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"LIGHT-CURVE"

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Editorial

It has been suggested that these *Circulars* are often a little 'dry' and technical for some members. We are always happy to receive more 'personal' items and hope to include more in future issues. We are also including an occasional short note on some of the terms encountered, and which may not be fully explained in some of the specific articles. The first such item appears on p.13. If you have any queries, however elementary, please send them in, and we shall do our best to provide the answers.

Tau Cassiopeiae

Following the note on suspected variables by Tony Markham in VSSC 61, Professor John Percy has sent a preprint of his paper on one of the objects, τ Cas. The paper is to appear in full in the AAVSO *Journal*, so we give just a summary of his conclusions here.

The VSS gradually dropped τ Cas as a comparison star, because it was suspected of variability by three observers. This, and a reference in a Hungarian publication led to its being included in the NSV - with a possible range of 0.3m - on no other evidence. Professor Percy has, however, been observing τ Cas photoelectrically for many years, using it as a comparison star for ρ Cas, together with another check star. No variation greater than 0.02m - or just possibly 0.05m - has ever been detected.

Professor Percy emphasises that it is impossible for the compilers of variable star catalogues to check the reliability of reports of variability, and that this responsibility rests with the 'discoverers'. Once an object has entered the literature as 'variable' it may become a considerable task to prove non-variability. [As we have commented before, observers should be very wary of announcing the 'discovery' of variability. Certainly if difficulty is repeatedly experienced with a star, this should be reported to the Director or Secretary, but no general announcement should be made without extended observation over a period of time and careful (statistical) checks to ensure that the variation is real and not merely the result of the scatter expected in visual observations, or the equally expected, occasional 'wild' observation.]

28 Cygni (V 1624 Cyg)

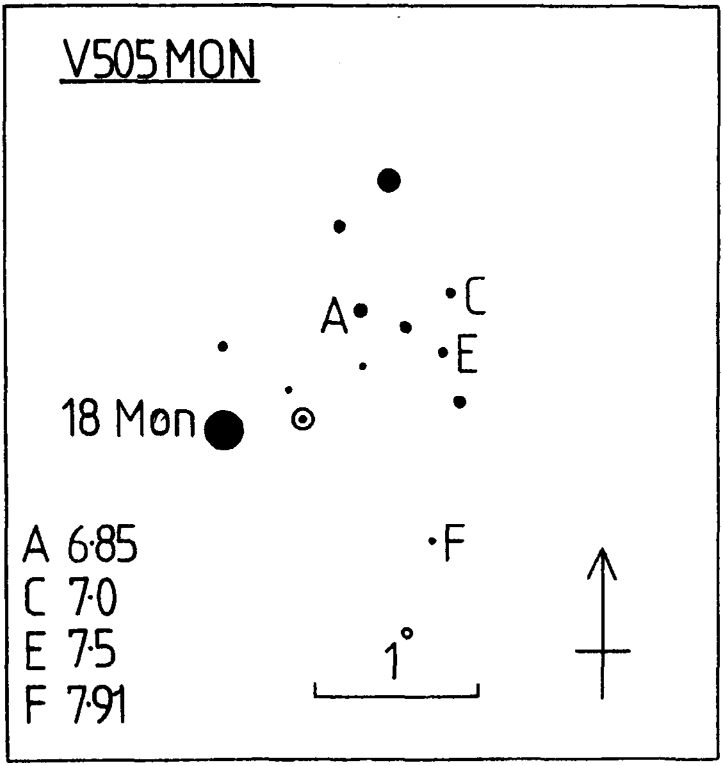
In another comment, Professor Percy points out that 28 Cygni is a Be star, which shows long-term variability of a few hundredths of a magnitude, on which are superimposed short-term variations of *up to* a tenth of a magnitude. He highly recommends this star for photoelectric study, preferably in co-operation with observers in North America, because with a characteristic time-scale of 0.8 day, it is difficult to study without observations from widely separated longitudes.

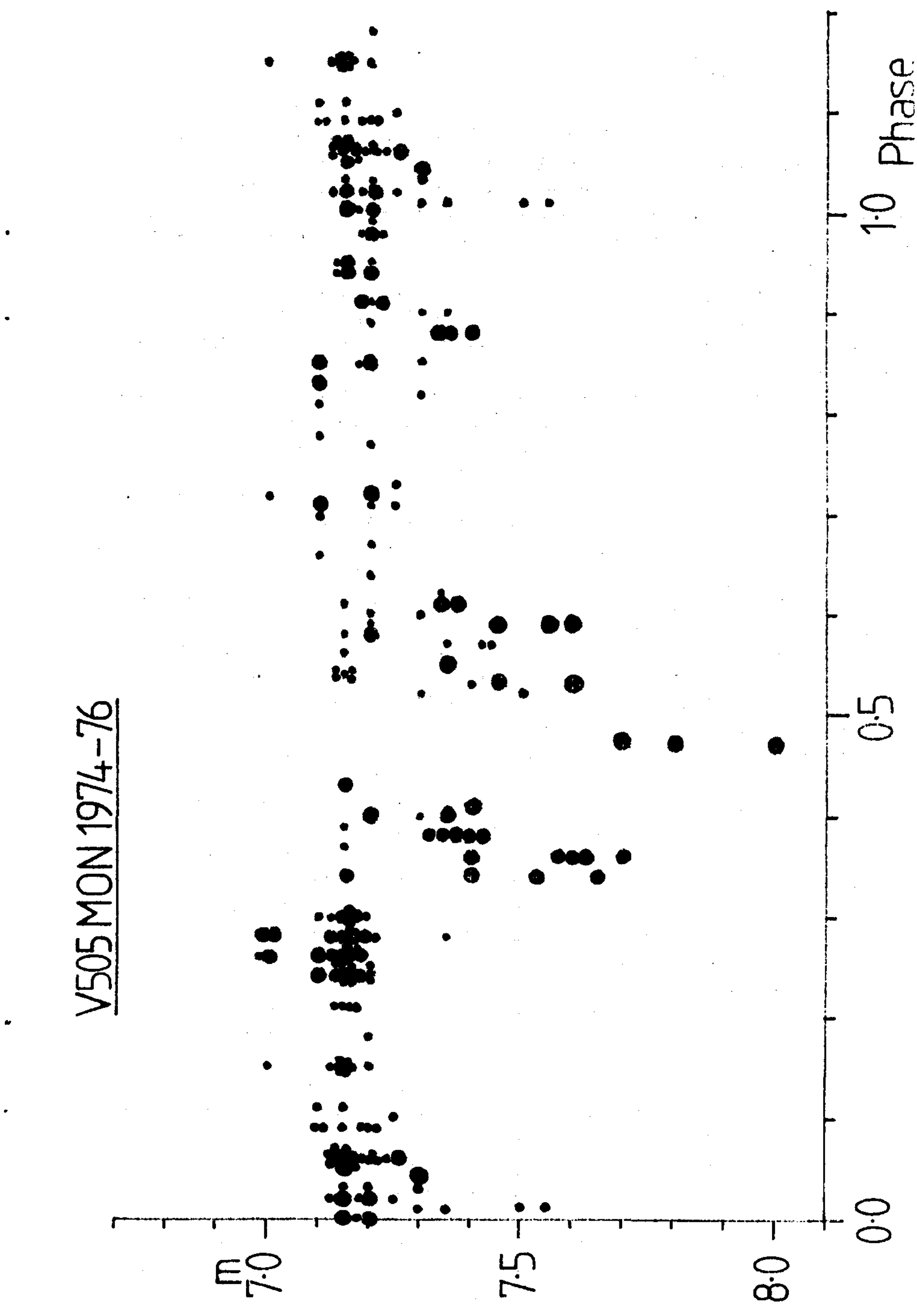
V 505 Mon - Tristram Brelstaff

The 1985 edition of the GCVS lists V505 Mon as a Beta Lyrae-type eclipsing binary with a range of 7.15 - 7.65 V, and a period of 53.7505 days. Secondary minimum is given as 7.55 V and the epoch of primary minimum is given as JD 2444635.318.

