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"LIGHT-CURVE"

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VARIABLE STAR SECTION

CIRCULAR 62

CONTENTS

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Classification of Variable Stars

In an earlier issue (*VSSC* 60, 24) we mentioned the new classification scheme that has been introduced with the latest edition of the *General Catalogue of Variable Stars*, and the expectation that we would give details of the revised classes and sub-classes in a later issue of the *Circular*. The changes are very extensive, there now being six main categories of variation: Eruptive (including young and high-luminosity objects, flare stars and RCB stars); Pulsating; Rotating (i.e. principal variation caused by the rotation); Cataclysmic (all nova-like systems); Eclipsing binaries; Optically variable X-ray sources. Many new classes and sub-classes are recognized, and there are many other changes. For example, binaries may now be described by the characteristics of their components. Rather than taking up a lot of space in this publication, we propose to give a fully detailed summary of the whole classification system in a separate leaflet, which is now being prepared. This will be similar to our previous *Information Sheet*, issued many years ago, which proved to be very popular, and which described the earlier method of classification. The leaflet will be made available to members as soon as possible.

Charting Southern Hemisphere Binocular Variables: Part 2
- Colin Henshaw

In part 1, I outlined how I set about producing charts for bright southern hemisphere variables. Here I give some details of the kinds of star I have been observing.

During school holidays, particularly the long Christmas break, I would go to Cape Town and use the library at the old Royal Observatory, now part of the SAAO. Their facilities are second to none, and such visits were valuable to me, since I could obtain catalogue information unavailable in Zimbabwe. By scouring catalogues such as the GCVS and the supplement to the 1982 Yale Catalogue, I uncovered bright variables which I had previously overlooked. Each visit turned up new variables, and I have been there four times now.

I did not discriminate in the kind of variable for which I produced charts. If it was visible through most of its range in binoculars, then I charted it. Therefore, all kinds of variable star are represented on my list. I have even produced a chart for the famous southern hemisphere counterpart of SS Cygni, VW Hydri, which is within range during a supermaximum.

I was, however, particularly interested in Cepheid variables. These are much neglected by variable star observers because they believe that as their periods are known accurately, they are not worth observing. In addition, to be observed effectively, they need an extended period of clear weather, which is not generally available from the UK. Poor weather conditions will be a further contributing factor to their neglect. In Zimbabwe, however, we have an extended dry season from April until November, and the majority of my Cepheid variables are seen to advantage around this time. After having observed these objects for a long period, and then plotted the results against GCVS elements, I came across quite a few surprises.

Included on my programme list are a number of interesting eclipsing binaries. UW Canis Majoris is listed as having a range of only 0.3 mag. I suspect that its range is actually larger than this, since I found its β-Lyrae type variation quite easy to detect. V 453 Scorpii also revealed an impressive β-Lyrae curve and observation of this object will continue in 1985. Nearby is the enigmatic V 449 Scorpii, which is listed as having a period of 38.8 days, but which I have found is about 36. It may be intrinsically variable as well. Of particular interest is BL Telescopii, which is the southern counterpart of ε Aurigae. A sequence has been drawn up with the assistance of A.W.J. Cousins, who was one of the first to observe it. It is scheduled to fade again in late 1985.

The number of variables in the southern hemisphere is still fewer than the total north of the Equator. I have drawn up a comparison between the two hemispheres, after subtracting out the Cepheids, eclipsing binaries and Miras that exist on my list. I am forced to conclude as a result that a considerable number of bright southern variables still remain undetected. In the three years that I have been in Zimbabwe I have come across a few suspicious objects, although they are not very convincing.

A breakdown of my programme list according to type is given below. The full listing will be provided on request, and I will be very pleased to hear from anyone interested in observing any southern variables.

Cδ	46	EW	4	SD	3	UV	2
CW	2	SR & Lb	99	Cst	8	RR	1
UG	2	Suspects	22	RCB	1	RRs	3
EA	20	M	23	Unique	1	RV	4
EB	9	Z And	2	γC	10	Unknown	2

Colin Henshaw
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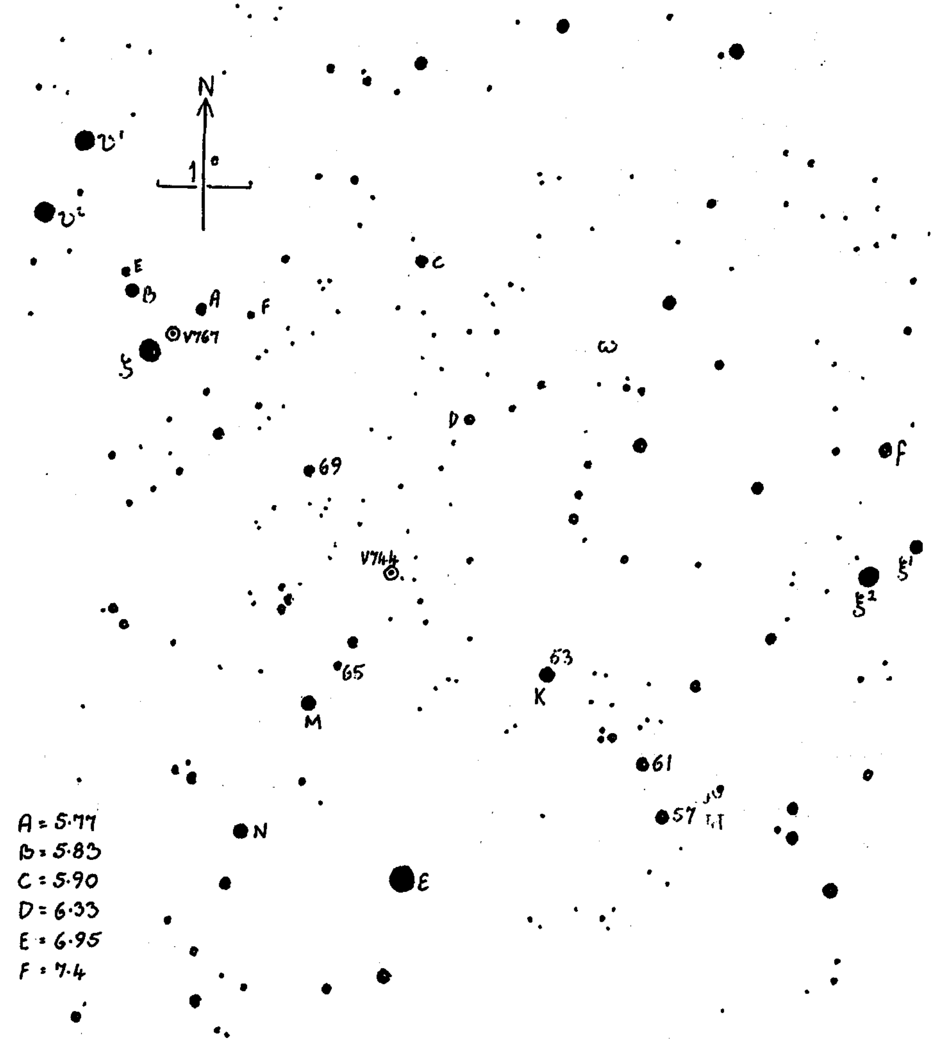
[One of Colin Henshaw's charts is reproduced opposite.]

