BRITISH ASTRONOMICAL ASSOCIATION

VARIABLE STAR SECTION

CIRCULAR No. 41 — 1979 JULY - OCTOBER

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Apologies We apologise for the excessive delay in issuing this Circular, which has been simply due to too great a work-load and too many calls upon a limited amount of time. However, from the number of enquiries it would seem that Circulars are greatly missed! Normal service will be resumed (we hope) from now on. Storm Dunlop would also like to apologise for omitting Rodney Lyon's name from the cover of Circular 40 and hopes that this error did not result in too much confusion.

Eruptive stars and novae We would like to thank all observers for their reports of activity of certain stars, coverage of which was requested in Circular 40. We hope to be able to give details of the results of the observational programme in a later Circular. Similar thanks are offered to members who sent in belated reports of observations of Nova Cygni 1978, although we would not like to encourage them in not forwarding the reports at the correct time! Unfortunately no observations of Nova Serpentis have come to light, so any reports of this object would still be welcome.

Circulars Will members please note that the introduction of mechanised sorting in the despatch area will mean that Circulars may be subject to some delay if SAEs do not give the postcode. This may make little difference when Circulars are late (as in this case) but may well be important when a special issue for a nova or other object is prepared. In addition, will members PLEASE send SAEs direct to Storm Dunlop, and not to other officers, as it only involves more time (and cost) to send them on.

Chart Checking (from T. Brelstaff)

My experience in checking charts for Melvyn Taylor's 'Chart and Sequence Notes' suggest that most of the Binocular Group charts contain errors or could be improved. I also suspect that the same could be said of the Main Programme charts (eg. stars k and l in the SS Cyg sequence: see JBAA 89 (3) 266).

I think that reasonably accurate sequences are needed if accurate and useful variable star observations are to be made. Magnitude errors in a sequence can lead to confusion, frustration and despair. This is as well as the obvious inaccuracy in the reduced magnitude. I have two suggestions which would help the discovery of these errors:

Firstly, the use of the Fractional method should be discouraged and the Pogson step method used instead. In this way, sequence errors could be found by looking ar observations of the variable star.

Secondly, I suggest that each observer should check the sequence of their favourite star. This can be done on a 'Class 1' night. The difference between one star and the next in the sequence is estimated in tenths of a magnitude. The results are recorded in this way:

A(2)B(5)C(3)D(6:)E

This means that A is $0^{m}.2$ brighter than B which is in turn, $0^{m}.5$ brighter than C, and so on. The colon indicates uncertainty because of the large magnitude difference or because of the faintness of the stars. The variable can also be included in the sequence estimates. The date, time and instrument should be recorded too. Preferably, three or four observations of the sequence should be made on different nights, but one or two will do. Even if the results agree with the chart magnitudes, they are of interest and should be sent in. Observations of binocular sequences (brighter than 9^m) should be sent to Melvyn Taylor for inclusion in CSN (please enclose an SAE). Observations of fainter VSS charts should be sent to the Director.

The checking of sequences is only part of the work done in CSN's. There is the finding of extra comparison stars to fill in gaps in the sequence or to replace awkward comparisons. Sometimes stars important for the identification of the comparisons are omitted. These have to be identified and marked on the charts. Some sequences are overcrowded with comparisons and have to be pruned down to a manageable size. We have to decide which comparisons to drop.

There is still a lot of work to be done on the checking and improving of charts but a few sequence estimates of the more popular charts would be a good start.

- I would like to endorse Tristram's remarks on the importance and value of checking sequences, both of the Binocular Group and Main Programme stars. 'Photoelectric and Visual Comparison Stars - II' is about to be submitted to the BAA Journal, and new charts and sequences, based on the results of these two papers are being prepared by Rodney Lyon, and hopefully should be available for use in 1980. - IDH

Secretary's Report 1978 This report covers only stars and observers of the Main Programme; the Binocular Group is reported separately. [NB - some belated reports are not included in this summary.] A total of 10,699 useable observations were received from 63 observers. This total is over 1000 more than for 1977, due mainly to observations of Nova Cygni 1978 (now V1668 Cyg) which, by sheer coincidence, totalled 699. The following table gives the observers' totals in alphabetical order.

