BRITISH ASTRONOMICAL ASSOCIATION

VARIABLE STAR SECTION

CIRCULAR No. 39 1979 JANUARY

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PRIORITY LISTS

Main Programme

W And	T CrB	SU Lac	WZ Sge
RW And	V CrB	X Leo	R Sct
DZ And	V Cyg	AY Lyr	T Tau
UU Aql	BC Cyg	U Mon	SU Tau
RW Aur	Chi Cyg	RS Oph	SU UMa
SU Aur	HR Del	CN Ori	SW UMa
V Cam	T Dra	CZ Ori	CH UMa
S Cas	AB Dra	TZ Per	V Vul
T Cas	RU Her	UV Per	
UV Cas	R Hya	GK Per	

Binocular Programme

V Aql	WZ Cas	V460 Cyg	AG Peg
UU Aur	V377 Cas	U Del	X Per
CO Aur	V465 Cas	EU Del	S Sct
RX Boo	Wr162 Cas	RY Dra	Y Tau
UV Boo	W Cep	X Her	BU Tau
X Cnc	RW Cep	IQ Her	Z UMa
RS Cnc	SS Cep	OP Her	RY UMa
V CVn	AR Cep	g Her	
Y CVn	AF Cyg	Y Lyn	
TU CVn	CH Cyg	BQ Ori	

Underobserved binocular stars

RS And	FZ Cep	SX Lac	TV UMa
SU And	33 Cet	RX Lep	V UMi
V Ari	RU Cyg	RV Mon	RW Vir
RV Boo	V1351 Cyg	SX Mon	RX Vir
RW Boo	NQ Gem	GO Peg	SW Vir
W CMa	U Hya	AD Per	BK Vir

OBSERVATIONS PLEASE Both SS Cygni and WZ Sge are the subject of considerable current interest. Could all observers who have made estimates of either star in the period 1978 Dec 1 to date, please communicate their data to the Director as soon as possible. (Any 1978 results should, of course, have also been submitted to the Secretary by now, in the usual way.)

Anyone with the opportunity to do so is strongly urged to obseve both stars in the coming couple of months, when they are poorly placed. Even one or two estimates from each of several observers will be very valuable.

WZ Sge News of the third observed outburst of this recurrent nova, or very long-period dwarf nova, came just as the last VSSC was about to be distributed. Observations to date show a max of about 7.9 around Dec 1, followed by a slow fall to 11.0 at the end of 1978. A more rapid drop then set in, to 12.8 at Jan 3. [A recovery to ≈ 11.0 on 1979 Jan 8 - 9 was first noted by Tony Porter and confirmed by Branchett, Hurst and Withers. The last positive observation was 11.4 on Jan 13 (Hurst) - SRD.] The star does not seem to obey the 'rate of decline' relationship, except perhaps for the rapid January fading. Jeremy Bailey and others have pointed out that the two cycles observed are the same to within a couple of months, or less than one per cent of the recurrence period.

Recent Papers of Interest [We had hoped to include an abstract of the paper by A.D. Mallama and V.L. Trimble in Q. Jl. R. astr. Soc. 19 430 - 441 (1978) on 'Novae versus Dwarf Novae: Energy Sources and Systematics'. This has unfortunately not been possible due to unexpected pressure of work, but it will be included in the next Circular.]

Summary of 'The Explosions of Novae' by G.T. Bath (Q. Jl. R. astr. Soc. 19 442 - 455 (1978)), prepared by Jeremy Bailey.

This paper is a review of recent work on dwarf novae and classical novae with particular reference to the outburst mechanisms of these objects. Kraft in 1962, showed that both dwarf novae and classical novae were close binary systems. This discovery led to the currently accepted model of these objects. They consist of a low-mass main sequence star filling its Roche lobe and transferring material onto its white dwarf companion. The transferred material forms an accretion disk around the white dwarf and the energy released in the disk can contribute a large fraction of the luminosity of the system.

Observations of dwarf novae, in particular Warner's photometry of Z Cha during outburst, have shown that it is the accretion disk which brightens during dwarf nova outbursts. This is thought to be caused by a sudden increase in the accretion rate onto the white dwarf. Thus if accretion onto the white dwarf does not occur at a steady rate, but rather in a series of bursts, the outburst behaviour can be explained.