Multiple-periodic red variables: Y Lyncis and W Cygni

- Károly Szatmáry, Attila Mizser, Gábor Dömény

A new power spectrum analysis of the light-curve of the red semi-regular variables Y Lyn and W Cyg shows the presence of three periodic terms, which may be interpreted as the fundamental and first and second overtone radial oscillation modes. Some physical parameters of these stars can be determined.

133349	V744	CENTAURI	5·1 - 6·0 V	Lb	M8III
	(1950)	13h 36m 52s	−49° 41'.8		
134746	V767	CENTAURI	5·85 - 6·14 V	γC	B2IIIe
	(1950)	13h 50m 50s	−46° 5'		



SOURCES: SAOC, SKY CAT 2000.

(H) 17-12-1982
SAAO, CAPE TOWN,
R.S.A.

The search for the periods was based on the Discrete Fourier Transformation (DFT) method for unequally spaced data (Deeming, 1975). Results obtained by this method are the power spectrum and the spectral window. The latter depends upon the length and the distribution of the data series, and helps to identify the peaks in the power spectrum that are caused by 'aliasing', and also to judge the accuracy of the periods. Phases are determined by the method of least squares. We used a Commodore 64 microcomputer for the calculations.

In the case of long-period red giants the pulsation is driven by the hydrogen ionization at the outer edge of the convective envelope. Usually pulsating variables oscillate in one or two modes, but sometimes three modes can be observed. In the power spectra of Y Lyn and W Cyg four main peaks can be found. The peaks (periods) can probably be linked with pulsation modes, using the fact that in the case of red giants the period ratios are $P_0/P_1 = 3:5$ and $P_1/P_2 = 1.2:1.5$ and $P_2/P_3 < 1.2$ (Wood, 1975).

072046 Y Lyn = HD 58521 = SAO 41784 = BD $+46^{o}1271$

RA = $7^h\ 20^m\ 11^s\!.6$ Dec = $+45^o\ 59'\ 27''$ (2000)
V = 7.43; B–V = +1.81; U–B = +0.89 (Abramjan, 1980)
Sp = M5, Ib–II TiO, ZrO Class: SRc

Up to now only a few periods have been published in the literature:

$P = 110^d$ (GCVS);
$P = 131^d\!.82 + 10.4$ (Toone, 1981)
$P = 270^d$

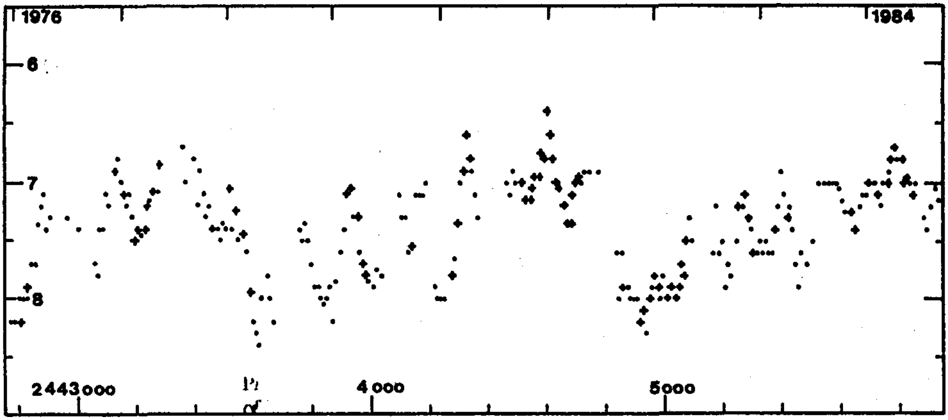
In the present analysis we used 244 data points, recorded between 1976 and 1984, formed from 10-day means of 1100 Hungarian and English visual observations. The light-curve is seen in Figure 1, while the power spectrum is shown in Figure 2. Results are given in Table I. The 650-day period is not a pulsational mode, but is a consequence of the asymmetric shape of the componênt in the light-curve that is varying with period P_0.

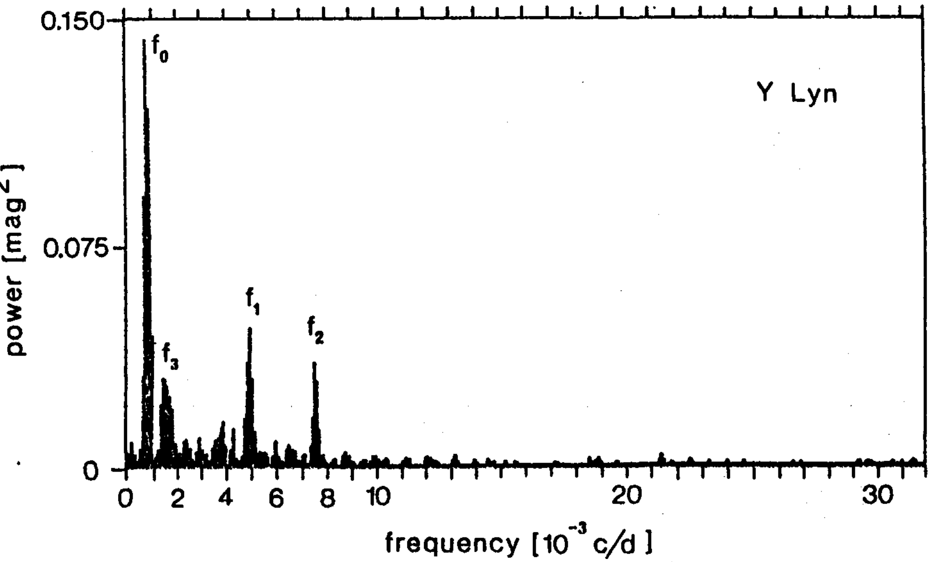
Table I

Y Lyn JD = 2 442 780 – 2 445 910 244 data points
Epoch: JD 2 442 750

	frequency $[10^{-4}$ c/d$]$	period [d]	amplitude [m]	phase [rad]
f_0	8.23	1215 ± 30	0.38	0.59 ± 0.05
	15.4	650 ± 50	0.17	4.01 ± 0.05
f_1	48.8	205 ± 5	0.21	4.33 ± 0.05
f_2	75.1	133 ± 2	0.19	3.68 ± 0.05