S.W.	Albrighton	929	P.	Lyon	29
J.A.	Bailey	124	R.L.	Lyon	635
T.	Brelstaff	222	R.H.	McNaught	533
C.	Brookman	47	I.A.	Middlemist	470
L.K.	Brundle	389	R.W.	Middleton	32
R.H.	Chambers	32	C.R.	Munford	485
F.D.	Chesterfield	56	M.	Peel	126
G.A.V.	Coady	586	R.D.	Pickard	306
E.H.	Collinson	87	A.K.	Porter	82
A.	Cook	68	J.H.	Robinson	37
J.W.	Ells	20	T.A.	Robinson	65
B.	Espey	91	D.R.B.	Saw	222
R.B.I.	Fraser	114	J.D.	Shanklin	127
R.J.	Godden	305	D.J.	Shepherd	27
T.	Gough	403	H.W.S.	Smith	48
M.	Hapgood	69	A.	Snook	95
G.	Hirst	132	D.	Stott	649
A.J.	Hollis	729	M.D.	Taylor	264
D.	Hufton	70	F.	Ventura	40
G.M.	Hurst	168	P.J.	Wheeler	297
M.L.	Joslin	63	H.C.	Williams	29
S.J.	Kay	150	P.B.	Withers	441
N.S.	Kiernan	99	16 Observers		178
K.	Lewis	422	Photographic		107

We are pleased to welcome a new observer, Stephen Kay, whose work is very good. Thanks are due to the following observers for their most useful early morning observations - a lot braved those cold winter and spring mornings:

Shaun Albrighton, Jeremy Bailey, Tristram Brelstaff, Len Brundle, Greg. Coady, Rhona Fraser, Thomas Gough, Tony Hollis, Stephen Kay, Norman Kiernan, Karl Lewis, Rodney Lyon, Roderick MacLeod, Robert McNaught, Colin Munford, Michael Peel, Jonathon Shanklin, David Stott, Melvyn Taylor, Frank Ventura and Philip Withers.

We are most fortunate at present inasmuch as our main observers are fairly evenly distributed over a wide geographical area. In the South-west are Rodney Lyon and Karl Lewis, whilst Dorset and Hampshire are covered by Graham Hirst and Ronald Godden. Eastwards in Sussex and Kent, are David Stott, Len Brundle and Roger Pickard. In East Anglia are Greg Coady and our most experienced observer Colin Munford, supported by Edward Collinson. In the Midlands are Philip Withers, Shaun Albrighton and Peter Wheeler, with Guy Hurst in support. The North-west is being covered by Tony Hollis and Ian Middlemist, whilst Yorkshire has Melvyn Taylor and Tristram Brelstaff. Scotland is now well represented by Robert McNaught and Tom Gough, with support from Rhona Fraser.

These 21 observers have made over 8,500 of the total of 10,699 observations and we hope all will continue, and if possible increase, their level of observations. We have never before achieved such an even geographical coverage by main observers and it is a great help in reducing gaps in the light curves.

In this respect, special thanks are due to Frank Ventura who, in Malta, continued to observe R Hydrae until July 21!

With regard to the Main Programme, the following table gives the number of observations and observers of each star, together with the percentage compared with 1977, where this is of some significance.

Star	Obsns	(%)	Obsrs	Star	Obsns	(%)	Obsrs
R And	107	-	14	γ Cas	222	170	10
W And	60	240	11	ρ Cas	215	-	11
RW And	45	-	11	o Cet	125	-	14
RX And	272	-	16	R CrB	326	-	16
DZ And	63	-	7	S CrB	134	60	16
R Aql	183	-	19	T CrB	75	77	6
UU Aql	34	52	5	V CrB	43	-	5
UW Aql	72	-	8	W CrB	74	-	12
RW Aql	11	-	2	R Cyg	188	-	14
SS Aur	284	-	18	S Cyg	152	153	11
SU Aur	174	348	11	V Cyg	48	-	10
U Boo	77	56	11	W Cyg	177	70	13
V Boo	121	-	15	SS Cyg	712	-	34
V Cam	117	-	10	BC Cyg	144	185	12
X Cam	212	-	13	BI Cyg	149	-	13
Z Cam	322	-	13	CI Cyg	305	280	16
XX Cam	207	-	11	V1500 Cyg	9	-	4
S Cas	99	-	12	χ Cyg	230	173	19
T Cas	133	229	14	HR Del	68	-	6
UV Cas	63	-	7	T Dra	43	-	5

