The British Astronomical Association

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VARIABLE STAR SECTION
CIRCULAR 65

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Change of Director

On 1987 July 1, Council appointed John Isles as Director of the Variable Star Section, Doug Saw having expressed a wish to retire, after several years as Director. Doug will, however, be continuing to help the Section with the reduction and analysis of observations, in particular those related to telescopic objects. He is also the person to be contacted on routine matters. Please refer any persons wanting to join the Section to Doug, rather than to John Isles.

Please note John Isles' address in Cyprus, given inside the front cover. General correspondence may be sent to him there, but all bulky material, requests for eclipsing binary charts and report forms, and observational reports should be sent care of the London address, which is also given.

Editorial

The Assistant Director wishes to apologize for the fact that no *Circulars* have been issued in the past year, but as many members will be aware, he has been faced with quite unexpected, extreme, and unprecedented problems since becoming President of the Association last October. Under these exceptional circumstances, most personal and BAA matters have had to be held in abeyance. Although the difficulties are by no means overcome, it is hoped that regular publication of the *Circulars* will now be resumed. However, we would remind members that publication cannot take place without suitable material. Please consider writing a contribution on any interesting work that you have carried out concerning any class of variable stars, or related topics. All material should be sent to Storm Dunlop.

Erratum

In *Circular* 63, p.2, an error occurs in the report on RS Oph. Thirteen estimates are credited to Ian Middlemist. The actual observer was R.W. Middleton, to whom we apologize for this mistake.

'Variable Stars' by Hoffmeister/Richter/Wenzel

Members will recall that some time ago we hoped to obtain a preferential price for this book by being able to order a quantity. Because of changes in the exchange rate the basic price (£50) became too high for most members to contemplate, even with a discount, so the matter had to be left in abeyance. We are now delighted to announce, however, that special arrangements have been made so that we are able to offer copies of this book at a price of £27, plus postage and packing (the latter amounting to about £1.80 for UK members). Anyone who is interested in having a copy of this book at this price, and who has not already indicated their interest should contact Storm Dunlop as soon as possible. An initial order has already been placed, and another is just being prepared.

Rho Cassiopeiae

In the note issued with *Circular* 64, we called members' attention to ρ Cassiopeiae, because it was believed that a deep fade might be imminent. Unfortunately this did not prove to be the case, and the star actually recovered quite rapidly from a magnitude of around 5.1-5.2 at minimum. If anything it then exceeded its usual brightness of around 4.6-4.8, being about 4.2-4.3 in 1986 December and 1987 January.

The GCVS extreme range of this object is 4.1-6.2 V. A peculiar fade began in 1945 November, and lasted for 165 days. A deep minimum of 320 days then occurred, centred on 1946 September, but the star recovered normal brightness by 1947 July. Since that period little significant activity has been noted.

The star warrants observation, and a chart is given opposite. This is drawn from the standard VSS chart for γ and ρ Cas (i.e. sequence no. 064.01). Any significant variation should be reported to Melvyn Taylor.

Binocular Programme Summary: 1986 - M.D. Taylor

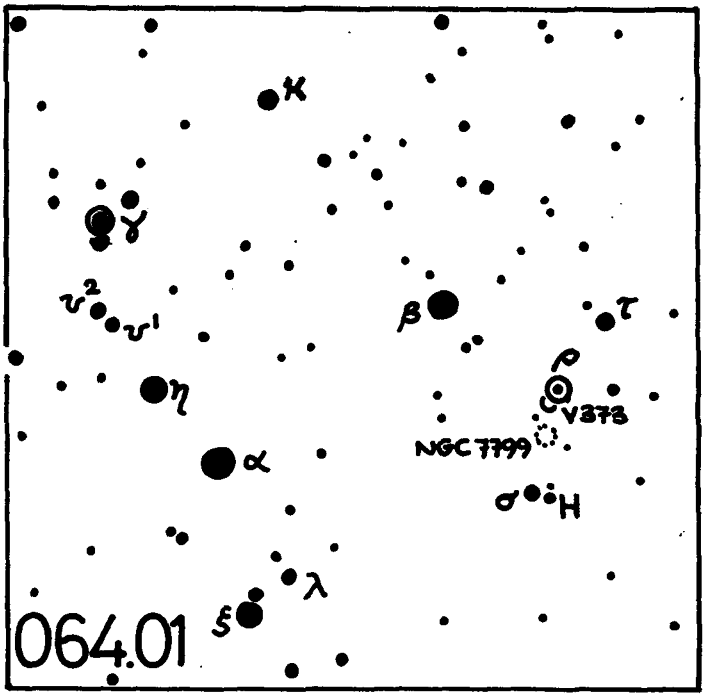
Forty-two observers submitted 22 873 light estimates of binocular variables on the Section's programme during 1986. One dozen observers contributed 86% of this total, with the principal observers being S.W. Albrighton (5274); T. Markham (3608); R.B.I. Fraser (1953); G. Ramsay (1659); I Middlemist (1368); A. Hutchings (1365) and R.A. Kendall (1128). D.M. Swain, M.D. Taylor, B.R.M. Munden, J.S. Smith and W.J. Worraker all presented more than 450 estimates. (Shaun Albrighton's grand total includes a mammoth 1355 of NSV 02537 in Auriga, a possible flare star, and 824 estimates of the γ-Cas-type V2048 Ophiuchi, which is catalogued as having rapid flares.)