Between 1974 Sep. and 1976 Apr I made 180 visual estimates of this star using binoculars. The comparison stars used are shown on the accompanying chart, which is based on one drawn by John Isles in 1971. The magnitudes of A and F are V-magnitudes and the rest are based on my visual estimates.

The results are shown in the accompanying light-curve. The phase is relative to the GCVS epoch and period. In spite of the scatter, the light-curve can be seen to be that of a Beta Lyrae star. The deep minimum near phase 0.5 is, according to the GCVS elements, the secondary minimum, whereas the shallow dip near phase 1.0 is supposed to be primary minimum! The GCVS epoch of primary minimum is actually in 1981 Jan and so, between 1976 and 1981, the minimum at phase 1.0 must have deepened by about half a magnitude. Changes in the depths of minima are not unknown in long-period Beta Lyrae stars (cf. Beta Lyrae itself), but this seems to be rather large. V505 Mon is certainly well-worth studying further.




V505 MON 1974–76
m
7.0
7.5
8.0
0.0
0.5
1.0
Phase

U Geminorum: 1985-6 - John Toone

The 1985-6 apparition of U Gem has been packed with unusual behaviour and incident. The October/November maximum was the longest ever observed. The outburst width was measured at 42.5 days, which is twice as long as the most extended maximum previously recorded. This maximum, therefore, could be categorised as a supermaximum of the type observed in SU UMa and other related stars.

Eighty-five days later there was a record short maximum, with a width of only 6 days. This maximum could easily have been missed, had it not occurred in January, when the Moon was past last quarter.

In addition, U Gem was abnormally bright at minimum throughout March and early April. Preliminary reports from several observers place the star at about 13.5-13.7, rather than the normal 14.0-14.6: there is no evidence of eclipses.

Because U Gem is close to the ecliptic, observations are difficult or impossible during the months of June, July and August, owing to the close proximity of the Sun. Observations are also hampered for a few days each month by the Moon. Therefore no matter how well U Gem is observed it is impossible to cover all the maxima exhibited by the star.

BAA observations of U Gem extend back to 1904, and give good coverage for about 8 or 9 months of the year. A summary of all observations of U Gem in the years 1855 to 1907 by Dr J. van der Bilt[1] shows that there was only good coverage for 4 to 6 months of each year during that period. Since then the figure has improved to around 75%. According to van der Bilt's work, the longest maximum observed in the years 1855 to 1907 was that of October 1857. This was seen only by Winnecke, and lasted 20 days.

Figure 1 shows the frequency distribution of the widths of 112 well-observed maxima (70 long and 42 short) determined by the BAA in the years 1908 to 1979. The short and long maxima are clearly defined, with peaks at 10 and 16 days respectively. The first two maxima of the 1985 apparition have been added and are represented by solid blocks.

The shortest well-observed maximum in those years 1904 to 1979 was that of April 1956, which had a width of 7.5 days. The January 1986 short, although a record, is not far from the main body of shorts. It could be considered part of the main body if there is a skew towards the shorter end, as indeed there is to the longer end of the longs. Shorts are more easily missed than longs and it is not unreasonably to suggest that several with widths of 6 or 7 days have occurred unobserved.

Figures 2, 3 and 4 give details of 3 of the 5 maxima that have lasted for more than 20 days, and are drawn from BAA data. Of the two not reproduced here, I was unable to obtain the individual observations of the April 1931 maximum, and the War meant that there were few observations of the January 1945 maximum.

FIG. 1

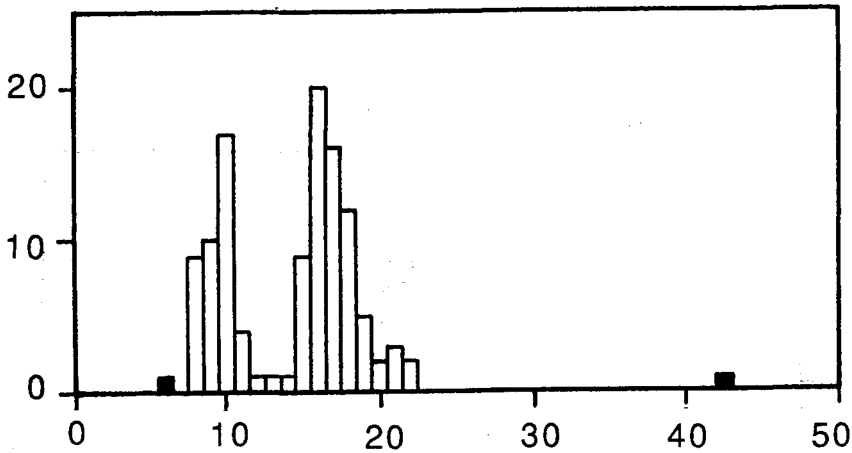


Figure 5 gives the light-curve of the 1985/86 apparition until the end of January. Details are given for the two maxima observed during that period. TA observations provided by Tom Saville have been added to give better coverage, because U Gem was a morning object at the start of the long outburst.

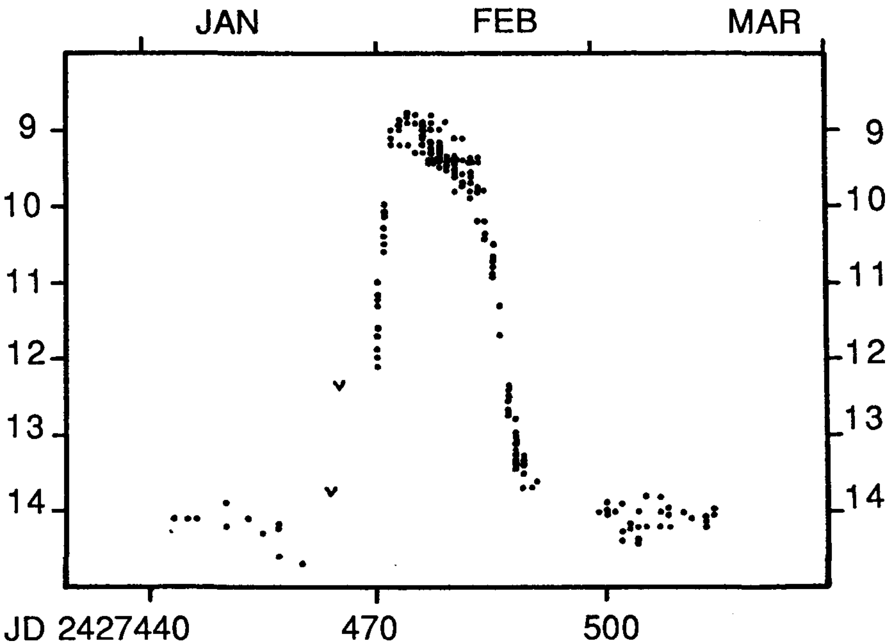
The rise to the long outburst on October 4 was observed only by Stott and it is more poorly defined than the fall. The fade back to minimum was in two distinct stages, with almost linear rates of fall. After reaching maximum on about October 11 at mag 9.4, the star declined slowly at a rate of 0.04 mag per day until November 10, when it reached mag 10.5. U [illegible] then faded rapidly to minimum at a rate of 0.53 mag per day. The decline from magnitude 11 to 13 took 3 days. This is close to the rate of fall of 1.51 days per magnitude derived by Saw[2] from 32 outbursts.

Unfortunately the start of the long maximum was not well-observed. It is worth-while reminding observers that eruptive stars such as U Gem should be observed on every night. If the star is caught on a rise then an estimate every hour is advisable. In addition, early morning observations in the period August to November are often twice as valuable as those made in the New Year. As can be seen from the light-curve, very few observations were made before the October maximum.