$P_0/P_1 = 5.93$ $P_1/P_2 = 1.54$


1976
1984
6
7
8
2443000
4000
5000


0.150
0.075
0
power [mag^2]
f_0
f_3
f_1
f_2
Y Lyn
0
2
4
6
8
10
20
30
frequency [10^{-3} c/d]

213244 W Cyg = HD 205730 = SAO 51079

RA = $21^h\ 36^m\ 02\overset{s}{.}2$ Dec = $+45^\circ\ 22'\ 29''$ (2000)
V = 6.43; B–V = +1.58
Sp = gM4e–M6 Class: SRb

The published periods for the variations in light are:
P = $129\overset{d}{.}6$, 243^d, and 1944^d (Turner and Blagg, 1919);
P = 132^d, 249^d, and 1100^d (Alter, 1929);
P = 130^d, 240^d, and 400^d (Mayall, 1961);
P = $119\overset{d}{.}81$, $130\overset{d}{.}85$ (GCVS)
P = 126^d (BAA VSS *Circular*, 56, 1983)

The present analysis uses 374 nearly equally spaced points between 1973 and 1984 from 10-day means of 2500 Hungarian and Finnish visual observations. The light-curve can be seen in Figure 3, and the power spectrum in Figure 4. Results are given in Table II. The longest period is uncertain because of the span of the series of data. It is interesting to note that the f_0, f_1 and f_2 frequencies are approximately equidistant, similar to the mode-splitting that is caused by rotation of the star in the non-radially pulsating δ Scuti variables.

Table II

W Cyg JD = 2 441 890 – 2 445 970 374 data points
Epoch: JD 2 441 890

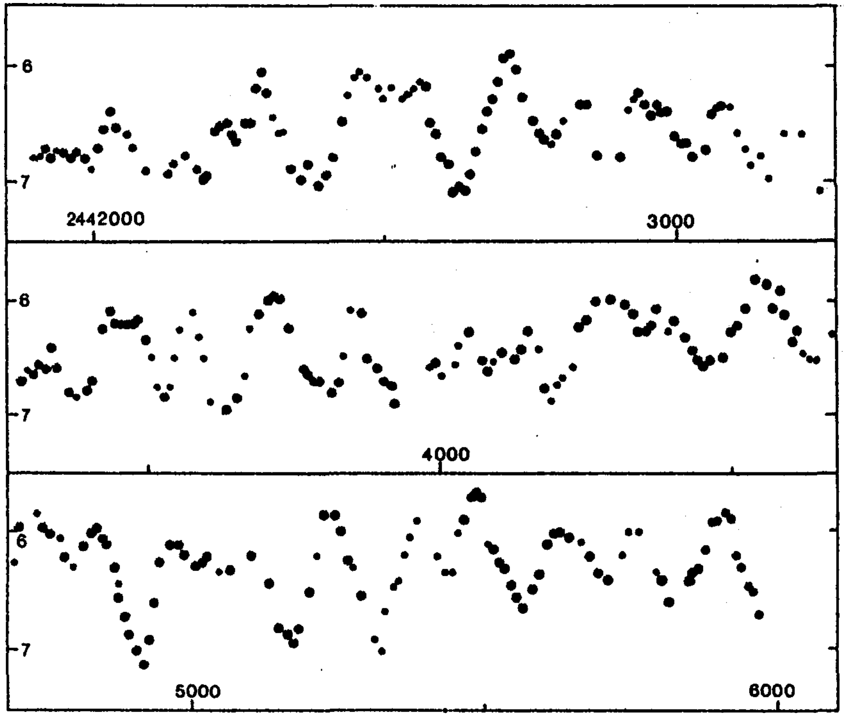
	frequency [10^{-4} c/d]	period [d]	amplitude [m]	phase [rad]
	1.65	6060 ± 200	0.20	5.83 ± 0.05
f_0	10.0	1000 ± 50	0.14	5.08 ± 0.05
f_1	44.0	227 ± 5	0.18	4.95 ± 0.05
f_2	78.5	127 ± 2	0.15	1.27 ± 0.05

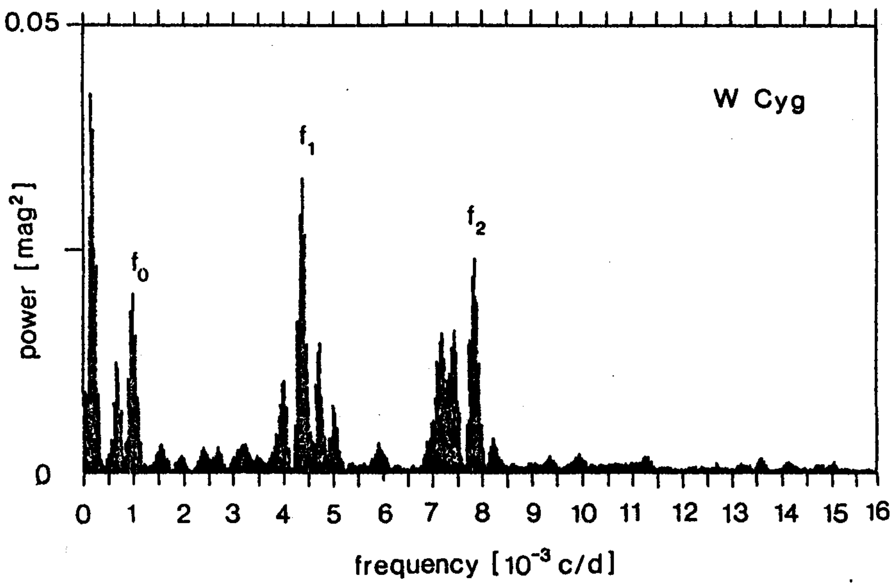
$P_0/P_1 = 4.40$ $P_1/P_2 = 1.78$

The light-curves show that from time to time variations with periods of either P_1 or P_2 predominate. Previously it had been suggested that mode-switching occurs, and that in red supergiants the irregular variations with time-scales of a few hundred days can be explained by convective motions. Our conclusion, however, is that in the case of Y Lyncis and W Cygni three radial pulsation modes are present simultaneously.