This leaves the controversial question of what cuases material to accrete in bursts. Bath argues for the model that he has largely been responsible for developing - that the outbursts are due to instability in the main sequence secondary. Some other astronomers propose that instability in the disk itself is the cause of the outbursts, as described in the paper by Mallama and Trimble in the same issue of QJ. Bath's theoretical studies of a main sequence star filling its Roche lobe have shown that it exhibits instabilities of just the right type required to explain dwarf nova outbursts. The star loses mass in bursts, each of about $10^{-11} M_{\odot}$ with an interval between bursts of around 30 days, comparable with the observed intervals between dwarf nova outbursts.

Classical novae have a similar binary structure to dwarf novae, but their outbursts are very different. They are much more energetic, and involve ejection of around $10^{-5} M_{\odot}$ from the binary system. Bath points out that the luminosity of novae during outburst (about 10^{38} erg s^{-1}) has a special significance. It is the Eddington limit for a solar mass star. This is the level at which the outward pressure of radiation balances the inward pull of gravity. This strongly suggests that mass loss from a nova is a continuous process being driven by radiation pressure from the central object.

The energy source in nova outbursts is probably runaway nuclear burning, on the white dwarf, of hydrogen-rich material accreted from the companion. However, Bath suggests that accretion energy may also play a part in some novae, and may be responsible for the novalike outbursts of symbiotic stars (Z And stars), and the outbursts of recurrent novae (as suggested by Webbink, see VSSC 29 and 32).

Finally, Bath mentions the X-ray novae (or transient X-ray sources) and suggests that these are binary systems similar to the novae but containing a neutron star instead of the white dwarf.

R CrB In Astronomy and Astrophysics 70, L45 (1978 Dec) Querci and Querci report the detection of the infrared $\lambda = 10830$ Helium line in the spectrum of R CrB in 1978 January, when the star was rising from minimum at $\approx 7^m$. The line shows a P Cygni profile, indicating an expanding gas shell; the line forms in conditions of high temperature (>20 000 K) and density ($>10^{12}$ cm^{-3}).

VW Hydri In the same issue of Astr. & Astrophys. (L65), Papaloizou and Pringle propose an explanation for the 'superhumps' observed in the light-curve of the SU UMa-type dwarf nova VW Hyi. Like many other dwarf novae this star shows a 'hump' at minimum light due to the varying visibility of a bright spot (where a stream of material from the red secondary component strikes the disk of gas circling the white dwarf) around the orbit. Naturally, it repeats with the orbital period.

During supermaxima a 'superhump' with a significantly longer (≈ 3%) period is observed. Papaloizou and Pringle suggest that, as in the AM Her variables, the accreting white dwarf is highly magnetised and almost co-rotating with the orbital period. They then identify the quiescent hump period with orbital motion, and the 'superhump' period with the white dwarf rotation, since material accreting along the magnetic field lines should form bright spots at the poles.

U Geminorum The 1978 Dec 15 issue of Ap.J. Letters (volume 226) contains two papers detailing the discoveries of soft (p 129; Mason, Lampton, Charles and Bowyer) and hard (p 133; Swank, Boldt, Holt, Rothschild and Serlemitsos) X-rays from U Gem. Both sets of data were collected during the 1977 Oct outburst of this variable, and the first paper cited contains an optical light-curve incorporating (unfortunately meagre) VSS observations made during this time.

No soft (0.15 - 0.5 keV) X-ray emission was detected during quiescent phases, at a level at least 100 times less than the peak outburst flux. During outburst, the flux appeared to be highly variable on a timescale of hours, possibly due to an orbital phase-dependence.

The hard (2 - 10 keV) flux appeared with the rise to optical maximum, about half a day before the onset of detectable soft X-rays, and persisted for about two days, fading away while optical maximum continued. Rather similar beheviour has been reported for SS Cygni by Ricketts, et al. (see VSSC 35, 1). No clear orbital phase-dependence is present in the hard X-ray data.