U Gem was the first dwarf nova to be discovered and has a well-documented history. The 1985-6 apparition, however, has shown that this star is capable of producing activity previously unknown to itself - but not to other dwarf novae. This illustrates, above all, the importance of continued observation of U Gem and all dwarf novae by the VSS.

References: (1) Recherches Astr. Obs. Utrecht, 3, 1908.
(2) Jrnl Brit. Astr. Assoc., 92, (3), 127 (1982).

FIG. 2. 1934

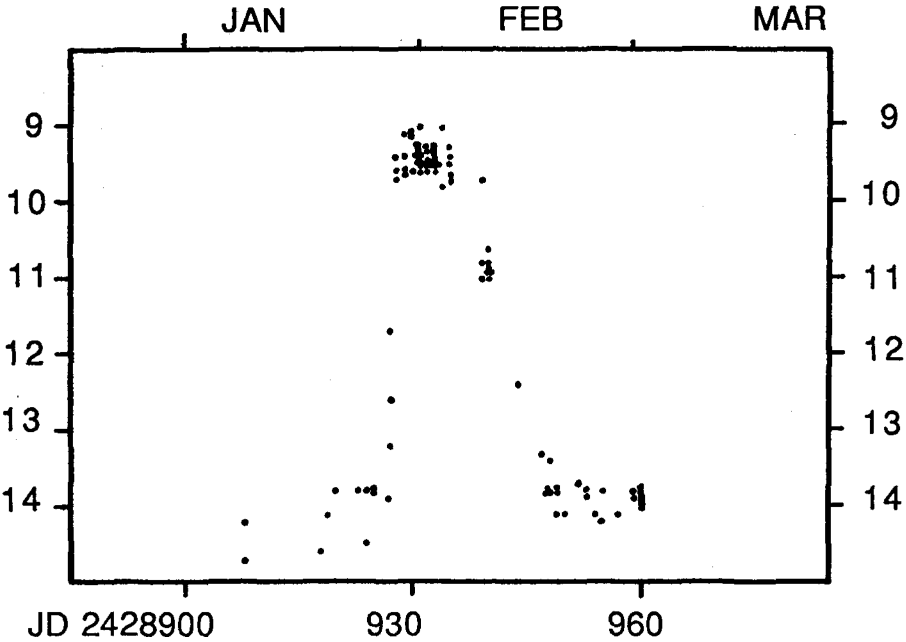


	JD 2427...	1934
Rise (13.7)	469	Jan 31
Maximum (8.9)	474	Feb 05
Fall (13.7)	490	Feb 21
Duration	21 days	

Observers:

Bappu, Brown, Chandra, De Roy, Holborn, Lane Hall, Lindley, Lishman, Nijland, Ryves, Sargent, Shinkfield, Steavenson, Webber

FIG. 3. 1938

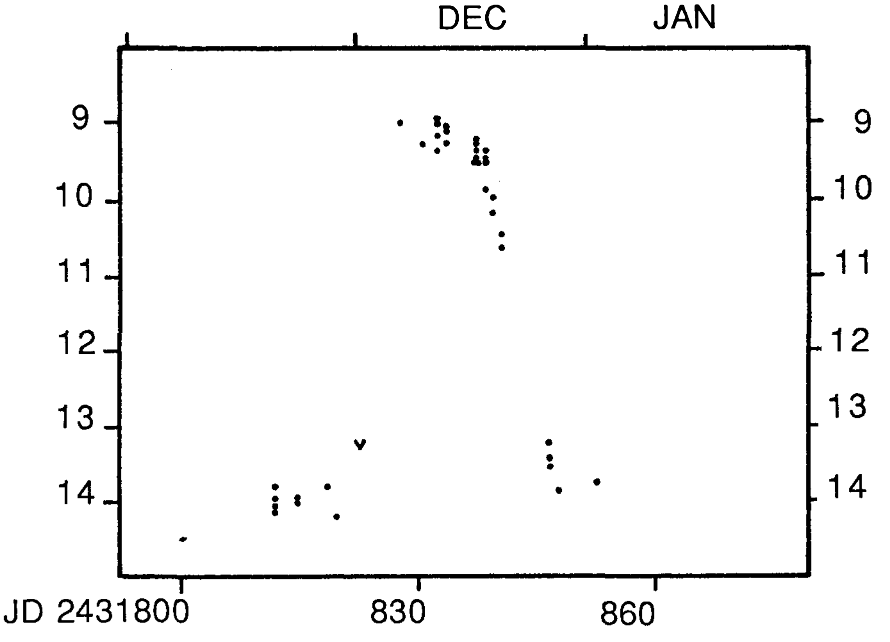


	JD 2428...	1938
Rise (13.7)	927	Jan 28
Maximum (9.4)	932	Feb 02
Fall (13.7)	948.5	Feb 18.5
Duration	21.5 days	

Observers:

Bappu, Bazin, Chandra, Collinson, Cox, H.W., Cox, L.A., Holborn, Knight, Lindley, Patston, Robinson, Sargent, Steavenson, Wildey

FIG. 4. 1945/6



	JD 2431...	1945/6
Rise (13.7)	804-808	Dec 14-18
Maximum (8.9)	812	Dec 22
Fall (13.7)	829	Jan 08
Duration	21-25 days	

Observers:

Cox, H.W., Heath, Holborn, Knight, Robinson, Whepherd, Wildey

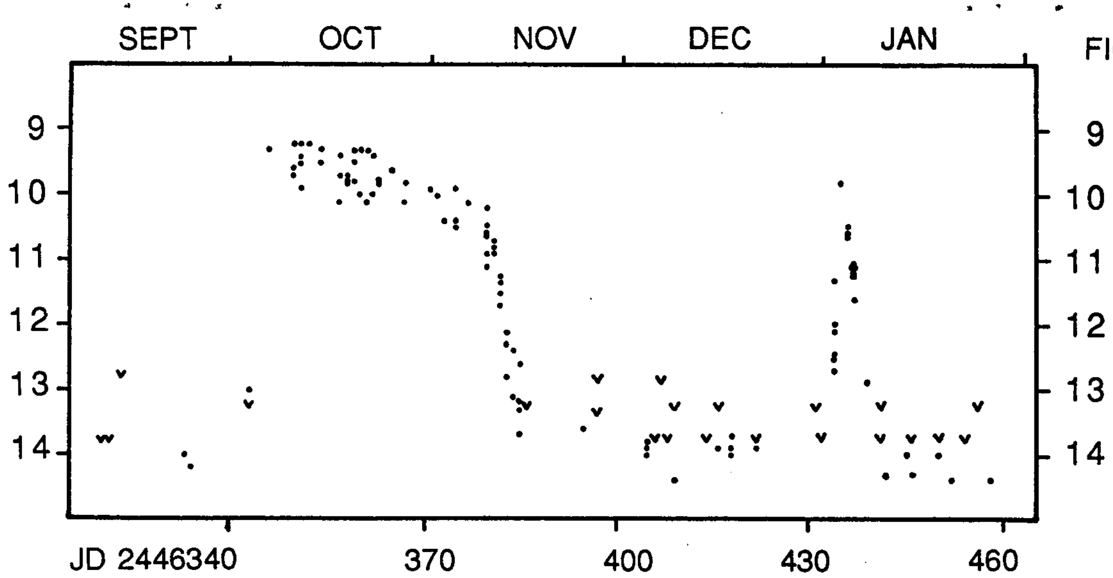


FIG. 5 1985/6

	LONG		SHORT	
	JD 2446...		JD 2446...	1986
Rise (13.7)	343	Oct 04	434	Jan 03
Maximum	350	Oct 11	435	Jan 04
Fall (13.7)	385.5	Nov 15.5	440	Jan 09
Duration	42.5 days		6 days	

Observers:

BAA: Albrighton, Gainsford, Lubbock, Mettam, Munford, Stott, Toone

TA: Dervan, Granslo, Smith, Verdenet

Predicted dates of maxima and minima for LPV stars in 1986-7

M = max., m = min.

