.547	1.7
	908.76864	12.469	-2.2731	.474	.561	.35	.532	1.7
	909.68450	12.474	-2.2750	.470	.552	.35	.537	1.8
	909.73877	12.474	-2.2750	.471	.551	.27	.512	1.7
	909.78602	12.468	-2.2728	.475	.596	.28	.525	1.7
	910.68639	12.469	-2.2732	.476	.537	.35	.537	1.8
	910.75420	12.469	-2.2731	.469	.540	.35	.523	1.7
	910.79623	12.471	-2.2739	.468	.575	.23	.530	1.8
	911.70399	12.467	-2.2721	.471	.564	.24	.554	1.7
	911.75216	12.473	-2.2748	.472	.561	.28	.524	1.7
	911.80071	12.470	-2.2734	.473	.558	.28	.536	1.8
	912.77359	12.453	-2.2665	.473	.559	.29	.542	1.7
	914.73997	12.436	-2.2596	.464	.534	.32	.526	1.7
	915.68816	12.444	-2.2629	.465	.480	.36	.508	1.7
	915.76119	12.441	-2.2615	.469	.485	.30	.505	1.7
	926.72691	12.479	-2.2769	.484	.567	.26	.550	1.7
1531	558.61397	13.497	-2.6891	.533	.482	.50	.511	2.2
	897.71538	13.443	-2.6672	.559	.541	.28	.574	1.9
	897.78775	13.438	-2.6653	.554	.624	.29	.543	1.7
	897.83731	13.454	-2.6717	.560	.644	.19	.610	1.8
	899.70713	13.419	-2.6577	.551	.549	.58	.564	1.9
	899.77975	13.452	-2.6711	.547	.537	.38	.559	1.7
	899.85128	13.502	-2.6912	.568	.770	.86	.531	2.0
	900.71164	13.458	-2.6735	.557	.613	.34	.596	1.8
	900.79507	13.495	-2.6884	.562	.690	.42	.654	1.7
	900.84770	13.509	-2.6941	.560	.592	.11	.561	2.0
	901.71872	13.446	-2.6687	.562	.601	.92	.560	1.8
	901.76819	13.485	-2.6842	.554	.532	.28	.616	1.7
	901.82042	13.519	-2.6980	.562	.547	.21	.600	1.8
	901.85382	13.545	-2.7086	.577	.660	.54	.564	2.1
	905.70788	13.531	-2.7028	.561	.655	.16	.520	1.8
	905.75246	13.549	-2.7101	.559	.657	.20	.514	1.7
	905.79032	13.536	-2.7052	.564	.568	.72	.518	1.7
	905.84074	13.464	-2.6760	.539	.693	.26	.519	2.0
	906.72590	13.544	-2.7081	.570	.539	.69	.571	1.7
	906.76770	13.523	-2.6996	.557	.578	.39	.577	1.7
	906.83367	13.479	-2.6821	.559	.746	.51	.523	2.0
	907.73777	13.525	-2.7005	.563	.572	.18	.531	1.7
	907.83512	13.465	-2.6763	.539	.657	.37	.613	2.0
	908.73596	13.500	-2.6905	.553	.636	.40	.636	1.7
	908.83104	13.446	-2.6686	.551	.580	.52	.494	2.0
	909.83135	13.445	-2.6683	.553	.579	.44	.505	2.0
	910.65480	13.503	-2.6918	.556	.574	.61	.558	2.1
	910.74052	13.455	-2.6724	.539	.661	.62	.563	1.7
	910.82754	13.433	-2.6635	.547	.619	.25	.565	2.0
	911.68467	13.470	-2.6784	.551	.541	.30	.539	1.8
1531	911.82676	13.441	-2.6664	.557	.672	.40	.627	2.1
	912.74452	13.420	-2.6581	.556	.529	.38	.593	1.7
	914.79497	13.492	-2.6871	.561	.542	.59	.502	1.9
	915.64256	13.437	-2.6650	.525	.574	.21	.606	2.1
	915.81796	13.518	-2.6976	.562	.580	.37	.632	2.1
	926.73870	13.443	-2.6674	.587	.732	.84	.605	1.7
1797	542.70248	10.101	-1.3142	.249	.301	.25	.240	1.8
	542.71559	10.096	-1.3122	.246	.307	.21	.243	1.7
	543.69045	10.089	-1.3093	.246	.305	.21	.245	1.8
	543.70325	10.091	-1.3104	.245	.302	.15	.246	1.8
	544.75086	10.095	-1.3118	.246	.302	.21	.243	1.7
	544.84675	10.095	-1.3120	.246	.301	.19	.244	2.2
	545.68313	10.090	-1.3098	.245	.303	.21	.244	1.8
	545.69822	10.091	-1.3104	.243	.309	.20	.246	1.8
	545.78527	10.085	-1.3079	.244	.307	.20	.243	1.7
	546.66507	10.090	-1.3099	.245	.300	.20	.244	1.9
	546.69620	10.090	-1.3097	.244	.304	.20	.247	1.7
	546.72524	10.087	-1.3084	.244	.301	.21	.240	1.7
	546.74142	10.088	-1.3090	.244	.302	.21	.241	1.7
	546.77016	10.085	-1.3077	.245	.300	.22	.247	1.7
	546.80254	10.092	-1.3105	.242	.306	.20	.245	1.8
	549.64136	10.103	-1.3151	.246	.300	.21	.246	2.1
	549.65845	10.110	-1.3178	.246	.299	.22	.245	1.9
	549.72123	10.101	-1.3142	.245	.300	.22	.248	1.7
	549.78433	10.108	-1.3169	.245	.302	.21	.248	1.8
	550.64244	10.090	-1.3100	.245	.301	.21	.243	2.1
	550.69028	10.095	-1.3118	.246	.297	.22	.240	1.7
	553.62936	10.084	-1.3075	.244	.301	.21	.241	2.1
	553.70873	10.094	-1.3114	.246	.303	.22	.239	1.7
	553.75439	10.096	-1.3123	.244	.302	.20	.239	1.7
	553.80245	10.067	-1.3006	.242	.301	.19	.242	2.0
	553.81097	10.067	-1.3003	.244	.291	.20	.237	2.1
	554.66445	10.098	-1.3131	.247	.305	.20	.242	1.8
	554.79129	10.105	-1.3160	.244	.302	.21	.243	1.9
	555.70517	10.087	-1.3087	.245	.304	.21	.242	1.7
	555.72187	10.085	-1.3076	.246	.301	.21	.243	1.7
	555.76734	10.095	-1.3117	.243	.298	.22	.243	1.8
	556.72093	10.092	-1.3105	.244	.302	.21	.243	1.7
	557.73422	10.081	-1.3063	.244	.296	.21	.244	1.7
	557.74741	10.086	-1.3080	.243	.299	.21	.242	1.7
	559.68479	10.096	-1.3122	.247	.295	.22	.246	1.7
	559.71570	10.091	-1.3103	.246	.294	.21	.242	1.7
	561.74718	10.096	-1.3121	.247	.299	.22	.242	1.8
	562.61846	10.085	-1.3077	.243	.306	.20	.242	2.0
	562.73745	10.088	-1.3091	.246	.300	.21	.244	1.7
	571.58152	10.088	-1.3090	.246	.304	.20	.244	2.1
	571.68882	10.088	-1.3092	.245	.298	.21	.239	1.7
1883	542.70676	12.563	-2.3109	.463	.502		.487	1.7
	542.71174	12.569	-2.3134	.461	.510	.19	.478	1.7
	543.69432	12.639	-2.3417	.486	.482	.40	.501	1.8
	544.74694	12.436	-2.2598	.466	.529	.28	.485	1.6
	544.75482	12.435	-2.2594	.473	.531	.31	.494	1.6
	545.67855	12.460	-2.2693	.469	.508	.33	.486	1.8
	545.68752	12.444	-2.2630	.466	.485	.31	.480	1.8
	545.69331	12.437	-2.2599	.467	.506	.38	.492	1.8
	545.78034	12.598	-2.3253	.473	.514	.21	.478	1.7
	545.78943	12.616	-2.3324	.475	.515	.25	.473	1.7
	546.66117	12.442	-2.2620	.462	.518	.31	.477	2.0
	546.66879	12.447	-2.2642	.468	.497	.23	.444	1.9
	546.69145	12.492	-2.2825	.468	.543	.31	.470	1.8
	546.70001	12.530	-2.2978	.457	.558	.18	.502	1.7
	546.72059	12.593	-2.3232	.480	.518	.30	.475	1.7
	546.72918	12.614	-2.3318	.479	.502	.39	.473	1.6
	546.73682	12.627	-2.3368	.485	.482	.32	.471	1.6
	546.74538	12.638	-2.3413	.481	.536	.24	.494	1.6
	546.76552	12.623	-2.3355	.486	.505	.39	.463	1.7
	546.77407	12.620	-2.3341	.474	.499	.29	.483	1.7

TABLE IV *(continued)*.