Using the period-luminosity relationship for red variables (Eggen, 1975) $M_{bol} = 0.5 - 2.25 \log P$, and the formula $M_{bol} = 4.7 - 2.5 \log L/L_\odot$:
Y Lyn $M_{bol} = -6.4$ and $\log L/L_\odot = 4.44$
W Cyg $M_{bol} = -6.25$ and $\log L/L_\odot = 4.38$

In both cases the bolometric corrections BC ≈ -1.3. According to theory, the mass of these stars M $\gtrsim$ 1.5 M (Wood, 1975). In this


6
7
2442000
3000
6
7
4000
6
7
5000
6000


0.05
0
W Cyg
f_0
f_1
f_2
power [mag²]
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
frequency [10^{-3} c/d]

case, the pulsation constant for the fundamental period $Q \approx 0.15$, thus using the formula:

$$Q = P_0 \sqrt{\frac{M}{M_\odot} \Big/ \left(\frac{R}{R_\odot}\right)^3}$$

we obtain for the radii $R \approx 450$ R . Finally from $L = 4\pi R^2 \sigma T^4$ and $g = GM/R^2$, the effective temperature $T \approx 3600$ K, and the acceleration at the surface $g \approx 1.35$ m/s^2.

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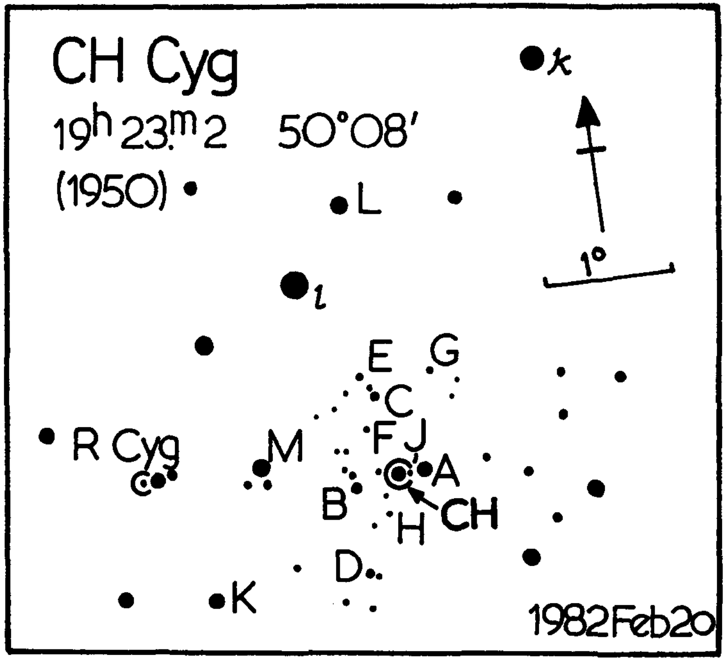
CH Cygni

This symbiotic (Z And) variable showed a marked drop in mid-1984 from its very bright state at magnitude 5.5 at the beginning of the year. It behaviour is shown in the accompanying light-curve (opposite), where it will be seen that the star remained well above its nominal minimum of 8.7. A chart for this binocular variable is also given, with an extract from the full sequence of comparison stars. The complete sequence and a wider-field chart are given in the booklet *Binocular Variable Star Charts: Vol.1*, recently issued. [For price and availability of this booklet, *see* details given on the inside back cover.]

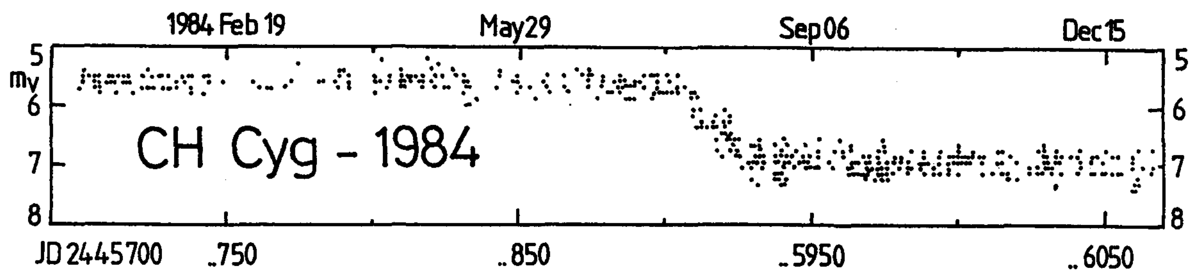
A Photographic Search for Novae in the Andromeda Galaxy

- James Bryan

For several years most of my effort in astronomy had been directed towards the discovery of supernovae in other galaxies. Since nearby bright galaxies are logical places to search, it was inevitable that the Andromeda Galaxy be considered. However, its large angular size and complex starfield were so overwhelming that I avoided the task of mapmaking for some time. During this period I became familiar with Halton Arp's paper 'Novae in the Andromeda Galaxy' (A.J., 61, 1235, February 1956) and learned of his discoveries of thirty common novae over 290 observations. Among these, ten stars were brighter than, or equal to sixteenth magnitude. Here was a strange prospect - with novae reaching sixteenth magnitude it should be possible to detect them photo-



CH Cyg
19h 23m.2 50°08′
(1950)
L
E
G
C
F
J
R Cyg
M
A
B
CH
H
D
K
1°
1982Feb20



1984 Feb 19
May29
Sep06
Dec15
mv
5
6
7
8
CH Cyg - 1984
JD 2445700
..750
..850
..5950
..6050

graphically with a 12.5" [32 cm] telescope. Furthermore, a rough estimate of frequency indicated that one 'bright' nova ought to appear at about monthly intervals.

By autumn 1982 I had assembled the resources necessary to begin my experiment to find novae in M31. The 12.5" reflector at my disposal had been fitted with a 6" [15 cm] f/15 Cassegrain guide telescope. I had located and purchased an unusual Japanese instrument to operate the guide 'scope and control the 12.5". Finally, and most importantly, the University of Washington Press had recently released Paul Hodge's *Atlas of the Andromeda Galaxy*, which presented many fine plates, and which clearly revealed faint stars across the entire face of the galaxy. This would serve as a set of standard charts to which I could refer during examination of my photographs. As for photography, I intended to use 35 mm Tri-X film, exposed for fifteen minutes and developed in D-19 for seven minutes at 68 F [20 C].