Star	Desig.	Jly.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.
R And	001838				3m				5M				
W And	021143		30M								14m		
RW And	004132							1m					4M
R Aql	190108				12m				16M				
V Cam	054974									26m			
X Cam	043274	3m		12M		23m			3M		15m		
SU Cnc	080714	31m				24M			3m			30M	
U CVn	124238						31m					26M	
V CVn	131546	27M				3m			4M			14m	
RT CVn	134434					9m				22M			
S Cas	011272		27m									16M	
T Cas	001755							19M					
Cet	021403				15m				8M				
R Com	115919						22M						
S CrB	151731		17m				17M						
V CrB	154639	10M						27m					
W CrB	161138			20m				6M					
R Cyg	193449					19M							
S Cyg	200357			14M					15m				
V Cyg	203847					27m							14M
RU Cyg	213753				7m			18M					
Cyg	194632		21M								10m		
T Dra	175458				17m						18M		
RU Her	160625	13m							6M				
SS Her	162807		16m		8M		1m	23M		28m		10M	
R Hya	132422			2M							15m		
SU Lac	221955		24M				19m						20M
RS Leo	093720			16M				4m				13M	
W Lyn	081040					23M					9m		
X Lyn	081935	31M						29m					18M
X Oph	183308					7M					15m		
U Ori	054920	2m				27M							
R Ser	154615							11m					9M
T UMa	123160	31M						6m			14m		
SS Vir	122001						25M						5m
		Jly.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.

From the literature: Publications of the Astronomical Society of the Pacific - (compiled by Dick Chambers)

U Sge

In 97 (588) 138 (1985 Feb.), J.J. Dobins and M.J. Plavec give results from an examination of this eclipsing binary (on the BAA list), using a combination of IUE and optical spectral scans, and photometric data, to derive reliable parameters of the system. The primary is found to be a B7.5V star (T_{eff} 12,250K), mass 5.70 $M_{\odot}$ and the secondary a G4III-IV star (T_{eff} 5250K), mass 1.90 $M_{\odot}$. The distance of the system is 295 ± 20pc.

IUE observations during total eclipse show a wealth of emission lines, the power of which is about half that received from U Cep (also on BAA list). This is a surprise as U Cep is much more active with a high mass-transfer rate. Further observations of longer time-span are required, which will rely on accurate predictions of totality.

The primary of U Cep rotates about five times faster than at the synchronised velocity, while in U Sge it is just a little faster. This might be the reason for the higher mass transfer found in U Cep.

The detection of circumstellar emission lines, together with the second finding that the primary of U Sge has accelerated its rotation from about 70 km^{-1} to about 100 km^{-1} within 12 years may herald an increase in activity of U Sge.

Further observations of this star and other Algol variables is therefore highly desirable.

Photometry of stars in the UVgr system

The UVgr system of Thuan and Gunn is a four-colour intermediate-to-wide-band photometric system which shows advantages over the standard UBV system.

The four bands are non-overlapping and exclude the strongest night lines. The U and V filters lie in a region of strong line blanketing in late-type stars and measure the Balmer jump in early- type stars. The g and r filters lie in less-affected regions and hence provide a measure of stellar temperature. The filters have close bandpasses and hence the system is not sensitive to the wavelength cutoff of the particular detector used.

The paper by S.M. Kent in 97 (588) 165 (1985 Feb.) presents the observations of over 400 stars in the UVgr system covering a wide range of spectral type, luminosity class and metalicity.

The calibration of the standard-star sequence is significantly improved. Approximate transforms in the UBVR system are also presented.

Supernova 1983g and the distance to NGC 4753

This bright (12m) supernova appeared in NGC 4753, one of the rare class IO galaxies.

In 97 (589) 229 (1985 Mar.), R.J. Buta, H.G. Corwin Jr., and C.B. Opal present photoelectric observations in UBVR which enable the distance of the system to be estimated. Calculations show a distance modulus of 29.7 ± 0.4 (= 8.7 ± 1.6 Mpc), which suggests that the system is in the foreground of the Virgo II cloud.

The 1983 outburst of GK Persei

GK Per (Nova Persei 1901 - on the BAA programme) reached a maximum of V = 0.2 in 1901 and after fluctuating slowly faded to 15m in 1916. Between 1916-1947 there was a continuous irregular variation of amplitude up to 1.5m and lasting months. Since 1947, GK Per spends most of its time in a quiescent state (V = 13.1m), interrupted by outburst of 2-3 magnitude amplitude and 1-2 months duration, at intervals of several years.

Spectroscopic analysis reveals that GK Per probably consists of a massive white dwarf and an under-luminous K2 star with an orbital period of 1.99679 days.

This paper [97 (589) 264 (1985 Mar.)] by P. Szkody, J.A. Mattei and M. Mateo, discusses AAVSO visual estimates since 1966, with a spectrum obtained during the recent 1983 outburst, which was the brightest so far (V =10.3m).

The normal quiescent spectrum of GK Per differs from other old novae (for example DQ Her and BT Mon) in that there is an absence of the strong blue continuum, the strong emission from HeII λ = 4686 and of CII λ = 4267. However, the outburst spectrum is similar to these other systems.

Comparisons with U Sco, BV Cen and TV Col reveal discrepancies which at the moment are not understood and require further theoretical work on unstable accretion discs.

Emphasis is placed on the importance of continuous monitoring of GK Per as there is a possibility that the slow increase in intensity is a precursor to another nova outburst.

Photoelectric observations of CN Andromedae

There do exist W Ursae Majoris contact binaries where the mass-ratio of the components is not unity. CN And (BD +39°0059) is such a system and photoelectric observations over 5 nights in both B and V are reported and discussed in 97 (590) p.310 (1985 Apr.) by J.B. Rafert, N.L. Markworth and E.J. Michaels.

The study shows that there is a surprisingly large temperature difference between the components (6200 K and 4600 K), which implies that CN And is in a phase of poor thermal contact. Some photometric disturbance was observed on each side of secondary eclipse, which may imply that CN And is creating energy flux in the contact plane and is further evidence that the system has just coalesced.

'Beginners, please' - Be stars

Be stars (such as 28 Cygni, mentioned on p.1) are hot, rapidly rotating, irregular variables, usually spectral class B, but occasionally of classes O or A. They show hydrogen emission lines, unlike *shell stars*, which have sharp hydrogen absorption lines. They are classed as γ Cas variables, and the variation could arise from a ring of gas, mass-exchange or a stellar wind.

The Period of HP Lyrae - Tristram Brelstaff

The 1969 GCVS lists HP Lyrae as a Beta Lyrae-type variable with the unusually long period of 140.75 days. The photographic range is given as 10.5 - 11.0 with secondary minimum also 11.0. The spectral types is A6, and the epoch of minimum listed is JD 2426910. The 1985 GCVS simply repeats these details without any changes.

Between 1981 and 1985, I made 185 visual estimates of the magnitude of this star using a 200-mm reflector. The comparison stars used are shown in Figure 1. Their magnitudes are based on visual estimates and are therefore only approximate.

Figures 2 and 3 show the results of combining the 1981-2 and the 1983-4 observations into single cycles using the GCVS elements. (The 1985 observations were too few in number for this to be done with them.) Although the visual range is only about 0.2m, the maxima and minima show up clearly. The column of points at phase 0.06 in Figure 3 result from observations made on one night when the star was followed to an unusually low altitude in the north-west. Their faintness is probably partially cause by the Position-Angle effect. The thing to notice is that the maxima and minima in Figure 3 are displaced by about 0.1 of a cycle towards the left, relative to those in Figure 2. The simplest explanation of this seems to be that the GCVS period is about 2 per cent too large.