NUMBER HII	HELIOC. JULIAN DATE	m V	V	V-B	B-U	U-W	B-L	SEC(Z)
				....log(I).....				
1883	546.79785	12.562	-2.3105	.481	.541	.26	.485	1.8
	546.80685	12.556	-2.3082	.474	.522	.39	.459	1.8
	549.63643	12.549	-2.3052	.471	.517	.29	.494	2.2
	549.64541	12.522	-2.2943	.471	.535	.30	.478	2.0
	549.65391	12.516	-2.2920	.466	.509	.27	.494	2.0
	549.66226	12.492	-2.2822	.476	.492	.31	.492	1.9
	549.71651	12.427	-2.2560	.464	.507	.26	.468	1.7
	549.72511	12.435	-2.2592	.467	.510	.32	.478	1.6
	549.77895	12.597	-2.3248	.475	.539	.28	.493	1.7
	549.78836	12.617	-2.3330	.481	.510	.38	.485	1.8
	550.63788	12.447	-2.2643	.465	.518	.38	.480	2.1
	550.64616	12.438	-2.2605	.466	.515	.35	.470	2.0
	550.68564	12.484	-2.2789	.472	.502	.23	.478	1.7
	550.69406	12.508	-2.2889	.472	.531	.27	.463	1.7
	553.62468	12.562	-2.3107	.485	.490	.39	.460	2.2
	553.63222	12.532	-2.2984	.473	.522	.40	.478	2.1
	553.63443	12.543	-2.3031	.479	.500	.28	.466	2.0
	553.70406	12.451	-2.2656	.466	.483	.28	.490	1.7
	553.71262	12.442	-2.2622	.467	.502	.38	.481	1.6
	553.74967	12.491	-2.2821	.476	.518	.23	.453	1.7
	553.75868	12.531	-2.2982	.468	.512	.35	.472	1.7
	553.79785	12.622	-2.3349	.478	.510	.31	.485	1.9
	553.80628	12.628	-2.3373	.480	.512	.25	.500	2.0
	553.81471	12.624	-2.3358	.473	.523	.39	.505	2.1
	554.65969	12.428	-2.2566	.465	.485	.28	.464	1.8
	554.66833	12.434	-2.2590	.464	.531	.28	.485	1.8
	554.78664	12.604	-2.3276	.474	.524	.33	.484	1.9
	554.79525	12.577	-2.3168	.473	.521	.16	.458	1.9
	555.70109	12.629	-2.3376	.487	.514	.39	.477	1.7
	555.70818	12.623	-2.3355	.482	.546	.17	.477	1.6
	555.71750	12.606	-2.3285	.480	.503	.27	.461	1.6
	555.72582	12.597	-2.3247	.481	.493	.45	.467	1.6
	555.76283	12.534	-2.2993	.465	.520	.32	.481	1.7
	555.77138	12.508	-2.2888	.468	.502	.29	.478	1.8
	556.71634	12.511	-2.2899	.473	.529	.24	.471	1.6
	556.72504	12.495	-2.2836	.471	.537	.30	.487	1.6
	557.72972	12.441	-2.2615	.465	.499	.28	.459	1.7
	557.73810	12.442	-2.2621	.472	.458	.31	.457	1.7
	557.74323	12.476	-2.2758	.462	.502	.24	.478	1.7
	557.75055	12.497	-2.2842	.470	.491	.24	.503	1.7
	557.75588	12.514	-2.2913	.465	.516	.26	.507	1.7
	559.67856	12.613	-2.3314	.482	.480	.33	.452	1.7
	559.68865	12.622	-2.3350	.468	.462	.25	.450	1.7
	571.57648	12.462	-2.2703	.466	.501	.20	.485	2.2
	571.58573	12.444	-2.2630	.465	.548	.29	.462	2.0
	571.68388	12.626	-2.3365	.483	.538	.29	.485	1.6
	571.69342	12.646	-2.3447	.491	.530	.21	.459	1.7
	895.71911	12.477	-2.2764	.475	.518	.34	.471	1.8
	896.75518	12.567	-2.3125	.487	.535	.82	.481	1.7
	896.78804	12.634	-2.3400	.477	.491	.31	.475	1.6
	896.81122	12.635	-2.3401	.476	.575	.30	.511	1.7
	897.70946	12.593	-2.3233	.471	.468	.31	.502	1.9
	897.76531	12.618	-2.3335	.481	.530	.20	.464	1.7
	897.80714	12.531	-2.2982	.479	.508	.31	.471	1.7
	899.73510	12.442	-2.2621	.462	.501	.28	.493	1.7
	899.76353	12.425	-2.2550	.463	.526	.28	.478	1.6
	899.78683	12.475	-2.2753	.464	.499	.34	.476	1.6
	901.76249	12.617	-2.3330	.472	.498	.31	.474	1.6
	901.78143	12.587	-2.3208	.476	.548	.27	.456	1.6
	901.84541	12.461	-2.2699	.465	.513	.24	.493	1.9
1883	905.80974	12.532	-2.2987	.469	.517	.22	.481	1.8
	906.68381	12.634	-2.3397	.479	.494	.37	.483	1.9
	906.77342	12.494	-2.2831	.466	.529	.33	.476	1.7
	906.81068	12.433	-2.2586	.462	.517	.33	.484	1.8
	907.68414	12.558	-2.3091	.475	.520	.24	.474	1.9
	907.77725	12.447	-2.2639	.466	.499	.34	.469	1.7
	907.80358	12.510	-2.2895	.473	.524	.25	.488	1.8
	908.68748	12.422	-2.2539	.464	.510	.30	.480	1.8
	908.79944	12.614	-2.3316	.479	.531	.31	.478	1.8
	909.72136	12.603	-2.3272	.477	.509	.31	.477	1.7
	910.69201	12.630	-2.3380	.477	.455	.43	.456	1.8
	910.76550	12.499	-2.2851	.470	.513	.36	.476	1.7
	911.67850	12.567	-2.3127	.475	.482	.36	.469	1.8
	911.75797	12.429	-2.2569	.463	.511	.28	.468	1.7
	912.75617	12.544	-2.3033	.473	.523	.23	.473	1.7
	914.80677	12.453	-2.2664	.460	.494	.27	.475	1.9
	915.74373	12.447	-2.2639	.456	.511	.18	.428	1.6
2034	559.60868	12.669	-2.3538	.451	.443	.23	.460	2.2
	906.70110	12.578	-2.3171	.449	.483	.30	.480	1.8
	906.75637	12.606	-2.3283	.450	.457	.31	.443	1.7
	906.82218	12.637	-2.3410	.458	.492	.35	.462	1.9
	907.70137	12.554	-2.3073	.453	.489	.36	.465	1.8
	907.78290	12.572	-2.3149	.448	.474	.28	.451	1.7
	907.82682	12.577	-2.3169	.448	.479	.28	.461	1.9
	908.67581	12.591	-2.3223	.446	.493	.23	.456	1.9
	908.76290	12.560	-2.3100	.444	.480	.24	.460	1.7
	908.80514	12.557	-2.3088	.444	.455	.26	.450	1.8
	909.67311	12.644	-2.3438	.445	.479	.37	.447	1.9
	909.73268	12.613	-2.3315	.445	.494	.24	.457	1.7
	909.80595	12.582	-2.3186	.442	.494	.23	.429	1.8
	910.68063	12.642	-2.3432	.452	.500	.31	.482	1.9
	910.72885	12.598	-2.3251	.441	.392	.29	.394	1.7
	910.78260	12.632	-2.3391	.449	.457	.31	.437	1.7
	910.81342	12.615	-2.3322	.448	.448	.29	.431	1.9
	911.66133	12.573	-2.3153	.438	.498	.24	.462	2.0
	911.69832	12.585	-2.3200	.453	.493	.28	.461	1.8
	911.73274	12.613	-2.3315	.449	.481	.27	.453	1.7
	911.77541	12.633	-2.3393	.451	.492	.25	.470	1.7
	911.81270	12.646	-2.3445	.448	.462	.38	.445	1.9
	912.73867	12.562	-2.3105	.450	.476	.30	.459	1.7
	912.77960	12.579	-2.3175	.449	.470	.31	.455	1.7
	914.69734	12.606	-2.3286	.446	.463	.20	.456	1.7
	914.73184	12.591	-2.3224	.440	.443	.31	.441	1.7
	914.76907	12.565	-2.3118	.437	.498	.20	.455	1.7
	915.67977	12.629	-2.3377	.441	.488	.21	.463	1.8
	915.72431	12.634	-2.3400	.440	.456	.23	.431	1.7
	915.76695	12.612	-2.3311	.436	.431	.31	.416	1.7
	915.79211	12.591	-2.3225	.425	.476	.24	.456	1.8
	926.70916	12.640	-2.3421	.452	.474	.29	.466	1.7
	926.74707	12.647	-2.3450	.462	.503	.39	.481	1.8
	926.77030	12.636	-2.3407	.456	.509	.27	.461	1.9
2786	545.65106	10.242	-1.3712	.259	.306	.22	.256	2.2
	555.67033	10.254	-1.3764	.263	.303	.23	.248	1.8
	555.75759	10.258	-1.3780	.261	.304	.22	.256	1.7
	555.81865	10.253	-1.3760	.262	.303	.22	.262	2.2
	556.71263	10.246	-1.3729	.258	.301	.22	.255	1.7
	557.66442	10.271	-1.3831	.267	.301	.22	.253	1.8
	559.75441	10.273	-1.3839	.265	.304	.22	.259	1.8