Star	Obsns	(%)	Obsrs	Star	Obsns	(%)	Obsrs
AB Dra	90	-	4	UV Per	110	-	11
U Gem	190	-	8	BU Per	129	-	10
RU Her	25	74	10	GK Per	107	(973)	10
SS Her	89	78	11	WZ Sge	89	(468)	9
AC Her	138	-	12	HS Sge	14	-	1
AH Her	106	-	6	R Sct	165	-	16
R Hya	31	70	7	R Ser	110	-	12
SU Lac	21	-	4	T Tau	121	228	12
X Leo	55	73	10	RV Tau	155	-	16
AY Lyr	102	80	9	SU Tau	109	-	11
U Mon	48	-	9	T UMa	196	-	15
RS Oph	33	-	6	SU UMa	192	-	11
U Ori	200	150	22	SW UMa	127	-	11
CN Ori	71	323	10	CH UMa	123	-	10
CZ Ori	111	326	12	V Vul	147	173	10
V529 Ori	44	-	4	NQ Vul	27	-	3
RU Peg	201	-	13	N Cyg 1978 (V1668 Cyg)	699	-	41
S Per	138	-	12				
RS Per	137	-	10	N Sgr 1977	1	-	1
TZ Per	148	-	10	V3876 Sgr	1	-	1
				N Ser 1978	4	-	2

SS Cyg is by far the best observed star. However there is a glut of observations in Sept/Oct; by contrast very few observers (to whom thanks) follow it during the Feb - Apr 'spring gap'.

It is pleasing to note that the newer programme stars are being observed increasingly; also those for which new charts have been issued. When unexpected change occurs in a star, there is, of course, great interest shown by observers. Thanks to all observers who increased the totals for SU Aur, T Cas, UV Cas, γ Cas, S Cyg, BC Cyg, CI Cyg, χ Cyg, U Ori, CN Ori, CZ Ori, T Tau and V Vul. Keep up the good work.

The Section is greatly indebted to certain observers who have kindly agreed to act as major observers of some stars. These observers have conscientiously observed these stars (say) 25 to 50 times during the year (including early morning observations). Each such set has formed a valuable frame of reference on which to base the light-curve for that star. If other observers would like to act as major observers of (say) 2 or 3 stars and would be willing to observe each star (say) once per week if possible, through the year, then if they would write to me suggesting which stars they consider they could best observe, I would be most pleased to select stars for them. The most suitable types of star would be M, SR or RV where fairly regular changes occur. It would not apply (of course) to UG or novae types which should be observed whenever possible.

Although the number of observations for 1978 has exceeded 10,000 there are many stars for which the number of observations is less than 100, including some for which the 1978 total is higher than that for 1977. Examples are: W And, DZ And, UV Cas, V CrB, V Cyg, CN Ori.

Observers will see from the star/observation table which stars are under-observed. However it may be helpful to give a priority list below of the most under-observed stars. For observers with telescopes of apertures of (say) 25 cm or more, the order of priority is:

Novae: RS Oph, T CrB, HR Del, WZ Sge, HS Sge.
UG: UU Aql, X Leo, CN Ori, CZ Ori, AB Dra, AY Lyr.

For observers with telescopes with apertures of about 21 cm or less:

R CrB: DZ And, UV Cas
SR: U Boo and, for binocular observers, W Cyg.

More binocular or small telescope observations are needed of the following all RV stars:
U Mon, V Vul, AC Her, R Sct. Early morning observations of these would also greatly extend the light-curves.

Finally, but by no means least, the following M type stars are suffering, especially when near minimum:
R Hya, RU Her, T Dra, V CrB, V Cyg, RW And, W And, SS Her, W CrB, S CrB, R And. Five of these are near one another, in Corona Borealis and Hercules, whilst three are in Andromeda. Nearly all are summer and autumn stars, observable during the more pleasant (climatically) time of year.

Now that the annual number of observations is again above 10,000, let us keep up the good work. Please include some under-observed stars in your programme, in addition to those already observed.