<u>SS Cygni</u> In the same issue of Ap.J. Letters (<u>226</u>, 137 (1978)) Patterson, Robinson and Kiplinger report on their high-speed (4-second integrations) optical photometry of SS Cygni, taken when the star was in outburst (1976 October). Low amplitude ($\approx$ 1%) 'flickering' is present in their data, together with a low amplitude periodic variation. The period found by power spectrum analysis is 9.735 $\pm$ 0.002 seconds, and the full amplitude only 0.0004 magnitudes. A pulsed fraction of up to 50%, at a period of 8.9 seconds, has been reported in the soft X-ray flux of SS Cyg during eruption. The small difference in the optical and X-ray periods, which were determined at different epochs, is entirely consistent with the small period changes observed in other dwarf novae.

<u>Nova Cygni 1978</u> M.H. Slovak and S.S. Vogt (Nature, <u>277</u>, 114 (1979)) use the equivalent width of the λ 7699 K I line to estimate a reddening of E_{B-V} = 0.38 $\pm$ 0.08 for Nova Cyg 1978. From a distance-reddening law established for field stars they find that this corresponds to a distance of 3.3 $\pm$ 0.6 kpc and hence M_V = -7.5 $\pm$ 0.5.

Givricin et al. report high-speed white-light photometry of the nova near maximum (IBVS 1524). The star showed flickering of up to $0^m.05$ amplitude, but no stable periodic variations.

<u>HR Delphini</u> J.B. Hutchings, Dominion Astrophysical Observatory, announces in IAU Circ. 3310 that Nova Del 1967 has been found to have a spectroscopic orbit of period $0^d.170$. The orbital inclination is about 45°.

<u>LPV Predictions</u> Overleaf are given data on Mira stars on the current VSS programme; headings should be self-explanatory. The predictions for maxima and minima supersede those in the current Handbook. Question marks are given for stars without maxima recently observed by the VSS. These objects are particularly deserving of attention.

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LPV Predictions, 1979

Star	Mean Range	P	(M-m)/P	Max.	Min.
R And	6.9 - 14.3	409[d]	0.38	Apr 10	Dec 19
W And	7.4 - 13.7	396	0.42	?	?
RW And	8.7 - 14.8	430	0.36	May 10	-
R Aql	6.1 - 11.5	291	0.42	-	Feb 12
				and Jun 14	Dec 01
V Cam	9.9 - 15.4	522	0.31	Feb 11	-
X Cam	8.1 - 12.6	144	0.49	-	Jan 16
				Mar 27	Jun 18
				and Aug 17	Oct 30
S Cas	9.7 - 14.8	612	0.43	-	Dec 10
T Cas	7.9 - 11.9	445	0.56	-	Feb 17
				and Oct 24	-
Cet	3.4 - 9.1	332	0.38	-	Jun 03
				and Oct 07	-
S CrB	7.3 - 12.9	360	0.35	Jan 18	Sep 09
V CrB	7.5 - 11.0	358	0.41	?	?
W CrB	8.5 - 13.5	238	0.45	Mar 21	Jly 31
				and Nov 15	-
R Cyg	7.5 - 13.9	426	0.35	-	Jun 01
				and Oct 28	-
S Cyg	10.3 - 16.0	323	0.50	-	Mar 12
				and Aug 21	-
V Cyg	9.1 - 12.8	421	0.46	?	?
Cyg	5.2 - 13.4	407	0.41	-	Jun 10
				and Nov 11	-
T Dra	9.6 - 12.3	421	0.44	Jan 31	Sep 24
RU Her	8.0 - 13.7	485	0.43	?	?
SS Her	9.2 - 12.4	107	0.48	-	Jan 07
				Mar 4	Apr 25
				Jun 19	Aug 10
				and Oct 04	Nov 27
R Hya	4.5 - 9.5	390	0.48	May 02	Nov 20
SU Lac	?	319	0.4	?	?
U Ori	6.3 - 12.0	372	0.38	-	May 28
				and Oct 16	-
R Ser	6.9 - 13.4	356	0.41	-	Mar 01
				and Jly 25	-
T UMa	7.7 - 12.9	257	0.41	-	Mar 31
				and Jly 14	Dec 12

Last SAE Reminder

Bailey, J. Brady, K. Brundle, L.K. Bullivant, J.S. Chambers, R.H. Cicognani, A.J. Currie, M. Kay, S.J. Kennedy, B. McGenity, P. McNaught, R. Smith, E.H. Spalding, G. Webb, A.J. Withers, P.B.