1987A&AS...67..483V

TABLE IV *(continued).*

NUMBER HII	HELIOC. JULIAN DATE	m_V	V	V-B	B-U	U-W	B-L	SEC(Z)
					....log(I).....			
3019	901.69501	13.395	-2.6480	.573	.608		.531	2.0
	901.73827	13.424	-2.6597	.557	.845	.21	.663	1.7
	901.78711	13.403	-2.6510	.548	.631	.60	.542	1.7
	901.83977	13.392	-2.6469	.568	.682	.46	.558	1.9
	905.69064	13.411	-2.6545	.573	.581	.89	.557	1.9
	905.76633	13.409	-2.6536	.565	.615	.24	.508	1.7
	905.82138	13.397	-2.6487	.566	.593	.40	.521	1.9
	906.69536	13.393	-2.6472	.567	.547	.49	.527	1.9
	906.80494	13.393	-2.6470	.567	.649	.37	.578	1.8
	907.67277	13.452	-2.6711	.560	.589		.622	2.0
	907.75935	13.437	-2.6651	.564	.613	.40	.589	1.7
	907.81533	13.361	-2.6340	.505	.402	.31	.385	1.8
	908.71273	13.450	-2.6701	.563	.662	.43	.625	1.7
	908.78010	13.435	-2.6643	.573	.597	.83	.562	1.7
	909.72712	13.422	-2.6589	.562	.642	.02	.626	1.7
	909.80016	13.423	-2.6594	.564	.540	.40	.554	1.8
3163	897.77110	12.648	-2.3453	.464	.484	.34	.494	1.7
	897.81876	12.705	-2.3687	.470	.488	.31	.451	1.7
	897.86247	12.742	-2.3837	.460	.475	.34	.525	2.0
	899.69572	12.652	-2.3472	.456	.516	.24	.466	2.0
	899.74648	12.611	-2.3307	.461	.510	.24	.443	1.7
	899.79814	12.611	-2.3303	.459	.495	.25	.473	1.7
	899.84527	12.644	-2.3440	.467	.517	.40	.463	1.9
	900.68387	12.646	-2.3448	.461	.483	.21	.472	2.1
	900.73230	12.687	-2.3613	.467	.505	.25	.456	1.8
	900.77782	12.726	-2.3771	.468	.509	.23	.449	1.7
	900.82398	12.722	-2.3754	.468	.473	.44	.480	1.8
	901.68158	12.721	-2.3750	.460	.497	.35	.440	2.1
	901.72699	12.693	-2.3638	.463	.484	.30	.426	1.8
	901.77582	12.655	-2.3483	.459	.497	.27	.456	1.7
	901.82821	12.632	-2.3388	.462	.490	.22	.437	1.8
	905.69635	12.633	-2.3394	.468	.511	.26	.456	1.9
	905.74087	12.684	-2.3601	.467	.459	.31	.455	1.7
	905.78458	12.730	-2.3787	.467	.468	.44	.483	1.7
	905.82690	12.730	-2.3785	.461	.523	.32	.460	1.9
	906.72024	12.712	-2.3715	.463	.491	.32	.456	1.8
	906.76201	12.679	-2.3580	.465			.463	1.7
	906.82786	12.645	-2.3441	.450	.529	.30	.467	1.9
	907.72025	12.620	-2.3341	.464	.479	.29	.466	1.7
	907.76517	12.636	-2.3406	.460	.510	.22	.466	1.7
	907.80957	12.673	-2.3556	.459	.520	.26	.499	1.8
	908.66168	12.688	-2.3615	.464	.506	.30	.456	2.1
	908.75124	12.726	-2.3771	.457	.517	.22	.444	1.7
	908.82204	12.691	-2.3627	.463	.441	.38	.451	1.9
	909.78015	12.632	-2.3392	.459	.489	.31	.470	1.7
	910.66308	12.626	-2.3366	.459	.492	.31	.457	2.1
	911.66692	12.725	-2.3766	.458	.473	.26	.463	2.0
	911.79465	12.671	-2.3547	.454	.452	.23	.458	1.8
	912.81090	12.683	-2.3597	.460	.576	.15	.462	1.9
	914.82103	12.626	-2.3367	.460	.473	.36	.459	2.1
	915.65034	12.632	-2.3388	.449	.511	.12	.442	2.1
	915.73207	12.665	-2.3525	.457	.494	.17	.481	1.7
	926.70322	12.726	-2.3771	.472	.475	.35	.432	1.7
	926.78430	12.715	-2.3727	.472	.482	.33	.436	2.0

TABLE V. — *Individual photometric measurements for 24 late G and early K dwarfs in the Pleiades (P-numbers refer to Van Leeuwen* et al., *1986, all others are HII numbers).*

NUMBER	HELIOC. JULIAN DATE	m_V	V	V-B	B-U	U-W	B-L	SEC(Z)
					.... log(I)			
81	555.79755	13.534	-2.7044	.417	.411	.49	.412	2.0
97	544.81727	12.648	-2.3453	.495	.585	.21	.532	2.0
357	554.63364	13.323	-2.6188	.586	.622	.55	.586	2.0
380	554.63780	13.321	-2.6179	.571	.679	.52	.675	2.1
522	555.81426	11.906	-2.0450	.413	.467	.29	.472	2.2
559	555.62640	13.309	-2.6130	.528	.596	.90	.516	2.2
636	556.61474	12.435	-2.2591	.463	.541	.34	.503	2.2
738	556.62238	12.293	-2.2017	.521	.515	.40	.421	2.1
740	555.63180	13.268	-2.5964	.488	.579	.19	.489	2.1
870	556.62617	12.572	-2.3149	.563	.503	.47	.447	2.1
945	556.79989	13.342	-2.6266	.492	.591	.08	.553	2.0
1136	557.61399	12.119	-2.1315	.452	.460	.29	.411	2.2
1298	558.60573	12.270	-2.1925	.460	.544	.26	.555	2.3
1553	545.82293	12.280	-2.1965	.497	.492	.33	.508	1.9
P 14	554.81045	11.870	-2.0303	.414	.479	.29	.458	2.2
P 19	544.80771	11.728	-1.9729	.404	.462	.30	.434	1.9
P 28	543.80933	11.697	-1.9604	.455	.477	.35	.454	1.8
P 31	544.80251	11.513	-1.8861	.453	.479	.35	.466	1.8
P 44	546.64124	11.667	-1.9483	.405	.465	.26	.454	2.3
P 66	543.77640	12.346	-2.2231	.467	.545	.25	.530	1.6
P 123	543.79825	11.903	-2.0439	.436	.518	.22	.484	1.8
P 184	543.80207	13.379	-2.6415	.449	.506	.14	.565	1.8
P 189	554.80650	12.246	-2.1829	.439	.492	.35	.486	2.2
P 193	546.83814	11.863	-2.0275	.402	.475	.30	.448	2.1