Variables well-covered include:

CH Cyg	(765 estimates)	5.60 - 8.49 V	Z And + SR
X Per	(433)	6.0 - 7.0 V	γ Cas
V465 Cas	(427)	6.2 - 7.2	SRb
AE Aur	(341)	5.78 - 6.08 V	Ina
AF Cyg	(332)	6.4 - 8.4	SRb
P Cyg	(329)	3 - 6 V	S Dor
AR Cep	(316)	7.0 - 7.9 V	SRb
BU Tau	(307)	4.8 - 5.5	γ Cas
RY Dra	(305)	6.03 - 8.0 V	SRb: 200 d
AG Peg	(287)	6.0 - 9.4	Z And

234956 23h 54.2m +57° 29′ (2000)

Rho Cassiopeiae



scale 10° 75mm

θ Cas C 4·33 σ Cas E 4·89

λ Cas D 4·73 H 5·56

Some variables remain grossly underobserved, notably:

SU And	RU Cyg	IQ Her	RX Vir
TZ And	V1351 Cyg	U Hya	SS Vir
BZ And	DW Gem	SX Lac	SW Vir
W CMa	SX Her	RW Vir	BK Vir

Stars suspected of variability: SAO 037607 (And), 6.0-6.7 ?; NSV 00021 (Cas) 7.0-8.0 ?; and NSV 03597 (Lyn) 6.69 ?, should be regarded as worthy of closer attention in future.

UV Boötis and V377 Cassiopeiae have been dropped from the programme as the latest catalogue shows them as: CST: 8.11-8.16 V, and δ Sct: 7.78 - 7.83 V, P = 0.03 d, respectively.

The following bright variables are on the binocular programme: some may be of interest to observers using photoelectric methods, allowing far more accurate estimation than visual means:

ψ^1 Aur	4.8 - 5.4	Lc ?	RX Lep	5.0 - 7.4	SRb
W Boo	4.7 - 5.4	SRb	R Lyr	3.9 - 5.0	SRb
VZ Cam	4.80 - 4.96	SR	δ^2 Lyr	4.22 - 4.33	SRc ?
μ Cep	3.6 - 5.1	SRc	S Mon	4.62 - 4.67	Ia ?
T Cyg	5.0 - 5.5	Lb ?	V2048 Oph	4.55 - 4.85	γ Cas
P Cyg	3 - 6	S Dor	TX Psc	4.9 - 5.8	Lb
BQ Gem	5.1 - 5.5	SRb	TV Psc	4.65 - 5.42	SR
g Her	4.3 - 6.3	SRb	BU Tau	4.8 - 5.5	γ Cas
U Hya	4.3 - 6.5	SRb	RR UMi	4.5 - 5.3	SR ?