Many thanks to all observers. - D.R.B. Saw

Recent Papers of Interest

Summary of 'Novae versus Dwarf Novae: Energy Sources and Systematics' by A.D. Mallama and V.L. Trimble in Q. Jl. R. astr. Soc. 19 430 - 441 (1978), prepared by Storm Dunlop.

This paper examines the theoretical and observational aspects of the relationship between the four major groups of eruptive or cataclysmic variables: classical novae, recurrent novae, dwarf novae and nova-like variables. The interpretation is naturally based upon the currently accepted model for these systems of a binary consisting of a degenerate dwarf and a late-type star which fills, and overflows, its Roche lobe. An accretion disk exists around the degenerate star and the impact of the stream of transferred material may give rise to a hot spot. Novae (and with a lesser degree of certainty) recurrent novae, exhibit mass loss during the outbursts, expanding nebular shells or circumstellar material. Following Warner and Paczyński the authors regard WZ Sge as a very long-period dwarf nova rather than a recurrent nova, on the basis of its low absolute brightness, its non-ejection of material, the rapid quasi-periodic fluctuations, [more characteristically found in dwarf novae and some novae] and the low mass-transfer rate. The amplitudes of recurrent novae appear smaller than those of classical novae only because of their greater brightness at minimum light. On this basis, and because it shows no evidence of ejected material, the authors suggest that T Pyx should be regarded as a dwarf nova. Recurrent novae are therefore reduced to five in number: U Sco, VY Aqr, T CrB, RS Oph and V1017 Sgr. The available data suggest that these systems contain giant components.

The nova-like variables are close binaries with spectra, variability and components like those of novae and dwarf novae between outbursts and are apparently part of the same problem, as may be the EUV binaries HZ 43 and F 24 studied by Shara, Prialnik and Shaviv. The symbiotic stars, with giant components and greater separations than the systems mentioned, may have the same relationship to recurrent novae as nova-like variables have to novae and dwarf novae.

Apart from the connection between giant components and recurrent novae there are no correlations between distinct classes of behaviour and stellar types. All cataclysmic variables can be explained on the basis of a cool star close to the main sequence, accompanying a degenerate dwarf. The general model is also applicable to transient and recurrent X-ray sources if a neutron star or black hole takes the place of the degenerate dwarf, and mass transfer by stellar winds rather than Roche-lobe overflow is also considered. There is no apparent correlation between outburst types and orbital periods, masses or spectral classes, again excepting the giants in recurrent novae, symbiotic stars and a few very slow novae. Quiescent luminosity is probably significantly different between the classes with M_v = +7 to +10 for dwarf novae, +4 to +5 for novae and +2 to +3 for recurrent novae, where the dominant light contributions are from the hot spot, the accretion disk, and the giant component respectively. There may be some difference in the rates of mass transfer (although based upon meagre data) with recurrent novae having the greatest rate, and dwarf novae the least.

The mass transferred carries both nuclear and gravitational potential energy (ratio about 50:1) and possibly magnetic energy. Each of these sources has been seen as providing the necessary energy for the outbursts. Several considerations suggest that the energy source for novae is more powerful than that of dwarf novae. Various models employing explosive burning of hydrogen accreted onto the degenerate star are consistent with observed nova outbursts and recurrence times of about 10^4 to 10^5 years. Compressional heating of accreted gas will be most important with the most rapid transfer rate (in recurrent novae) and the combined effect could be to bring the outburst intervals down to the order of 60 years. So novae and recurrent novae can be interpreted as having a similar (nuclear) energy source.

Release of gravitational energy in bursts is probably the source of dwarf nova outbursts. The transfered material is either expelled (the rate would be too small to be detectable) or accumulated to give rise to a classical nova outburst after about 10^6 years. In seeking to explain the accretion in bursts, the authors reject the view held by some investigators [such as Bath - see summary of paper in VSSC 39] of instability in the cool star. If matter is shed at a constant, slow rate, it will accumulate in the disk until a critical size or density is reached and instability sets in, the gas spiralling onto the degenerate dwarf, releasing its gravitational energy. This model still leaves unexplained the behaviour of Z Cam stars, and also there is no precise understanding of the cause of the sudden change which triggers the outburst, although Syunyaev and Shakura suggest magnetospheric instability.