TABLE VI. — *The compiled information on variations, periods and lightcurves.*

HII	period	V(1980)	V(1981)	A1	A2	dPh	A2/A1	dV	N
	days	log(I)		log(I)		deg.		log(I)	
34	6.61	-2.0720		0.0109	0.0019	54.	0.18	0.0027	44
	0.11	0.0004		0.0006	0.0006	19.	0.06		
	6.60		-2.0627	0.0121	0.0039	61.	0.32	0.0018	19
	0.17		0.0005	0.0007	0.0008	12.	0.07		
	6.553	-2.0719	-2.0632	0.0110	0.0019	57.	0.18	0.0025	63
	0.006	0.0004	0.0006	0.0005	0.0005	14.	0.05		
625	0.4283		-2.3672	0.0207	0.0050	33.	0.24	0.0055	41
	0.0009		0.0009	0.0013	0.0012	14.	0.06		
686	0.3965	-2.6586		0.0187	0.0023	170.	0.13	0.0073	89
	0.0011	0.0008		0.0012	0.0012	28.	0.06		
	0.3974		-2.6644	0.0188	0.0053	145.	0.28	0.0063	32
	0.0007		0.0012	0.0016	0.0016	17.	0.09		
	0.39654	-2.6587	-2.6642	0.0189	0.0028	163.	0.15	0.0072	121
	0.00004	0.0008	0.0013	0.0010	0.0009	19.	0.05		
879	7.40	-2.3879		0.0134	0.0014	27.	0.10	0.0031	21
	0.19	0.0007		0.0010	0.0011	40.	0.08		
	7.12		-2.3903	0.0157	0.0057	65.	0.36	0.0024	22
	0.10		0.0006	0.0009	0.0008	8.	0.06		
	7.387	-2.3878	-2.3904	0.0143	0.0016	63.	0.11	0.0034	43
	0.007	0.0008	0.0008	0.0009	0.0008	28.	0.05		
882	0.5799		-2.3957	0.0242	0.0021	154.	0.09	0.0033	36
	0.0014		0.0006	0.0008	0.0008	23.	0.03		
1124	5.94	-2.2226		0.0100	0.0042	118.	0.42	0.0052	38
	0.24	0.0009		0.0013	0.0013	22.	0.14		
	6.04		-2.2328	0.0157	0.0003	126.	0.02	0.0027	27
	0.10		0.0005	0.0008	0.0007	150.	0.05		
	6.051	-2.2222	-2.2331	0.0122	0.0027	117.	0.22	0.0049	65
	0.009	0.0008	0.0009	0.0008	0.0009	20.	0.07		
1332	8.3		-2.2679	0.0093	0.0031	55.	0.33	0.0021	21
	0.3		0.0006	0.0008	0.0008	15.	0.09		
1531	0.4830		-2.6844	0.0215	0.0017	135.	0.08	0.0041	35
	0.0010		0.0007	0.0010	0.0010	33.	0.05		
1883	0.23538	-2.2984		0.0391	0.0061	93.	0.16	0.0029	67
	0.00007	0.0004		0.0005	0.0005	5.	0.01		
	0.23540		-2.2989	0.0400	0.0041	84.	0.10	0.0031	36
	0.00007		0.0006	0.0008	0.0008	11.	0.02		
	0.235405	-2.2984	-2.2987	0.0395	0.0054	91.	0.14	0.0030	97
	0.000003	0.0004	0.0006	0.0004	0.0004	5.	0.01		
2034	0.5516		-2.3235	0.0168	0.0016	114.	0.10	0.0044	33
	0.0017		0.0008	0.0013	0.0011	41.	0.07		
3163	0.4177		-2.3565	0.0221	0.0020	92.	0.09	0.0036	38
	0.0004		0.0006	0.0008	0.0009	25.	0.04		

TABLE VII. — *Phases at HJD 2444550.0 (Nov. 1980) and HJD 2444900.0 (Nov. 1981).*

HII	period days	phase (1980)	phase (1981)
34	6.553	0.516	0.926
625	0.4282		0.514
686	0.39653	0.947	0.604
727	8.07	0.019	
879	7.386	0.693	0.079
882	0.5798		0.859
1124	6.051	0.895	0.736
1332	8.3		0.769
1531	0.4830		0.102
1883	0.235405	0.770	0.570
2034	0.5516		0.556
3163	0.4178		0.992

TABLE VIII. — *Combined variations in the colour indices for all stars presented in table VI relative to their variations in the V channel.*

	V-B	B-U	U-W	B-L
ratio	-0.22	-0.22	-0.8	-0.08
st.dev	0.02	0.10	0.3	0.09

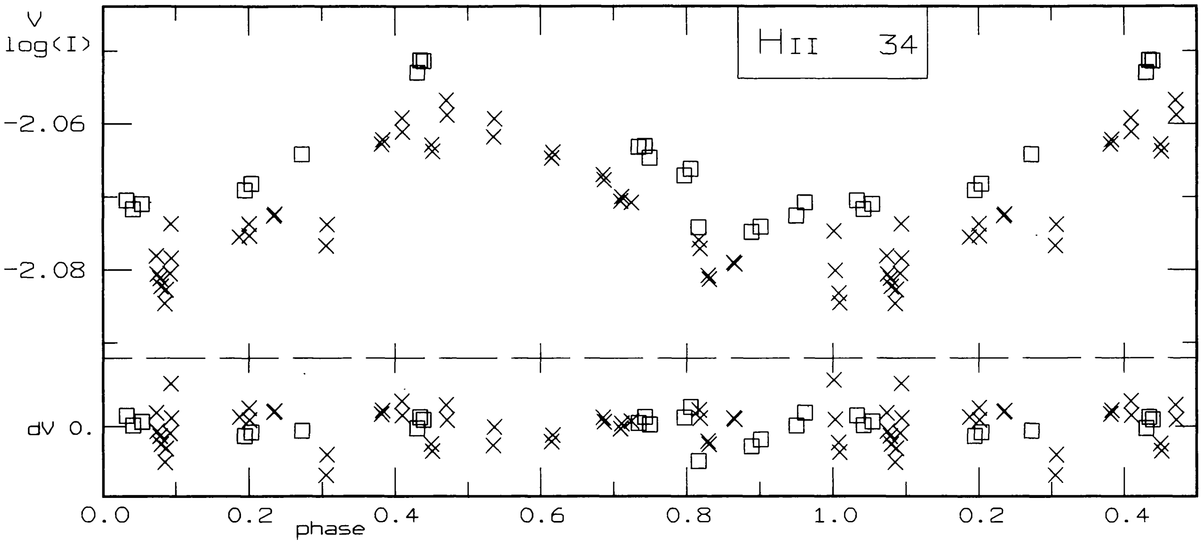


FIGURE 1. — The 1980 and 1981 data for HII 34 in *V*, folded with a period of 6.553 days. Crosses refer to 1980 and squares to 1981 data points. The lower curve represents the residuals left after a fit with first and second order harmonics as described in the text. The scale for the residuals is the same as for the observations (0.02 in log (*I*) equals 0.05 magnitudes). The zero phase coincides with the minimum in the first harmonic.