Binocular Programme, 1986: Observer Estimate/Star Totals

Albrighton, S.W.	5274	139	Maris, G.	119	9
Allmand, S.	31	13	Markham, T.	3608	154
Beveridge, M.	412	20	Mettam, P.J.	132	8
Bone, N.M.	402	30	Middlemist, I.A.	1368	71
Collinson, E.H.	33	14	Munden, B.R.M.	603	37
Comeron, F.	32	1	Nicholls, M.	34	5
Duncan, H.G.	118	10	O'Neill, P.	141	16
Edwards, A.R.	62	7	Privett, G.	69	11
Ells, D.J.	11	4	Ramsay, G.	1659	9
Fraser, R.B.I.	1953	142	Shanklin, J.	47	11
Horton, A.	1	1	Smeaton, A.	62	17
Howarth, J.J.	244	7	Smith, J.S.	564	33
Hufton, D.	178	38	Srinivasan, C.S.R.	333	22
Hurst, G.M.	89	10	Stott, D.	58	1
Hutchings, A.	1365	46	Swain, D.M.	934	66
Isles, J.E.	47	29	Tanti, T.	99	18
Kendall, R.A.	1128	48	Taylor, M.D.	880	79
Kiernan, N.S.	30	1	Thorpe, J.	80	16
Kimber, A.J.	6	1	Watts, R.	39	8
Knight, N.F.H.	8	1	Woodbridge	16	4
Livesey, R.J.	134	8	Worraker, W.J.	470	33

Binocular Programme, 1986: Star Totals

RS And	68	NSV 00021	47	UX Dra	148	BQ Ori	87
SU	41	NSV 00436	114	VW	124	CK	108
TZ	52	NSV 00650	256	AH	148	NSV 02917	101
AQ	68	021020 *	69	AT	180	AG Peg	287
BZ	26	W Cep	207	Fl 69	90	GO	93
037607 *	11	RU	118	TU Gem	94	X Per	433
V Aql	155	RW	246	TV	138	SU	98
V450	137	RX	267	WY	132	AD	88
V1293	136	SS	150	BN	212	KK	61
NSV 12088	131	AR	316	BQ	74	PR	94
V Ari	58	DM	227	BU	152	Z Psc	68
UU Aur	232	FZ	85	DW	23	TX	72
AB	271	μ	101	IS	63	TV	94
AE	341	NSV 13656	85	+23 1192	70	S Sct	110
ψ^1	65	NSV 13729	73	X Her	228	Y Tau	92
NSV 02537	1471	NSV 14680	146	ST	60	TT	66
W Boo	104	RR CrB	123	SX	15	BU	307
RV	65	SW	124	UW	110	CE	81
RW	70	T Cyg	72	IQ	42	NSV 01280	88
RX	83	RU	45	OP	202	NSV 01702	60
UV	97	RV	128	V566	138	W Tri	71
U Cam	109	TT	69	g	230	Z UMa	213
RY	134	AF	332	U Hya	43	RY	236
ST	123	CH	765	SX Lac	52	ST	144
UV	134	V460	189	NSV 14213	146	TV	84
VZ	137	V973	241	NSV 14260	119	VW	184
ZZ	133	V1351	29	RX Lep	68	VY	197
+61°0668	137	V1624	103	Y Lyn	133	V UMi	140
X Cnc	140	P	329	SV	77	RR	139
RS	177	NSV 12247	54	NSV 03597	45	RW Vir	33
RT	67	NSV 12439	50	R Lyr	125	RX	28
V CVn	202	NSV 13874	66	XY	178	SS	44
Y	172	NSV 13857	74	δ^2	112	SW	30
TU	153	+47°2801	75	S Mon	135	BK	41
W CMa	35	U Del	249	RV	65		
WZ Cas	197	EU	245	SX	53		
V377	109	NSV 13150	95	X Oph	120		
V391	181	RY Dra	305	V2048	1047		
V393	198	TX	177	W Ori	94		
V465	427	UW	115	BL	111		

* SAO star number

Total no. of light estimates in 1986: 22 873 (42 observers)

Miscellaneous Binocular Variables: 1986

RS And (7.0-9.1, SRb, 130 d, M7)
Fading from about 8.4 at the beginning of the year to 9.0 in early March. The star was next seen in late May, and from July to September brightened from 8.8 to about 7.8, subsequently fading to 8.7 by the year's end.
68 estimates by: Fraser, Isles, Markham, Middlemist & Taylor

SU And (8.0-8.5, Lb, N)
About 8.6 in Jan.-Feb.; no observations March to May. Minor variations about mean magnitude 8.3 from June-December.
41 estimates by: Albrighton, Allmand, Fraser, Isles, Markham, Middlemist & Taylor