Taking into consideration the actual times that the star was seen faint, and the GCVS epoch of minimum, leads me to suggest 138.32 days as the most probably value for the period. However, because of uncertainty in the number of cycles in the interval since the GCVS epoch, the values 137.80 and 138.86 days are also possible. Figure 4 shows the combined light-curve using the 138.32-day period and the GCVS epoch. The other possible periods give similar results.

Further visual observations of HP Lyrae over the next decade should enable the true value of the period to be identified unambiguously. Alternatively, a quicker way would be to study photographic patrol plates taken in the years since the GCVS epoch.

Figure 1

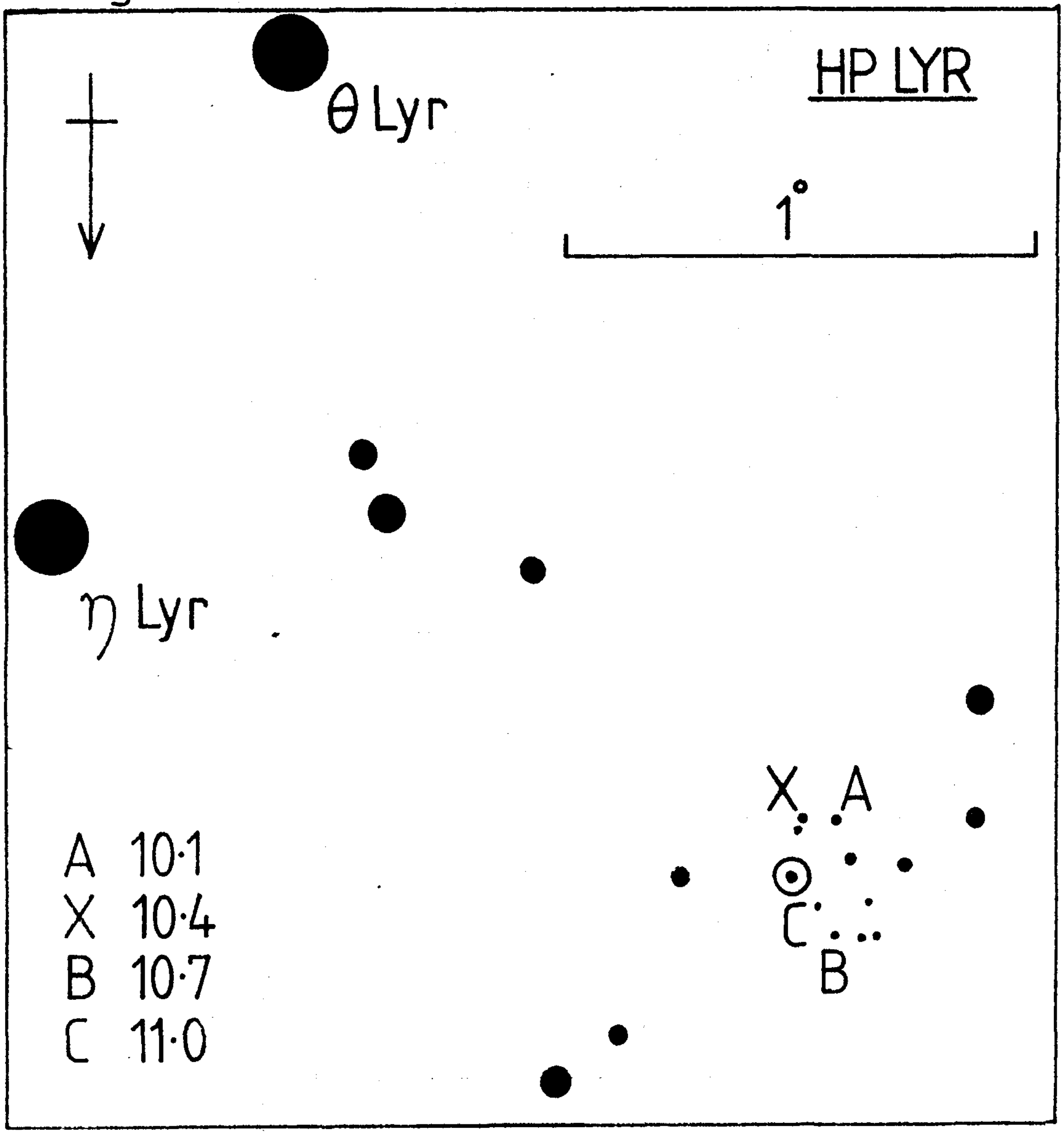


Figure 2

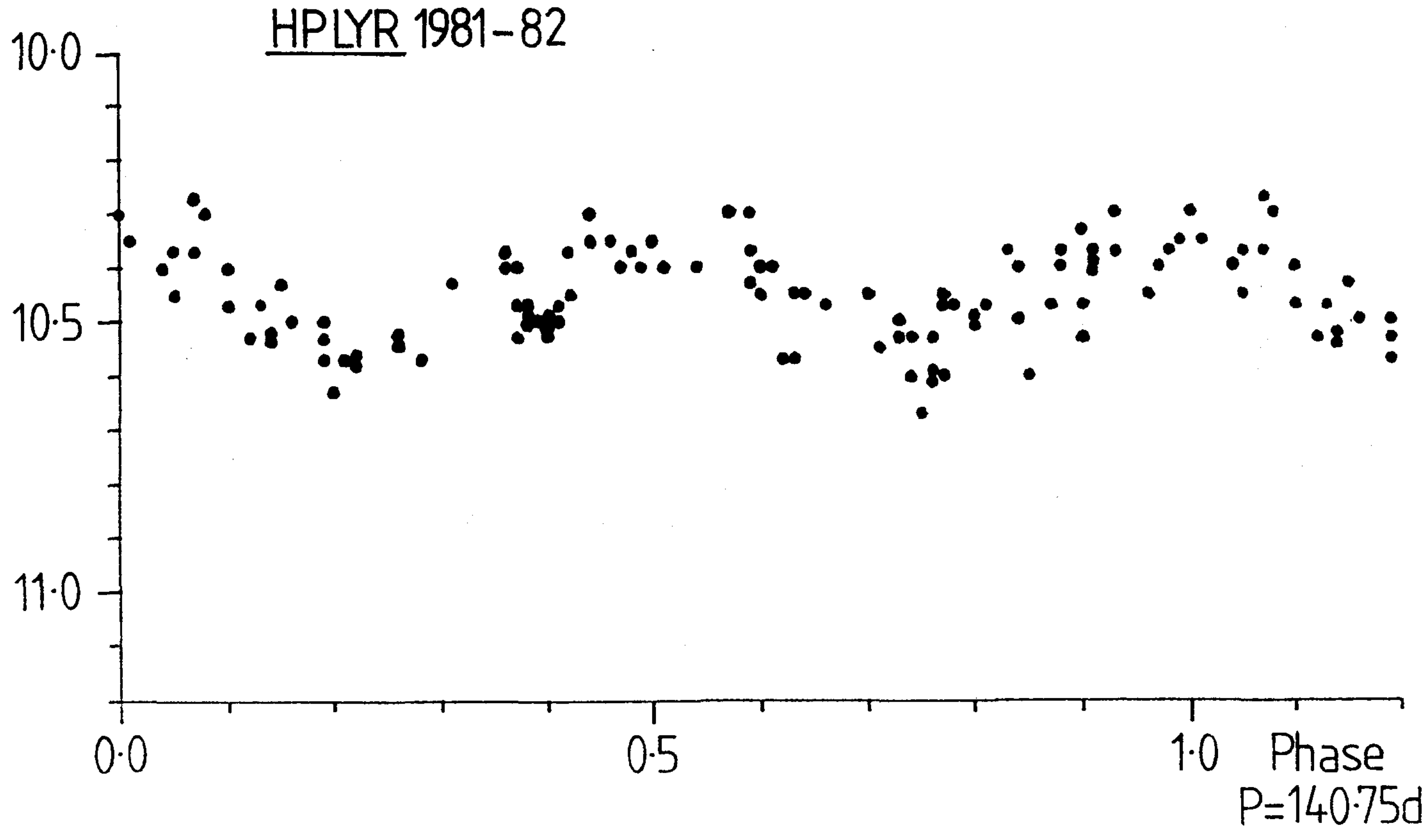


Figure 3

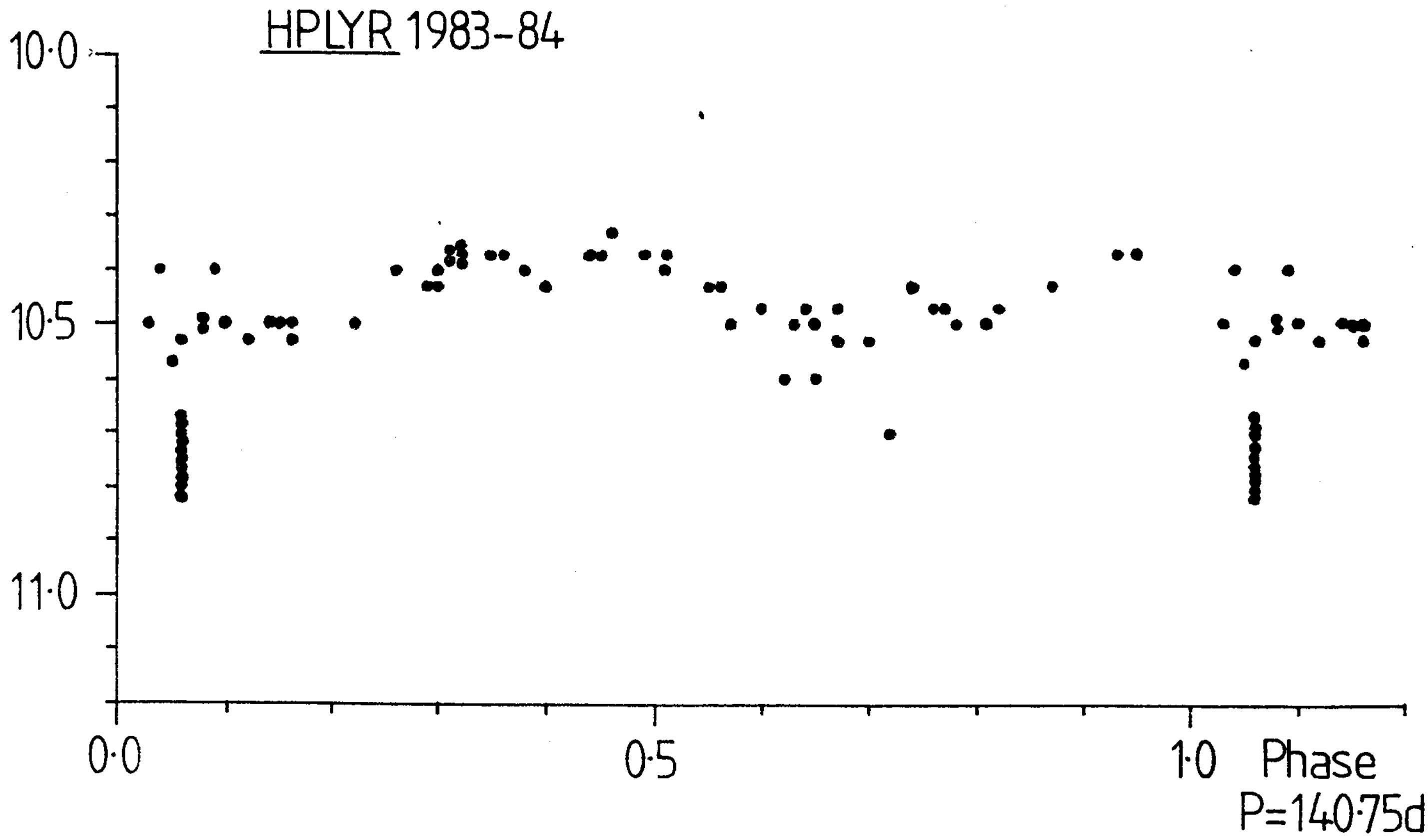
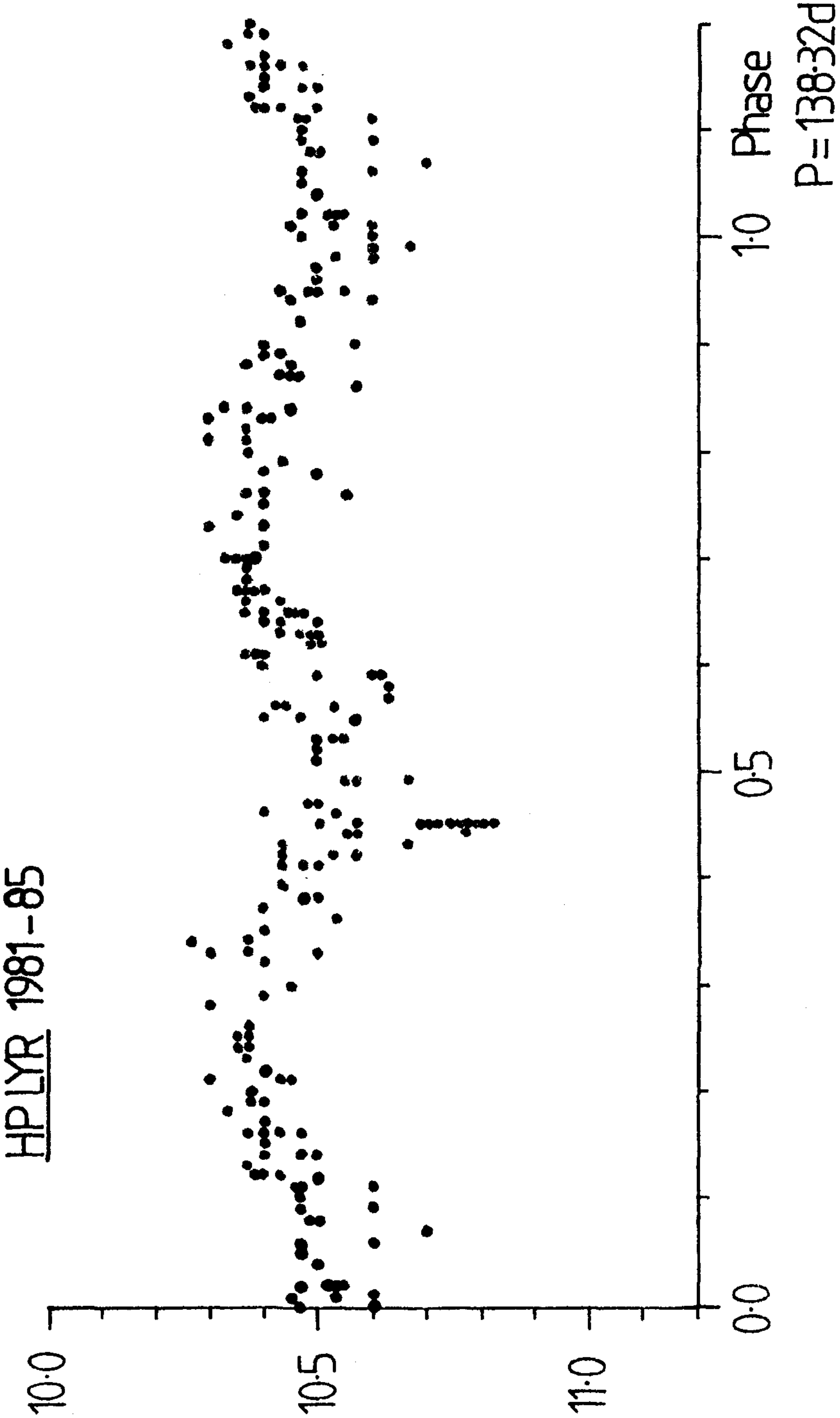


Figure 4

HP LYR 1981–85



Review:

Variable Stars, C. Hoffmeister, G. Richter and W. Wenzel, Springer-Verlag, Berlin, Heidelberg, 1985. Pp. xV + 328, hbk, £37.00

More than a decade has passed since the publication of the last major English-language surveys of the field of variable stars, and the works of Strohmeier (1972) and Glasby (1968) now seem woefully outdated. The present volume fills this gap in the literature admirably and will undoubtedly be 'The Book' on the subject for years to come.