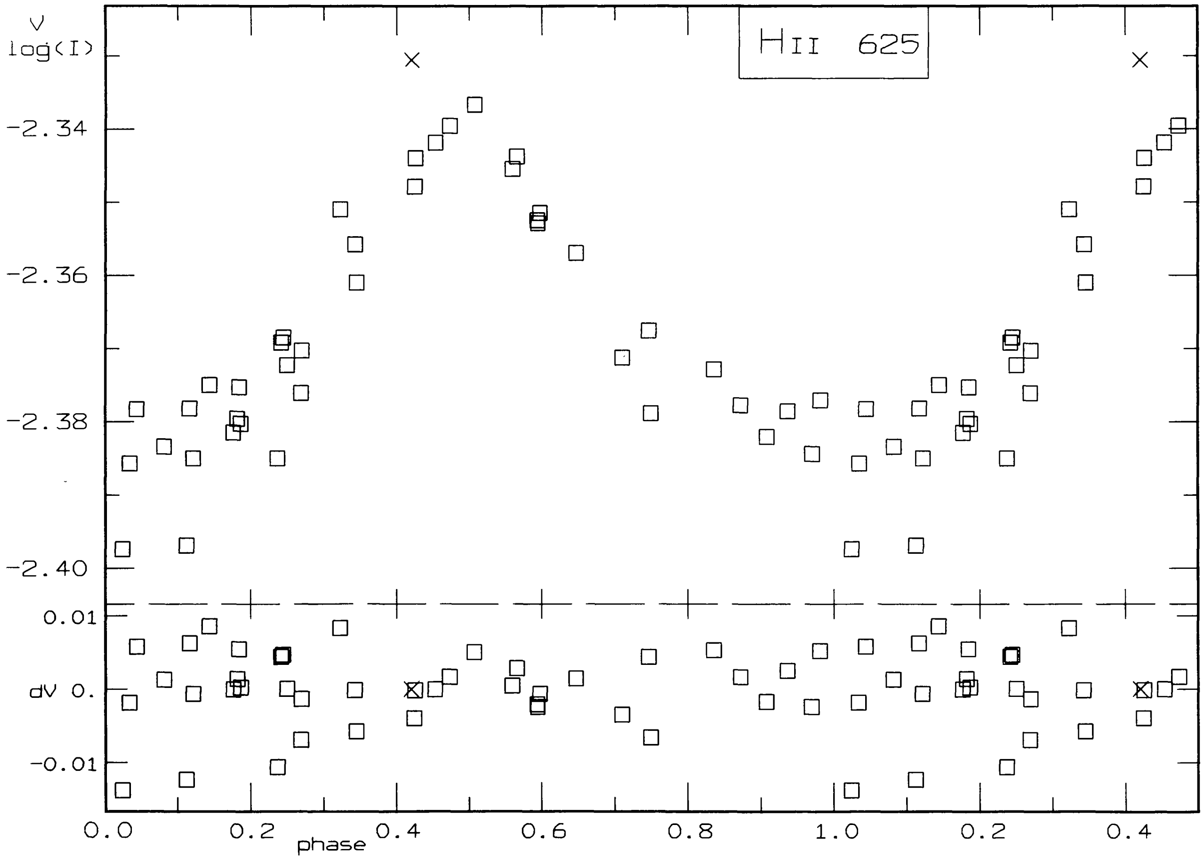


FIGURE 2. — The 1981 data for HII 625 in *V*, folded with a period of 0.4283 days. Further as figure 1.

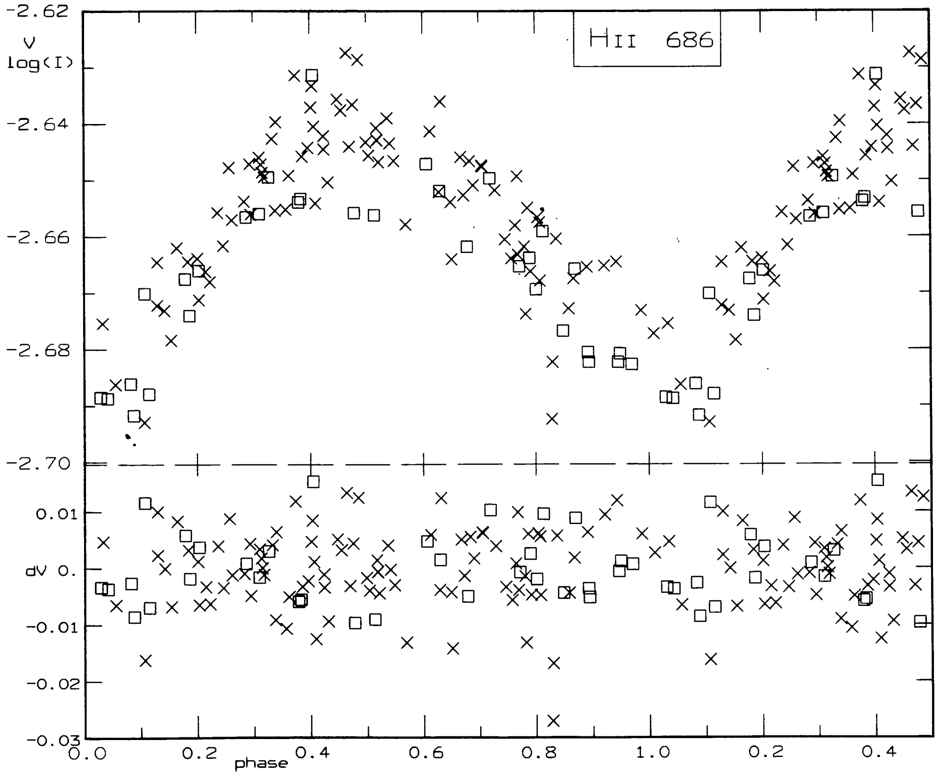


FIGURE 3. — The 1980 and 1981 data for HII 686 in *V*, folded with a period of 0.39654 days. Further as figure 1.

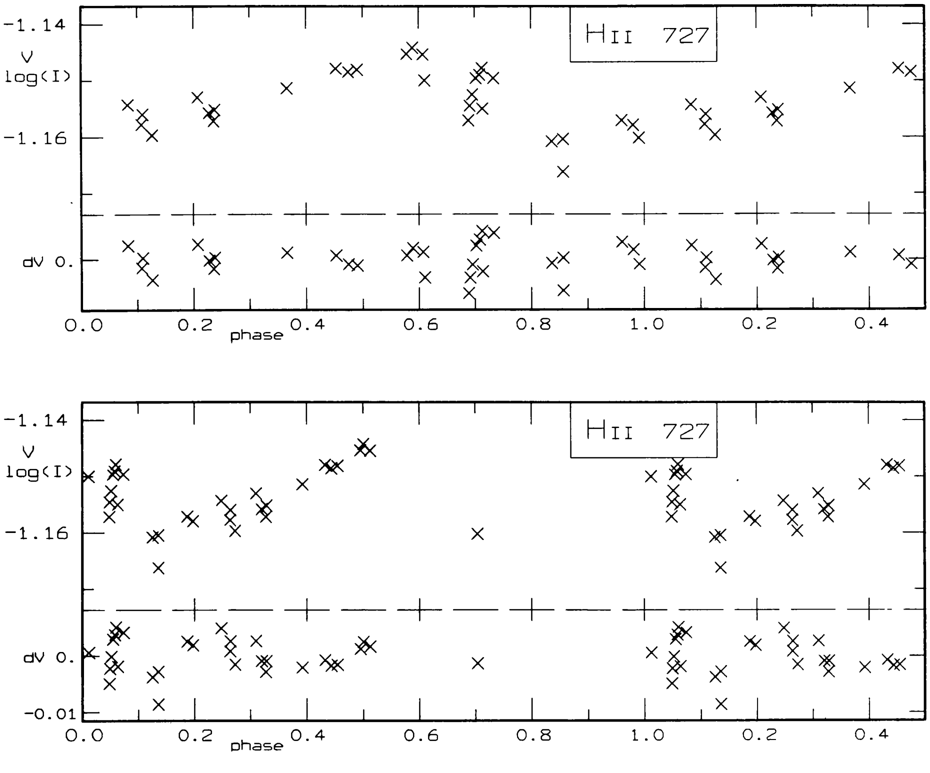


FIGURE 4. — The 1980 data for HII 727 in *V*, folded with periods of 8.07 and 16.2 days (lower graph).

1987A&AS...67..483V

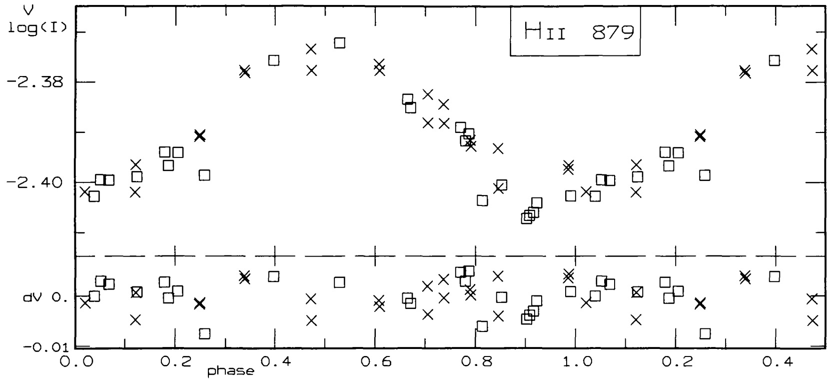


FIGURE 5. — The 1980 and 1981 data for HII 879 in V, folded with a period of 7.387 days. Further as figure 1.

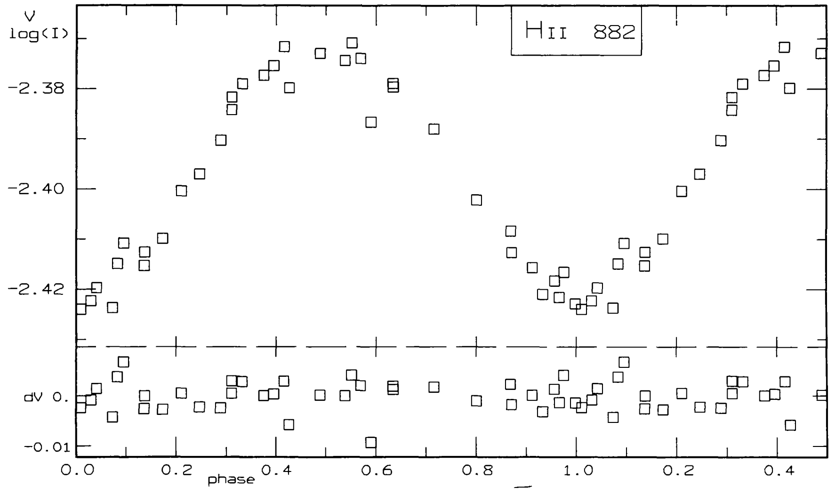


FIGURE 6. — The 1981 data for HII 882 in V, folded with a period of 0.580 days. Further as figure 1.