Returning to Arp's paper, I gathered two useful points. My original intention was to photograph the outlying spiral arms on the supposition that along these features would occur the most likely nova-producing regions. This misconception was corrected by Arp's comment that "[T]he frequency of novae drops off with increasing radius more sharply than the general light of the nebula (Redman and Shirley 1937)."[1] To illustrate, he presented evidence showing that at a distance of five arc minutes from the nucleus along the major axis in a swathe five arc minutes wide, eight novae per unit area could be expected. At a distance of ten arc minutes in radius the rate of occurrence dropped to two stars per unit area. My objective became to direct the telescope and camera at the centre of M31.

Also valuable was field star photometry spread across the galaxy at the sites of Arp's discoveries. These measured stars provided a basis of comparison magnitudes for any sightings that I might make and would also reveal the limiting magnitudes that were being achieved.

On [1982] October 24 I obtained two exposures. My plan for their examination called for projection of the images upon a small and smooth white screen, while I compared the scene with the same filed in the Hodge *Atlas*. No means of blink comparison existed. The work was tedious, especially since the starfield was complex and unfamiliar. On November 9, by which time I was reviewing the image only as a means of learning the field, I located a magnitude 15.8 object that did not appear in the *Atlas*. While the quality of the second exposure would not permit confirmation, the 'discovery' image sufficiently resembled surrounding stellar images to suggest an astronomical origin.

In subsequent communications with the staff of the Central Bureau for Astronomical Telegrams, who received my claim with a gratifying level of attention, I learned two lessons. Due to the highly ephemeral nature of these distant novae, no use would be served by announcing a sighting in the hope of confirmation by others since the star would probably fade into obscurity too soon. Accordingly, would-be discoverers are obliged to confirm their claim by further observation prior to contacting Cambridge. Instead of two frames, a larger series of exposures taken on the same night would be necessary to ensure confirmation. A second point was that quick review of the film was essential - a two-week old nova in M31 was, both literally and figuratively, ancient history. The value of my negatives as a discovery tool declined rapidly in only a few days past the observation.

With these experiences in hand, I returned to the telescope on [1982] December 16 for another attempt. Several good frames were obtained and the search commenced with a better idea of what to expect and how to proceed. Inspection over the next few days revealed nothing, but after nine days I located a surprisingly faint image present on the new frames, but absent from the October 24 frame and the Hodge *Atlas*. With a high level of confidence, I reported a nova at magnitude 17.2.

[1983] January 8 was the next opportunity to observe the galaxy and resulted in four exposures. The following day a stellar image corresponding to a disk size of magnitude 15.1 was found on the best frame. The remaining frames, which were less densely exposed, appeared to support the first frame. Following announcement of this unusually bright star, I corresponded with Leonida Rosino at the Asiago Astrophysical Observatory in Italy. Asiago is active in searching other galaxies for novae and supernovae. Among Arp's sightings the brightest were one-half magnitude fainter than my observation. Rosino advised that novae in the Andromeda Galaxy at fifteenth magnitude were known by rare. As for confirmation, he had plates from a 72" telescope for two days before and after January 8, which revealed no nova at the estimated position I had provided. The inability of a large telescope to record an object at the same position with so few days intervening was a disappointment. Assuming that no misunderstanding of the position occurred, I infer an error on my part in interpreting the more lightly exposed frames used for confirmation.

The results of my observations are summarized here:

Claimed novae in M31

Date	RA and Dec	m_{pg}	Status
1982 Oct.24	00 39 07 +40 49' 40"	15.8	Unconfirmed
1982 Dec.16	00 39 34 +40 45' 05"	17.2	Confirmed
1983 Jan.08	00 39 26 +40 52' 17"	15.1	Unconfirmed, probably false

Estimated positions are based on interpolation between coordinate markings in the Hodge *Atlas*. It became impossible to derive precisely measured positions when an available measuring engine developed mechanical problems.

Lessons learned in the process include:

1. Be certain to obtain an adequate number of acceptable exposures in one session to ensure the ability to confirm a claimed sighting;
2. Study the frames over as short a period as possible after the observation;
3. Become more sceptical over results.

None of these points is unexpected. Being predominantly a visual observer, the first and second stem from using a different method of search for these of especially challenging objects. Experience in supernova hunting had taught that conservative responses are always best when analyzing search results. The number of days elapsing between observations of M31 and subsequent identification of probable novae, as well as the rejection of various spurious images, suggest a correctly conservative stance. While this attitude is needed, it has to be balanced by early discovery and reporting. It is my impression that to achieve this balance more consistent quality of photography is necessary.

My perspective on this experiment is that it concluded surprisingly well. For five observing runs during an equal number of months, two produced no result, one a doubtful sighting, another an unconfirmed object, and another a well-supported, confirmed discovery of a nova. For an effort relying upon a telescope of modest size and employing routine photographic techniques, this is a good record.

While reading Robert Smith's historical account of the recognition of the true nature of galaxies, the following passage possessed special meaning:

> "In late 1923 Hubble began to focus on a study of novae in the spiral nebulae. In doing so, he took numerous plates of the Andromeda Nebula. For someone anxious to establish an accurate distance to the Nebula this programme had much to recommend it. In particular, by observing more novae he would be able to determine ... the mean apparent brightness of novae in the Nebula, and thus estimate its distance with more certainty. He was also excellently placed to pursue such a programme because he had access to the world's most powerful telescope, the Mount Wilson 100-inch. ...
>
> On 19 February 1924 Hubble disclosed to Shapley: 'You will be interested to hear that I have found a Cepheid variable in the Andromeda Nebula (M31). I have followed the Nebula ... as closely as the weather permitted and in the last five months have netted nine novae and two variables ... The two variables were found last week.'"

Before the end of 1924 Hubble had discovered other variable stars associated with M31 and M33. He also suspected objects in M81 and M101. "Here, then, was the conclusive proof he had desired of the stellar nature of some of the condensations in spiral nebulae and he was now sure that he had resolved the outer regions of M31 and M33 into clouds of stars."[2] In consideration of these facts, my hobbyist's assignment is at least mildly impertinent. It is a curiosity that an amateur astronomer may handle some part of the technique used to define the spiral nebulae as galaxies distinct from the Milky Way.

References:
1. *The Astronomical Journal* , 61, 1235, February 1956
2. *The Expanding Universe: Astronomy's Great Debate 1900-1931,* Robert W. Smith, Cambridge, 1982

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Observations of Telescopic Programme stars in 1984

A booklet containing light-curves of 56 stars on the main Telescopic Programme was issued with VSS *Circular* 61. Light-curves for the stars T CrB (220 obs.) and CI Cyg (209 obs.) are published on page 18.