It has been aimed at professional researchers, students and well-informed amateurs, and provides a detailed guide to the subject and its literature up to 1983. The level is such that many VSS members could follow most of the text. The emphasis is on the variations in the optical region of the spectrum and so the text is well-illustrated with light-curves, many of them visual. Much use is made of amateur results and suitable areas for further work by amateurs are suggested. The only thing which will deter amateurs from this excellent book is the rather high price. However, this is not unusually high for a well-produced specialist book of this type.

The book starts with an introductory chapter which gives a brief history of the filed, reviews some basic astrophysics, and explains the use of elements, Julian dates and the nomenclature of variable stars.

The next three chapters deal, in turn, with the pulsating stars, the eruptive stars, and the eclipsing binaries. The first two are divided into subsections which deal with the different classes of object within these groups. The classification used is similar to, by not quite identical to that used in the 1985 GCVS.

The chapter on pulsating stars is pretty standard, and covers, in decreasing depth, Cepheids, RR-Lyrae stars, Delta Scuti variables, Mira stars, semiregulars, and non-radial pulsators.

By far the longest chapter in the whole book is that devoted to the eruptive variables. This is where most of the advances have been made in recent years. The highlight of the book is the section on the eruptive binaries (a rather confusing term which covers novae, U Gem and AM Her stars, symbiotics and those X-ray binaries involving neutron stars or black holes). The accounts of the models and mechanisms proposed for these stars makes fascinating reading and makes the following section on supernovae seem positively mundane in comparison. Next there is a rambling section on nebular variables and then shorter ones on flare stars, S Doradus stars, Gamma Cassiopeiae stars, variables planetary nebulae (e.g. FG Sge) and their central stars (e.g. UU Sge), R CrB stars, gamma-ray bursters (concluding that the optical flashes are unproven), BY Draconis stars, RS CVn stars, pulsars and finally Alpha CVn stars (what are they doing here?). If that seems like a lot it is because there is a lot, and there is enough material in this chapter alone for a perfectly respectable book.

The various types of eclipsing binaries are dealt with in parallel, rather than in separate sections. The subjects covered are the geometry of eclipses, the classification and analysis of light-Curves, and period changes. Some particularly interesting systems are then described in more detail.

The next three chapters are more concerned with statistical matters, though there is a short account of the optical behaviour of Seyfert galaxies, BL Lac objects and quasars in Chapter 5. The rest of this chapter deals with the frequencies of the various types of variable stars in clusters and in external galaxies. Chapter 7 covers the closely related use of variable stars in the mapping of our Galaxy. In between, Chapter 6 gives a detailed account of the discovery of variable stars, mainly by photography. The probabilities involved are gone into in some depth. The fact that Hoffmeister had 10,000 discoveries to his credit does lend a certain authority to this part of the book!

Chapter 8 describes the various ways of determining stellar magnitudes and discusses their relative merits. In spite of the growth of photoelectric photometry, there is still a place for visual observers, so long as they make their estimates with care and observe the most suitable types of stars.

The final chapter cover the literature of the subject. There are lists of star catalogues and atlases (no mention of Papadopoulos, though), compilations, review articles, monographs, and 700 references cited in the text.

The book includes both subject and star indexes. It is well printed and bound, so you would expect for the price, and contains only a few errors. The only one which I found that might lead to confusion is the inclusion X Oph in with the Gamma Cas stars. Most VSS members will know that this should be Chi Oph.

Tristram Brelstaff

New eclipsing binary charts

Charts for the stars in the accompanying list are now available from John Isles (see inside front cover). The chart of Y Cygni, which replaces the previous issue, gives a revised sequence for Y plus comparison stars for the nearby V367 Cygni. The combined chart for CW and NN Cep also shows AH and NY Cep, whose amplitudes (0.3m and 0.2m) are probably too small for effective visual observation; as also is that of χ^2 Hya (0.3m) on the chart for TT Hya. The charts are based largely on field sketches and sequence estimates by Tristram Brelstaff, Jack Ells, Colin Henshaw, John Isles and Melvyn Taylor.

Observers will be able to compile their own 1986 predictions for the new systems, using the current light elements quoted on each chart. The 1987 Eclipsing Binary Handbook will include predictions for the EA stars.

Star	R.A. (1950) Dec.		Range	A_2*	Type	Per.	With*
	h m	° '	m m	m		d	
YZ Cas	00 42.3	+74 43	5.7 - 6.1B		EA	4.47	
AB Cas	02 32.9	+71 05	10.1 -11.8V		EA	1.37	
BM Cas	00 51.7	+63 49	8.8 - 9.3V		EB	197.28	
DO Cas	02 37.6	+60 20	8.4 - 9.0V		EB	0.68	
V523 Cas	00 37.3	+49 58	10.6 -11.4V	0.7	EW	0.23	
CW Cep	23 02.0	+63 08	7.6 - 8.0V	0.4	EA	2.73	
EG Cep	20 17.3	+76 39	9.3 -10.2V	0.3	EB	0.54	
NN Cep	23 00.1	+62 15	8.2 - 8.6V	0.3	EA	2.06	CW Cep
VV Cet	00 53.2	-02 22	10.3 -11.0p	0.7	EW	0.52	
RS Cha	08 45.0	-78 53	6.0 - 6.7V	0.5	EA	1.67	
RW Com	12 30.5	+27 00	11.0 -11.7V	0.6	EW	0.24	
RZ Com	12 32.6	+23 37	10.4 -11.1V	0.7	EW	0.34	
SS Com	12 47.2	+18 58	11.3 -11.9B	0.6	EW	0.41	
CC Com	12 09.6	+22 49	11.3 -12.2V	0.8	EW	0.22	
U CrB	15 16.2	+31 50	7.7 - 8.8V		EA	3.45	
Y Cyg	20 50.1	+34 28	7.3 - 7.9V	0.5	EA	3.00	
SW Cyg	20 05.4	+46 09	9.2 -11.8V		EA	4.57	
BR Cyg	19 39.4	+46 40	9.4 -10.6v		EA	1.33	
KU Cyg	20 11.2	+47 15	10.7 -12.4V	0.4	EA	38.44	
V367 Cyg	20 46.1	+39 06	6.7 - 7.6V	0.5	EB	18.60	Y Cyg
V448 Cyg	20 04.3	+35 14	7.9 - 8.7V	0.5	EB	6.62	
V453 Cyg	20 04.7	+35 36	8.3 - 8.7V	0.4	EA	3.89	V448 Cyg
V466 Cyg	19 52.6	+32 52	10.8 -11.7p	0.6	EA	1.39	
V1143 Cyg	19 37.6	+54 51	5.9 - 6.4V		EA	7.64	
BI Del	20 25.3	+14 10	11.4 -13.3p		EA	7.25	
GW Gem	07 49.4	+27 16	10.5 -11.5V		EB	0.66	
TX Her	17 17.0	+41 46	8.5 - 9.3V	0.4	EA	2.06	
AK Her	17 11.7	+16 24	8.3 - 8.8V	0.4	EW	0.42	
TT Hya	11 10.8	-26 12	7.3 - 9.0V		EA	6.95	

* A_2 = depth of secondary minimum, if at least 0.3m
With = other variable on whose chart the star appears

MINIMA OF ECLIPSING BINARIES, 1985 - (2) Cyg to Ori

John Isles

The present report continues from VSSC 63 the listing of eclipsing binary minima observed by the Section in 1985 (plus one late result for 1984). The constellations covered are those in volume II of the 1985 GCVS, whose linear elements have been taken as the basis for calculating O-C values, unless otherwise noted below. In the accompanying table, photoelectric determinations are underlined. For further explanations, see VSSC 58.