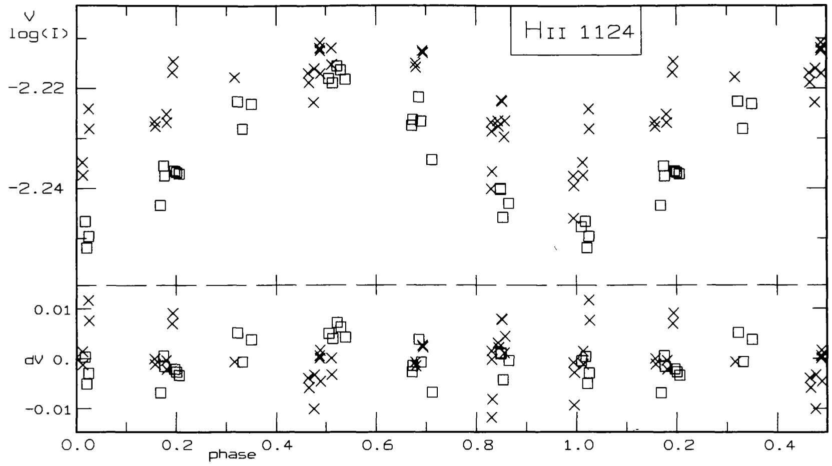


FIGURE 7. — The 1980 and 1981 data for HII 1124 in V, folded with a period of 6.051 days. Further as figure 1.

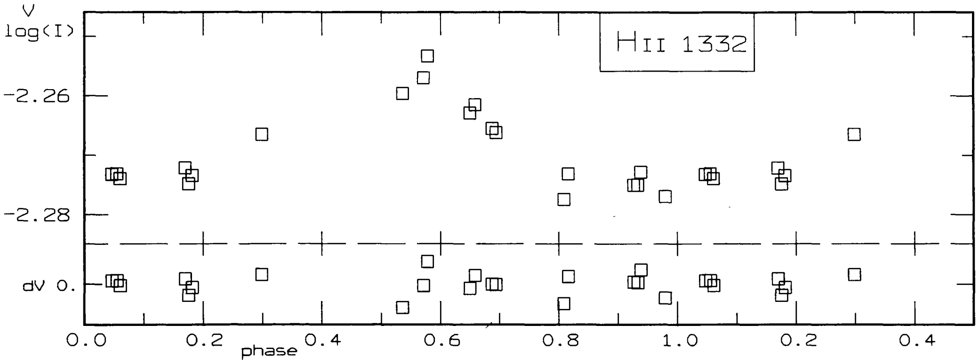


FIGURE 8. — The 1981 data for HII 1332 in V, folded with a period of 8.3 days. Further as figure 1.

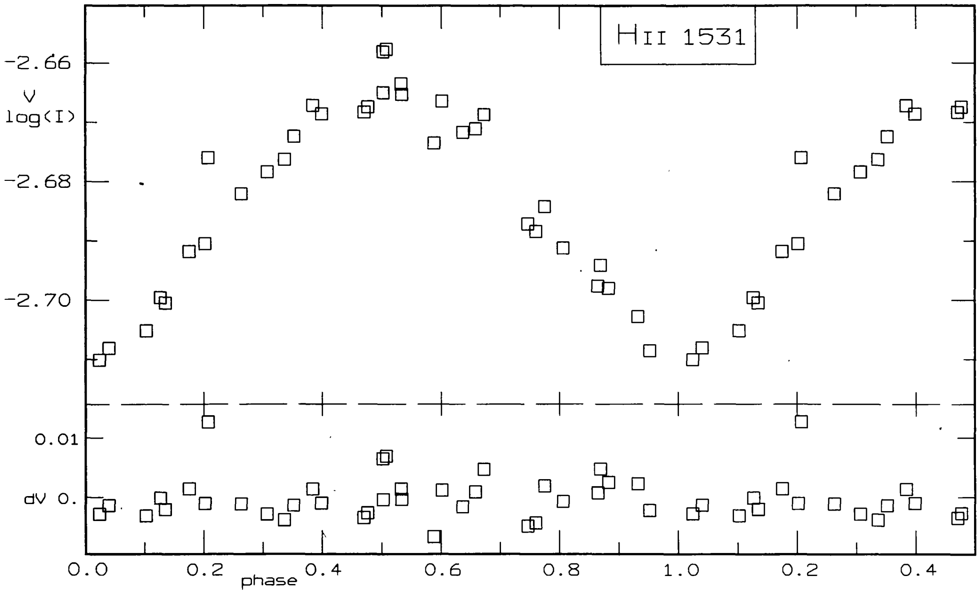


FIGURE 9. — The 1981 data for HII 1531 in V, folded with a period of 0.4830 days. Further as figure 1.

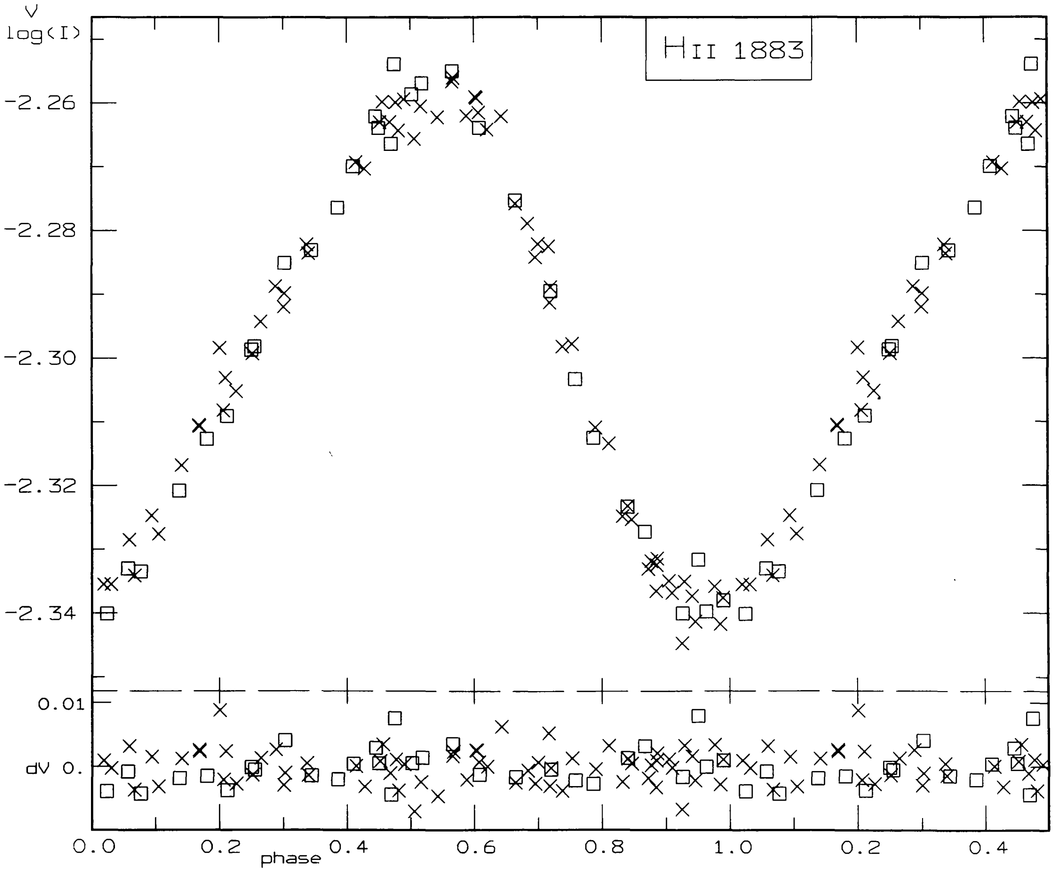


FIGURE 10. — The 1980 and 1981 data for HII 1883 in V, folded with a period of 0.235405 days. Further as figure 1.