The authors point out that all the systems referred to may have subtypes or analogues where the degenerate dwarf has a very strong magnetic field. The 'polar' nova-like variables, AM Her, AN UMa and W Pup probably form one such group. In their view then, the various classes of behaviour can be summed up as follows:

A giant secondary not filling its lobe will lose mass in a stellar wind and form a symbiotic variable;

High mass transfer rate from lobe-filling giant gives rise to a recurrent nova;

In a nova gas is transfered through the disk at the same rate as it arrives, minimum light being mainly due to the disk's contribution;

At lower transfer rates, gas accumulates in a torus well away from the dwarf. Main minimum light contribution is from the hot spot.

Accretion onto the surface of the dwarf with release of gravitational energy occurs in bursts, and gives rise to dwarf nova outbursts.

Cataclysmic systems between outbursts will be seen as nova-like objects, but continued observation should prove these to be subject to recurrent nova, nova or dwarf nova explosions.

Quasi-periodic variations in dwarf novae In Ap. J. Suppl. 39 (4) 461 - 480 (1979), Robinson and Nather discuss variations found in U Gem, SS Cyg, RU Peg, KT Per and VW Hyi (all dwarf novae) and also in the X-ray source Sco X-1. Mean periods range from 32 s in SS Cyg to 147 s in KT Per and 165 s in Sco X-1. Amplitudes are small, typically 0.005 - 0.01 mag. Oscillations only occur during outbursts of the dwarf novae, and when Sco X-1 is bright. The authors argue that they are produced by the accretion disk, not by the stars or the boundary between the disk and the central star. As the disk itself is not responsible for any X-ray flux, they predict that quasi-periodic variations will not be seen in the X-ray flux of SS Cyg.

Nova-like object in Vulpecula The true nature of this object remains obscure. All recent observations agree that it is remaining steady at around 9th magnitude. A plot of recent TA data indicates mag 8.9 with the scatter being from about 8.7 to 9.1.

LPV Predictions Members will note that the 1980 LPV predictions given overleaf differ from those given in the 1980 Handbook, due to the use of improved data.

Changes of Address

BELL, M. now 38 Malton Road, North Hykeham, Lincoln.

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Welcome back

MILLER, I. 37B Queens Road, Sketty, Swansea, West Glamorgan SA2 OSB

Last SAE reminder Bell, M. Brelstaff, T. Brookman, C.E. Davies, A. Duffill, K. Espey, B. Hapgood, M. MacLeod, R.M. Munford, C.R. Paterson, R. Porter, A.K. Price, M. Stott, D. Taylor, P.B.

BAA VSS - LPV predictions for 1980 - selected stars only
(All dates are only approximate.)

Star	Range M	Range m	Period d	(M-m)/P	Max.	Min.
R And	6.9	14.3	409	0.38	Apr 10	Dec 20
R Aql	6.1	11.5	291	0.42	Mar 26	Sep 11
X Cam	8.1	12.6	144	0.49	-	Mar 08
					May 18	Jul 30
					Oct 09	Dec 21
S Cas	9.7	14.8	612	0.43	Aug 17	-
T Cas	7.9	11.9	445	0.56	-	May 12
Mira Cet	3.4	9.1	332	0.38	-	May 15
					Sep 18	-
S CrB	7.3	12.9	360	0.35	Jan 13	Sep 03
W CrB	8.5	13.5	238	0.45	-	Mar 24
					Jly 09	Nov 17
R Cyg	7.5	13.9	426	0.35	-	Jul 11
					Dec 07	-
S Cyg	10.3	16.0	323	0.50	-	Jan 21
					Jun 30	Dec 08
Chi Cyg	5.2	13.4	407	0.41	-	Jly 06
					Dec 20	-
SS Her	9.2	12.4	107	0.48	Feb 01	Mar 28
					May 18	Jly 13
					Sep 02	Oct 28
					Dec 18	-
R Hya	4.5	9.5	390	0.48	May 09	Nov 28
U Ori	6.3	12.0	372	0.38	-	May 08
					Sep 26	-
R Ser	6.9	13.4	356	0.41	-	Mar 10
					Aug 03	-
T UMa	7.7	12.9	257	0.41	Mar 21	Aug 20
					Dec 03	-

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