The total numbers of observations received for known and suspected eclipsing variables in constellations Cyg-Ori, including estimates reserved for separate discussion, are summarised below.

	Observations	Timings
Photoelectric:		
J Ells (EJ)	277	11
A Hollis (HO)	73	3
R Pickard	19	-
Total	369	14
Visual:		
N Bone	12	-
T Brelstaff (BS)	489	34
H Duncan (DH)	292	3
R Geddes	77	-
A Gibbon	12	-
J Hilder	72	-
J Isles (IS)	101	4
S Jenner	4	-
S McRoyall	1	-
A Markham (QM)	74	2
I Middlemist (MM)	143	11
G Pointer	8	-
M Reynolds	35	-
M Savage	15	-
J Saxton (XT)	10	1
M Taylor	7	-
N Taylor	67	-
W Williams	3	-
Composite timings	-	2
Total	1422	56
Grand total	1791	70

An asterisk draws attention to further information in the following notes.

68u Her. Observations by DH 6127-6395 folded onto a single cycle in order to derive timings of Min I and II nearest the median date of the observations.

HP Lyr. Observations 6214-6219 and 6351-6372 folded onto a single cycle in order to derive the timing.

Beta Lyr. All observations in the calendar year folded onto a single cycle in order to derive timings of Min I and II nearest the median date of the observations. Observers were BS, DH, IS, QM, Geddes, Gibbon, Hilder, Jenner, McRoyall, Pointer, Reynolds, Savage, M and N Taylor.

V651 Mon. Central star of planetary nebula NGC 2346. Observations 6052-6170 folded onto a single cycle in order to derive the timing. Not listed in 1985 GCVS. O-C is against Kohoutek's elements in M.N., **204**, 93P (1983).

The numbers of estimates given against certain minima include estimates made on other nights which were also used in deriving the time of minimum. These were as follows.

Star	Date	No	Other dates
Y Cyg	6344	3	6326
V466 Cyg	6383	5	6387
V1143 Cyg	6094	3	6109
RR Del	6383	7	6217
AI Dra	6142	5	6172
68u Her	6320	7	6322-6382
RX Hya	6135	7	6142
DI Hya	6135	6	6109
GK Hya	6091	4	6095-6113
	6095	5	6109-6135
RT Leo	6113	5	6135
AM Leo	6095	2	6094
Delta Lib	6165	15	6172-6300
TT Lyr	6292	4	6308

Star	Epoch	Helio JD 244...	O - C	No	Observer	
Y Cyg	12304	6320.375	+0.077	5	MM	
	12312	6344.366	+0.098	9	MM	*
SW Cyg	985	6372.314?	-0.040?	6	BS	
WZ Cyg	9229	6219.530	+0.020	9	BS	
	9516	6387.276	+0.023	9	BS	
BR Cyg	3587	6319.375	+0.002	7	BS	
	3611	6351.346	-0.008	7	BS	

Star	Epoch	Helio JD 244...	O - C	No	Observer	
BR Cyg	3653	6407.320	-0.003	7	MM	
GO Cyg	17305	6351.3280	+0.0195	34	EJ	
V466 Cyg	12654	6383.272	+0.004	13	BS	*
V836 Cyg	2274	6339.3453	-0.0043	30	EJ	
V1143 Cyg	508	6094.258	-0.014	9	BS	*
	524	6216.517	-0.007	10	BS	
V1425 Cyg	4760	6362.2928	-0.0133	31	EJ	
	4778.5	6385.4743	+0.0003	25	EJ	
RR Del	6131	6383.348	+0.177	12	BS	*
Z Dra	2061	6297.439	-0.014	10	BS	
AI Dra	2373	6136.420	+0.006	7	MM	
	2378	6142.419	+0.011	12	MM	*
	2398	6166.3819	-0.0025	26	EJ	
	2531.5	6326.4313	+0.0052	12	EJ	
	2559	6359.3940	+0.0005	21	EJ	
BH Dra	3521	6418.2915	-0.0037	30	EJ	
GW Gem	31038	6113.414	+0.011	9	BS	
RX Her	7407	6344.2813	-0.0025	16	EJ	
	7416	6360.2912	+0.0003	21	EJ	
AK Her	9563	6217.4762	+0.0012	44	HO	
	9807	6320.3400	+0.0137	13	HO	
	9826	6328.3405	+0.0053	16	HO	
68u Her	19691.5	6217.782	-0.049	47	DH	*
	19692	6218.857	+0.001	59	DH	*
	19741.5	6320.330?	-0.052?	8	QM	*
RX Hya	1178	6135.499	+0.021	15	MM	*
DI Hya	24272	6114.442	-0.008	10	BS	
	24306	6135.334	-0.016	13	BS	*
GK Hya	8676.5	6091.849?	-0.070?	8	IS	*
	8677.5	6095.502?	-0.004?	6	BS	*
SW Lac	3171.5	6292.515	+0.001	7	BS	
	3187	6297.490	+0.004	10	BS	

Star	Epoch	Helio JD 244...	O - C	No	Observer	
SW Lac	3355	6351.360	-0.006	7	BS	
	3420.5	6372.385	+0.011	9	BS	
VX Lac	967	6297.498	-0.003	9	BS	
AR Lac	2404	6361.2758?	-0.0302?	14	EJ	
CM Lac	11892	6109.309	0.000	7	BS	
RT Leo	2990	6113.277	+0.001	14	BS	*
UV Leo	12786	6113.402?	-0.009?	5	IS	
VZ Leo	13716	6113.453	-0.013	9	BS	
	13737	6136.348	-0.006	9	BS	
AM Leo	9847.5	6095.578?	-0.001?	9	IS	*
AP Leo	15241	6095.620	-0.003	7	IS	
Delta Lib	1377	6165.467	+0.001	17	DH	*
TT Lyr	1466	6292.564	-0.004	16	BS	*
TZ Lyr	2710	6217.531	+0.001	9	BS	
	2963	6351.337	+0.014	11	BS	
HP Lyr	137.5	6217	-46	9	BS	*
Beta Lyr	2943.5	6293.34	+33.52	253	15	*
	2944	6299.88	+33.61	240	15	*
V651 Mon	66	6057.3?	-6.5?	10	XT	*
V451 Oph	676.5	6320.384	+0.021	6	MM	
	686.5	6342.362?	+0.034?	6	MM	
V839 Oph	14103	6216.510	+0.036	8	BS	
	14103	6216.512	+0.038	8	MM	
	14105.5	6217.536	+0.039	10	BS	
	14108	6218.549	+0.030	9	BS	
	14193.5	6253.513	+0.025	10	MM	
	14274	6286.456	+0.044	6	MM	
ER Ori	10588	6109.371	+0.011	8	BS	
	10597.5	6113.380	-0.002	10	BS	
FZ Ori	5225	6114.378	-0.011	10	BS	
	5280	6136.372	-0.016	9	BS	

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