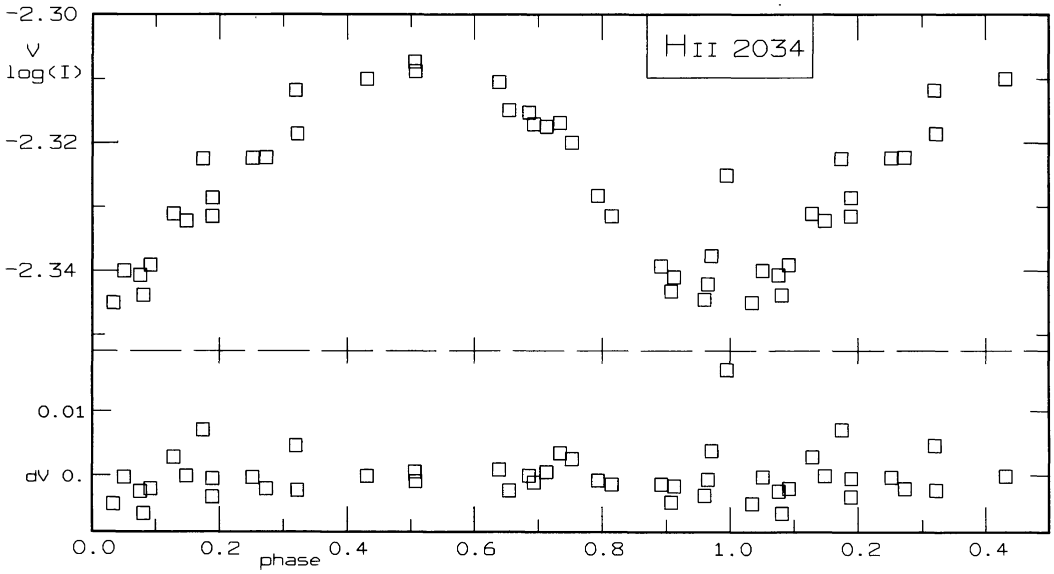


FIGURE 11. — The 1981 data for HII 2034 in V, folded with a period of 0.5516 days. Further as figure 1.

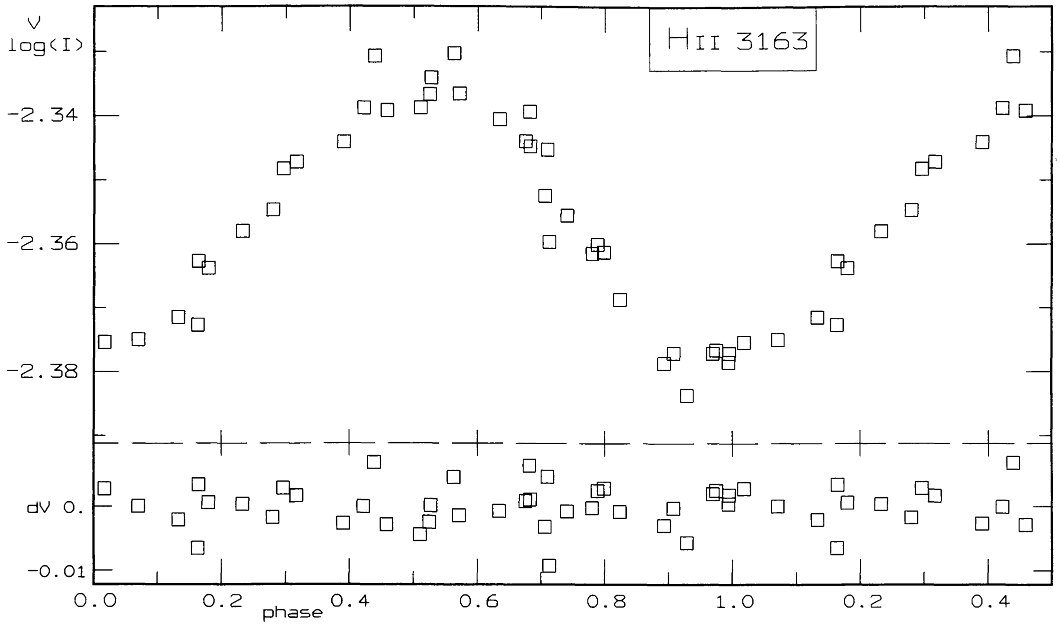
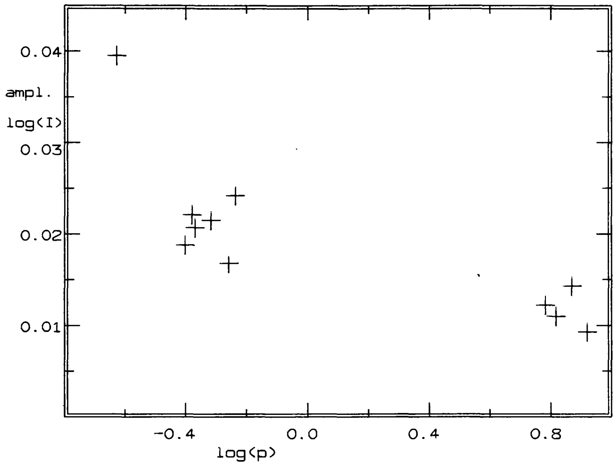


FIGURE 12. — The 1981 data for HII 3163 in V, folded with a period of 0.4177 days. Further as figure 1.



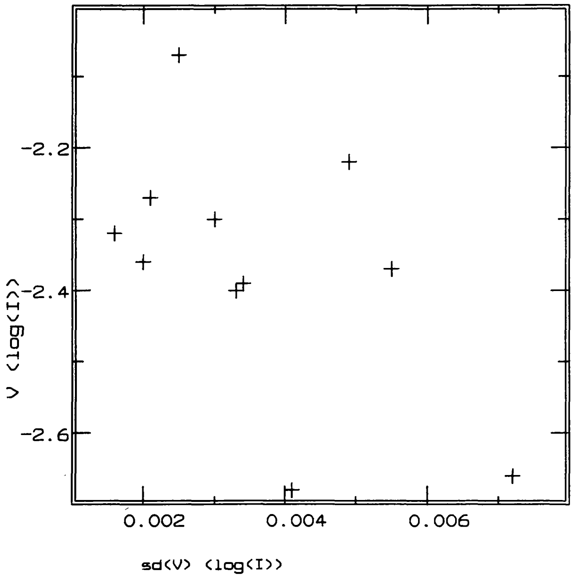


FIGURE 13. — The systematic increase of the first harmonic amplitude with decreasing photometric period. Note also the gap between periods shorter than 0.6 days and longer than 6 days. The scale for the periods is logarithmic.

FIGURE 14. — The remaining standard deviation in V after the first and second harmonic fits, as a function of mean brightness. Stars 625, 1124 and 686 (the three points to the right of sd 0.0045) show an additional spread in their observations, which still has to be explained.

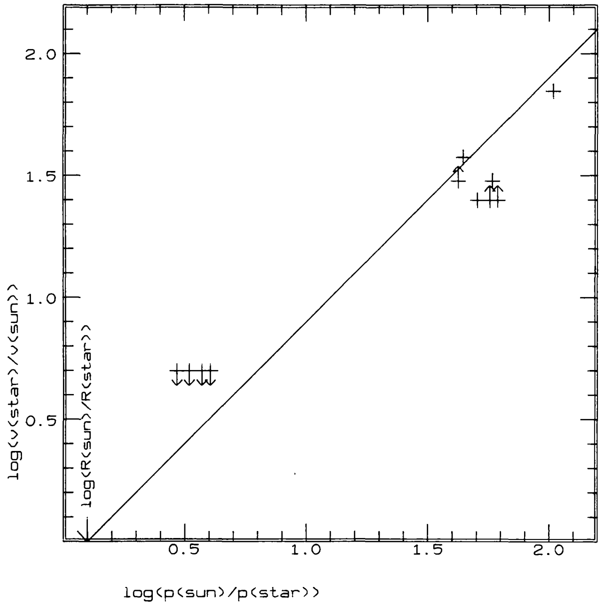


FIGURE 15. — The projected angular velocities as measured by Stauffer *et al.* (1984) as a function of the inverse photometric periods. The clear relation confirms that these stars are variable due to rotational modulation and indicates an average radius of 0.8 *R* (sun).