Many objects on the programme showed little or no variation throughout the year, produced only negative observations, or were too poorly observed for useful plots to be made. Light-curves of these objects are not being published, but are available if required. In the details set out below, the number of observations for each object is given in parentheses.

Negative observations only:

VY Aqr (68)   UV Per (192)   WZ Sge (119)   SW UMa (145)

Too few observations: V603 Aql (4) Mag. 11.5

Minimal (or no) change:

DZ And (112) Probably constant at approx. 10.0 throughout year.
UW Aql (91) Probably constant at approx. 9.4. Insufficient observations in first six months to ascertain whether it brightened slightly in latter half of year.
XX Cam (337) Probably constant at 7.5, although observations scatter between 7.0 and 7.9, with some suggestions of low-amplitude, short-period fluctuations.
UV Cas (206) Constant at 11.8.
γ Cas (410) Constant 2.2-2.3.
ρ Cas (281) Probably constant at approx. 4.8. Very wide scatter of 1 mag. at times.

DM Cep (31) Constant at 7.5.
BC Cyg (198) Very slight indication of rise from approx. 10.0 to approx. 9.7, but observations in first half-year too few to be certain.
HR Del (225) Constant at 11.8.
RS Per (297) Essentially constant at 8.8, increased scatter in Nov. and Dec.
GK Per (81) Mag. 13: possible irregularities Jan. and Feb.
SU Tau (112) Essentially constant at 9.8-9.9, minimal coverage mid-Apr to end-Sept.
PV Vul (187) Very slight indications of a decline from 8.5 at beginning of year to 8.7 at end.

NGC 4151	(70)	Probably constant at 12.0.
Markarian 421	(17)	Probably constant at 13.8.
3C 373	(46)	Probably constant at 13.0.

U Monocerotis

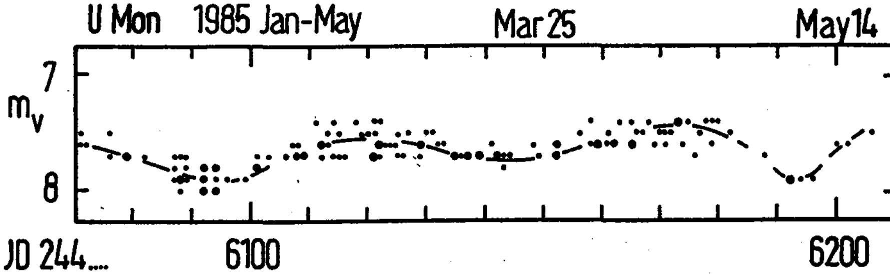
Since 1984 October/November this RV Tauri variable [HD 072609; range 5.9 - 7.8; Class RVb; Period 92.26; Spectrum F8 - K0] has gone into a transitory phase with the 'normal' amplitude (deep minimum to first maximum) subdued to only 0.3 - 0.4 magnitudes. Our observer in Gujrat, India, C.S.R. Srinivasan, was the first to notify the Section that this activity was occurring. A total of 229 light estimates made by 16 observers have been submitted for the period 1985 January to June. These are shown in the accompanying light-curve, which is a plot of high quality estimates. Two or more coincident observations are shown by a larger dot, and the star's overall activity is evident from the mean curve, indicated by the dashed line.

Primary minimum	JD 2446094	7.9	
Maximum	...6119		7.55
Secondary minimum	...6144	7.75	
Maximum	...6173		7.50
Primary minimum	...6193	7.9	

Observers: Collinson, Dryden, Fraser, Gainsford, Houchen, Kiernan, Knight, Markham, Middlemist, Middleton, Shanklin, Stott, Srinivasan, Swain, Tanti, Worraker.

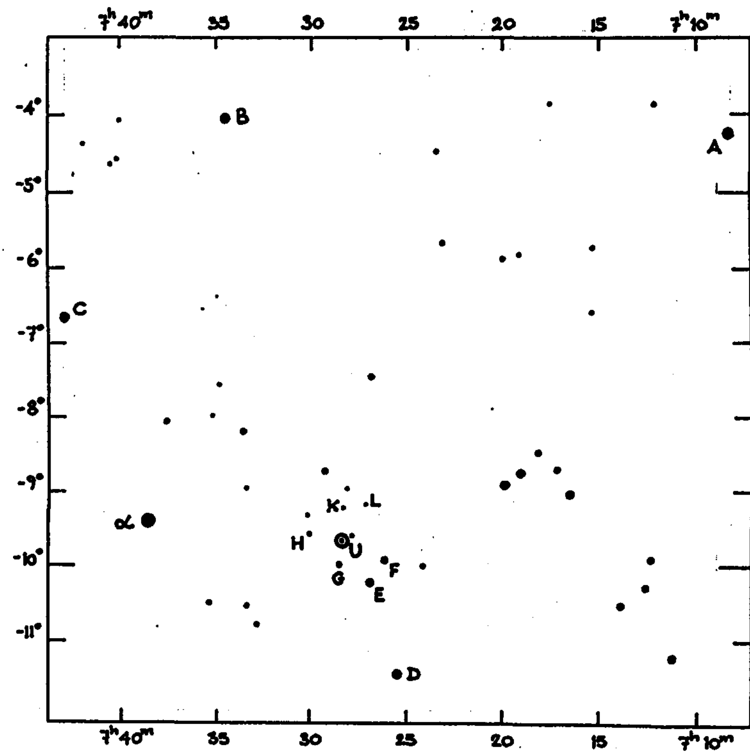
The chart (029.01, 1981 January) is given opposite. Please make estimates of this object, especially when it moves into twilight - and later, the morning sky. It is quite well placed for UK observers, being some 2.6 preceding and 0.2 south of α Monocerotis. The sequence is as follows:

A = 5.02	B = 5.17	C = 5.72	D = 5.85	E = 6.00
F = 6.62	G = 6.97	H = 7.51	K = 7.81	L = 8.03



072609 U Monocerotis 9° field (direct)

(1950) $07^h 28^m.4$, -09°40'



029.01 South Epoch 1950

Semiregular variations in RS Ophiuchi at minimum light between 1972 and 1984 - Lajos Szánthó, Betty Petrohán, Attila Mizser

The recurrent nova RS Ophiuchi is one of the most interesting of its class because of its semiregular variations at minimum, which are of relatively large amplitude, and which have an extreme range of 9.7 to 12.5.

RS Oph is closely monitored by the various variable star observing organizations around the world. Hungarian observers have followed this star since 1972. Unfortunately our series of data has a large gap for the years 1978-1981, so for the present analysis we also used observations for this interval that have been published in the *Bulletin de l'AFOEV*. A total of 649 estimates are plotted in Figure 1 opposite, as ten-day means.