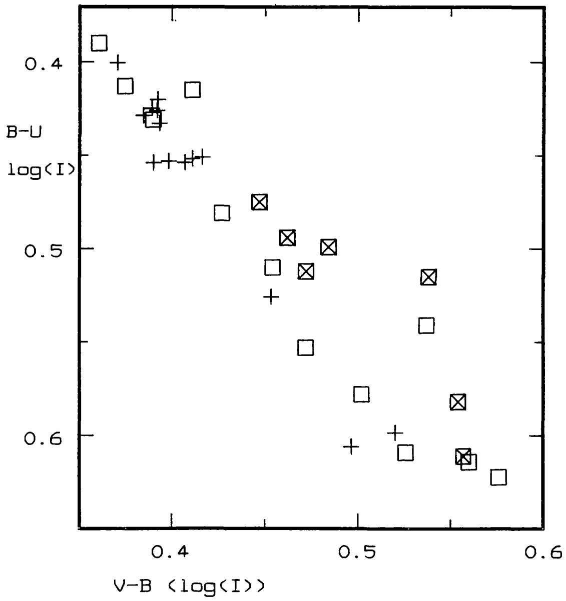


FIGURE 16. — The *V-B versus B-U* diagram for the Pleiades K-dwarfs and a selection of very nearby K- and G-dwarfs. Beyond *V-B* = 0.45 the Pleiades K-dwarfs can be found well above the relation set by the nearby, probably much older, K-dwarfs. Symbols : « + » nearby stars ; squares : Pleiades stars ; crossed squares : rapidly rotating Pleiades stars.

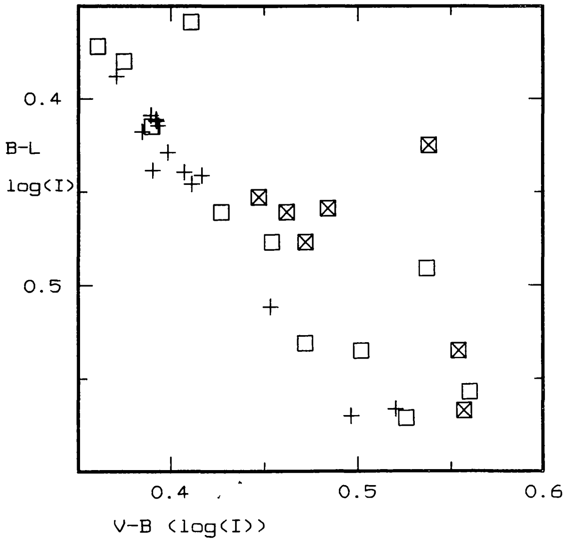


FIGURE 17. — The *V-B versus B-L* diagram for the same stars as in figure 16. The effects are more pronounced in *B-L* than in *B-U*, but strongly correlated between these indices. Symbols as in figure 16.

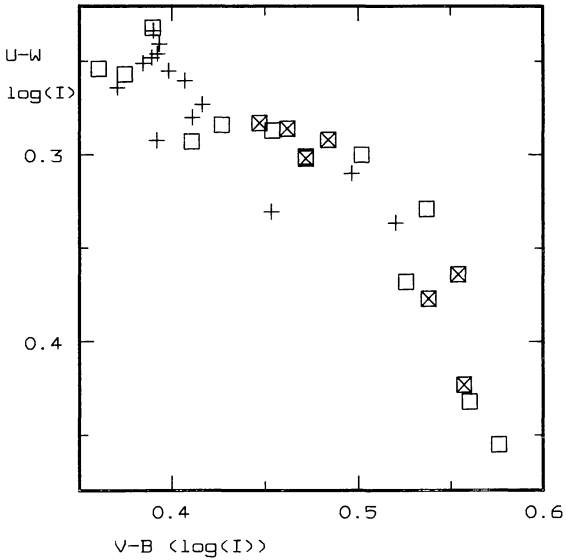


FIGURE 18. — The *V-B versus U-W* diagram for the same stars as in figure 16. Here no obvious differences between the two groups can be observed, indicating that both *U* and *W* are increased by the same ratio. Symbols as in figure 16.

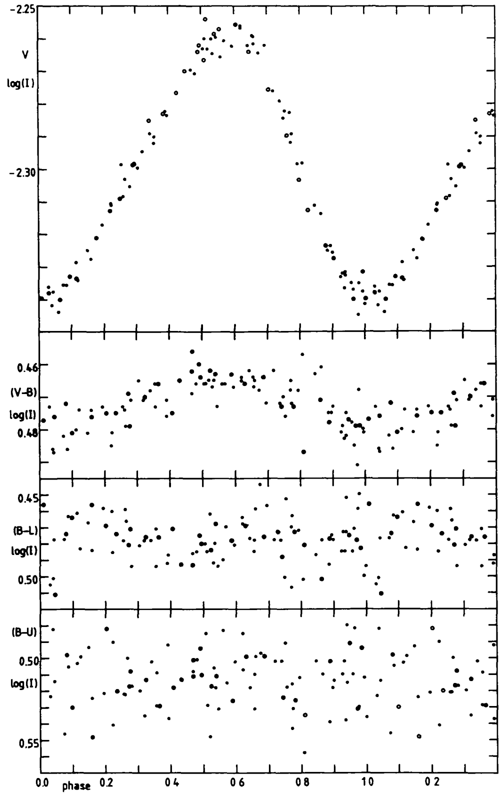


FIGURE 19. — The lightcurves of HII 1883 in the *VBLUW* system *V* channel and *V-B*, *B-L* and *B-U* colour indices. Note the clear variations in *V-B* (equivalent to 0.04 magnitudes) and the lack of variations in the other indices. The 1980 observations are represented by dots, the 1981 observations by open circles.

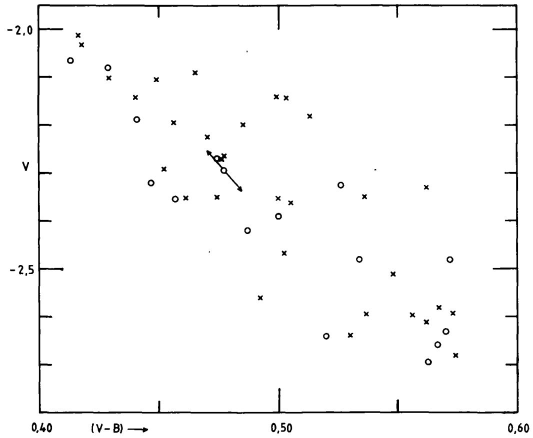


FIGURE 21. — The *V versus V-B* relation (in units of log (I)) for the Pleiades K-dwarfs. Open circles represent stars for which multiple measurements were obtained, while crosses represent other members. The size and direction of the variations of HII 1883 are indicated by the arrows.

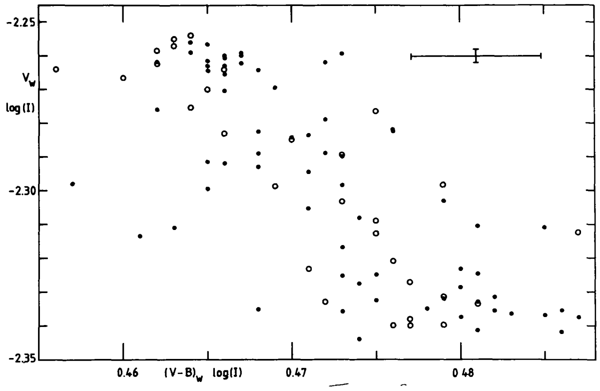


FIGURE 20. — The *V versus V-B* relation for HZ 1883 as derived from the 1980 and 1981 observations (symbols as in Fig. 19).

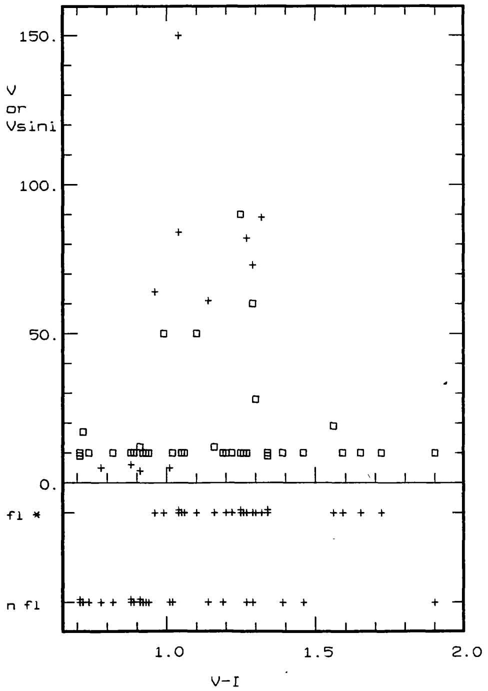


FIGURE 22. — Stellar rotation and flare activity as a function of the *V-I* colour index (data from current paper, Stauffer *et al.*, 1984 ; Haro *et al.*, 1982). The transition at $V\text{-}I = 0.95$ is obvious in both cases, and is most likely a reflection of the turn-on point of hydrogen-burning of the cluster. In the upper graph the squares indicate data from Stauffer *et al.* « + » indicates data from the present paper, and refers to equatorial rotational velocities derived from photometric periods, using a radius of $0.8\,R_{\odot}$.