Tempesti (1973) concluded from his photoelectric measurements that RS Oph show semiregular variations with periods of 50-70 days. The observed amplitude was 0.5 mag in V during the 1972 and 1973 observing seasons. The presence of such variations is also clear in our light-curve.

We made a Fourier analysis of our data using Barning's method. The search for short periods showed a peak at a period of 91 days (*see* Figure 2). The most noticeable value for a longer period is 1310 days, with an amplitude of 0.8 mag. This wave is seen in the upper panel of Figure 1. The analysis produced the following possible periods for the variable:

period in days	amplitude in mag.
1310	0.8
530	0.7
285	0.5
630	0.5

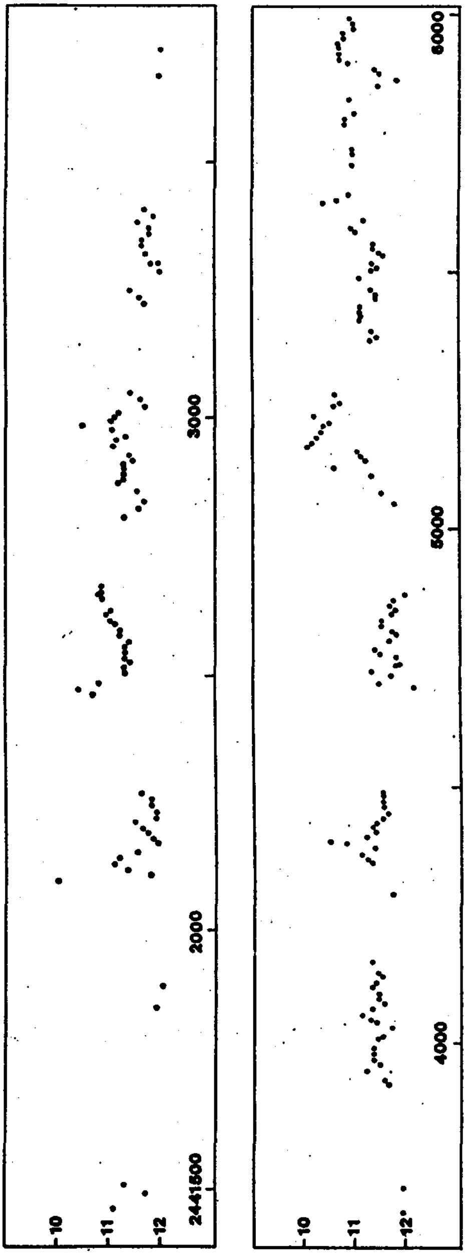
It should be noted, however, that the analysis was made difficult by gaps in the light-curve caused by conjunction with the Sun.

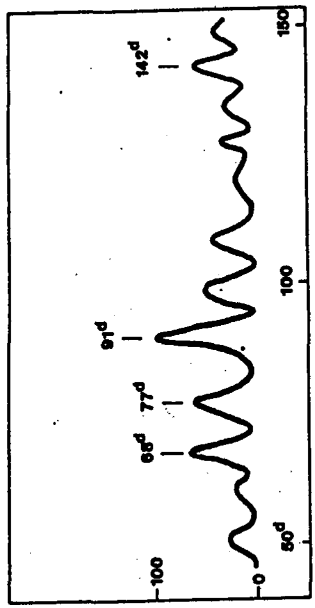
A small outburst occurred in 1982, when the star reached magnitude 9.9 on JD 2 445 169. A more detailed light-curve is given by Taylor (1983) for this 'mini outburst'. The presence of a similar brightening is mentioned by Barbon *et al.* (1969). The star rose to 9.7 on 1966 March 9, 1½ years before the 1967 outburst. Perhaps such brightenings precede 'real' larger outbursts.

A detailed description of the semiregular behaviour and the possible connection between minor outbursts and the major ones requires an analysis of observations back to the 19th century.

References:

Barbon, R., Mammano, A., Rosino, L., 1969, *Non-Periodic Phenomena in Variable Stars*, p.257, Academic Press, Budapest
Taylor, M., 1983, *The Astronomer*, 255
Tempesti, P., 1975, IBVS 974


10
11
12
2441500
2000
3000
4000
5000
6000


0
100
50d
100
150
65d
77d
91d
142d

T CrB and CI Cyg in 1984

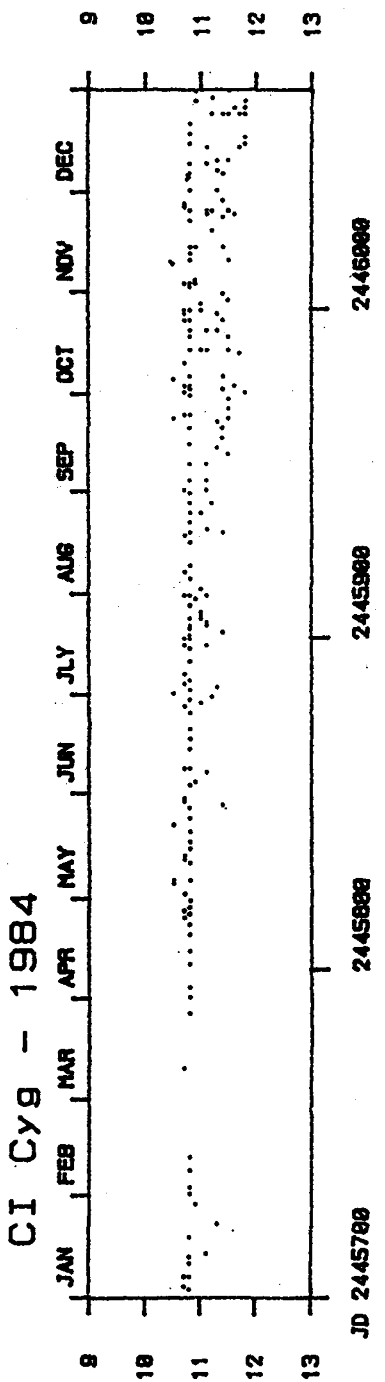
Shown opposite are the light-curves for 2 stars omitted from the booklet of 1984 light-curves for reasons of space. T CrB is, of course, the famous recurrent nova, and the slight variations evident are typical of its behaviour between outbursts. More observations to achieve a denser coverage are very desirable.

CI Cyg is a symbiotic object that also shows eclipses. These are thought to be caused by the secondary eclipsing a hot spot on an accretion disk. (See notes in VSSCs 54, 7; 57, 16; and 58, 8.) From the more or less continuous run of observations at magnitude 10.8 throughout 1984 it would be possible to conclude that it was constant. However, an eclipse was expected around JD 2446045 (1984 Dec.10), extending into 1985. It is therefore distinctly possible that the fluctuations indicated later in the year are almost certainly real, and some of the bright observations are incorrect identifications. This is yet another case where more comprehensive coverage would make it easier to decide the exact course of the variations.

Notes from Other Journals - IBVS

GK Per: In IBVS 2751 (1985 June) Bianchini and Sabbadin discuss the behaviour of this nova (1901), which has previously shown 'dwarf nova-like' activity. Examination of X-ray, UV and optical data for a 1978 outburst - the only one for which X-ray data are available - indicates that there is a delay of about 30 days between the onset of X-ray and optical activity. The X-rays cannot be caused by increased overflow from the Roche lobe surrounding the secondary star, which would be expected to cause essentially simulataneous X-ray and optical outbursts. Delays - although not necessarily of such a high order - are observed in X-ray novae, where it is thought that material is falling more or less directly onto the compact object, producing the enhanced X-ray flux. The X-rays are then thought to excite the secondary to higher luminosity. In the case of GK Per, the authors suggest that simultaneous observations in all wavelengths are essential to understanding the processes involved. [In the meantime, visual estimates are of great importance in gauging level of the star's activity.]

CH Cyg: In IBVS 2753 (1985 June), Rodriguez discusses recent activity in this star, which has gone through various episodes in 1963 September to 1965 August, 1967 June to 1970 December, and 1977 May to date. In its quiescent state CH Cyg has an M6III spectrum. During the outbursts this late spectrum is veiled by a blue continuum extending far into the ultraviolet, with numerous emission lines of hydrogen and ionized metals. Outside outbursts, the M6III spectrum normally only shows weak hydrogen emission lines. In 1974, however, a number of emissions were detected,


CI Cyg - 1984
JAN
FEB
MAR
APR
MAY
JUN
JLY
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JD 2445700
2445800
2445900
2446000
9
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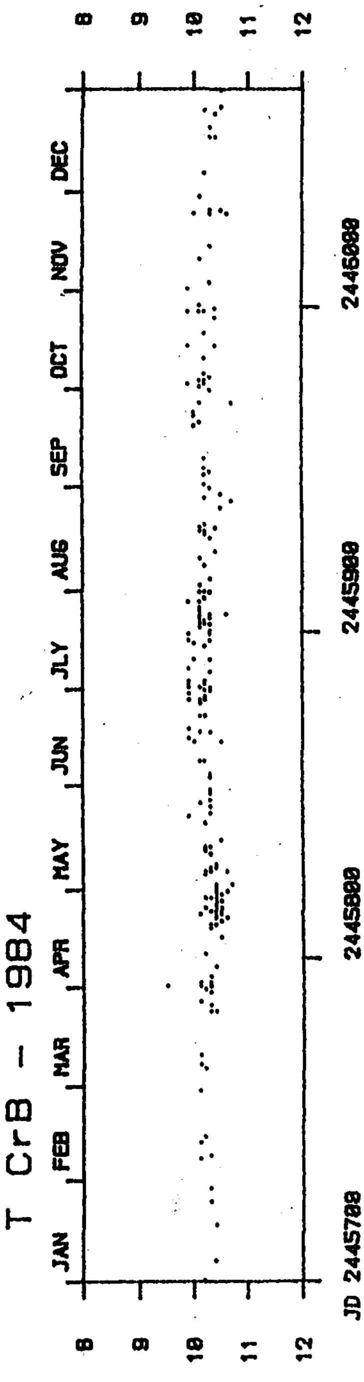
T CrB - 1984
JAN
FEB
MAR
APR
MAY
JUN
JLY
AUG
SEP
OCT
NOV
DEC
JD 2445700
2445800
2445900
2446000
8
9
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12

when no trace of the blue continuum could be seen. The ratio of intensities between the (forbidden) OIII auroral and nebular lines could be determined. This ratio is very low (< 0.06), more akin to the 0.01 found in planetary nebulae than the 0.3 associated with many symbiotic stars.

RR Delphini - a correction - Tristram Brelstaff

In VSSC 60 a timing of minimum of the eclipsing binary RR Del was given. This is wrong and should be ignored. It was purely the result of confusion over the comparison stars. Recent observations of RR Del give O - C's of about +0.20 days and show a duration of eclipse of only 12 hours against the 17.7 hours given in the 1969 GCVS.

Submission of observations

Members are reminded to submit observations for 1985 July to December to Melvyn Taylor as soon as possible, please, after the end of the year. The sooner observations are received the better. All estimates of stars on the Telescopic Programme are now being entered on computer as they are received, and we hope that in the near future all Binocular Programme estimates will be treated in the same way. This should greatly assist in the production of light-curves and in providing information about the behaviour of programme stars.

Editorial

We must make yet another apology to members for delays in publication. Although the light-curves are now easier (in some respects) to reproduce than previously, a special 40-page booklet was required to do them justice. Preparation and printing of this - and other unforeseen circumstances, such as illness - held up distribution of VSSC 61. In order not to delay publication of this issue any further, many items of notes from other journals have been held over until VSSC 63.

Contributions are always welcome and we are particularly pleased to be able to include those from our Hungarian colleagues in this issue. Items for publication should be sent to Storm Dunlop. For those with computers, it may be possible for contributions to be sent on floppy disks - if it is possible, they are encouraged to do so, as it greatly helps the editor. More than 70 different 5.25" disk formats may now be read directly - including MSDOS, IBM-PCDOS, and many CP/M versions. (But not Apple or Commodore formats - yet.) Files on standard BBC disks can be read via a computer-computer link. Anyone considering sending text or data files in this manner should contact Storm first to check whether the disk format is available, and to finalize other details.

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*** Booklet of Binocular Variable Star Charts ***

Copies of this booklet may be obtained from Storm Dunlop at a cost of £1.25 (U.K) or £1.50 (Overseas) each, including postage. This booklet will also be available from the BAA Office and at meetings of the Association.

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Charges: (4 issues)	U.K. & Eire - £2 for Circulars and light-curves Other countries - £3

Payments (made out to the BAA) and material for inclusion should be sent to Storm Dunlop.

CHARTS: Eclipsing - John Isles; All others - John Parkinson

Charges:	Telescopic	- SAE plus 20p per star (4 charts)
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