TZ And (7.6-9.0, SRb, M6)
Magnitude 8.7 from Jan. to early March; 8.5/8.8 June-December, with possible maximum about 8.5 early September.
52 estimates by: Albrighton, Allmand, Fraser, Isles, Markham, Middlemist & Taylor

V Aql (6.7-8.2, SRb, 353 d, N6)
Magnitude 7.4 in April fading to 7.9 in early August; rising to 7.2 in early November, then a fade to 7.5 in December. (Large amount of scatter.)
155 estimates by: Albrighton, Bone, Fraser, Hutchings, Knight, Markham, Middlemist, Srinivasan, Swain, Tanti & Taylor

U Cam (7.7-8.7, SRb, N5)
Varying 8.1 to 8.8 during the year. Maxima appear about Apr.24, 8.3 and Oct.24, 8.1. Magnitude 8.8 by end of December.
109 estimates by: Albrighton, Fraser, Markham & Worraker

W Cam (6.9-7.5, Lb, N)
About 7.3 Jan. to mid-Apr. and Oct.-Dec.
35 estimates by: Fraser, Markham, Swain & Worraker

RU Cyg (8.0-9.4, SRa, 234 d, M6)
During Jan.-Feb. magnitude 9.2; May-Aug., 8.6-8.5; Sep.-Dec. 8.5-8.7, with possible rise to 8.5 in early December.
45 estimates by: Fraser, Isles, Middlemist, Markham & Taylor

UW Dra (7.0-8.2, Lb?, K5)
Mainly 7.5-7.8 all year.
115 estimates by: Albrighton, Fraser, Kendall & Markham

SX Her (8.0-9.2, SRd, 102 d, G3-K0)
15 estimates by: Albrighton, Fraser, Isles & Markham
Deserves much better coverage. Rising 9.4 March/April to 8.0 in June; 8.1 in September, 8.8 by end of December

UW Her (7.8-8.7, SRb, 103 d, M5)
Main variation 7.8 to 8.5. Magnitude 8.3 Jan.-Feb., rising to 7.8 in Apr./May then fading to indistinct minimum in June. Magnitude 8.0 to 8.2 in August, fading to 8.5 in mid-October and rising to 8.0 by December

IQ Her (6.99-7.47, SRb, 75 d, M4)
Main variation 7.2-7.6: 42 estimates by: Fraser, Markham & Swain

U Hya (4.3-6.5, SRb, 450 d)
Fading Jan.-Apr. 5.7 to 6.1, and in May 6.0. Oct.-Dec. 5.6-5.2. 43 estimates by: Albrighton, Markham, Ramsay, Srinivasan, Taylor & Worraker

RX Lep (5.0-7.4, Lb, M6)
Jan. to mid-April about 6.2; Sep. to Dec. 6.2 to 6.4; possibly brighter (6.1) in early Dec., then fade to 6.4 at end of year. 68 estimates by: Albrighton, Fraser, Markham, Srinivasan & Worraker.

Y Lyn (6.9-8.0, SRc, 110 d, M5)
Rising (Jan.) 7.8 to maximum 6.9 in late February then 7.7 mid-May. Rising June to ill-defined maximum. In July 7.3, fading to 7.6 early Sept.; rising to maximum about 6.7 in November; 7.4 by end of December. 133 estimates by: Albrighton, Allmand, Fraser, Markham, Middlemist, Ramsay, Shanklin, Smith, Swain & Worraker

R Lyr (3.9-5.0, SRb, 46 d?)
Much scatter but mean variation 4.3-4.8. 125 estimates by: Albrighton, Bone, Fraser, Kendall, Markham & Taylor

X Oph (5.9-9.2, M, 334 d, M6)
Few observations Jan. to Apr. during which 7.9 to 9.1 minimum in mid-May, rising to 6.9 maximum in mid-Oct.; 7.7 in mid-December. 120 estimates by: Fraser, Markham, Middlemist, Shanklin, Swain, Taylor & Worraker.

BQ Ori (6.9-8.9, SR, 110 d, M5)
Some observers have identification problems, which are reflected in some light-estimates that have been omitted. Rising, 8.3 in Jan. to maximum 7.6 in early March; fading to 8.4 in Apr./May. In Sept., 7.8 rising to long max. centred mid-November at 7.5/7.6, then 8.2 at end of the year. 87 estimates by: Albrighton, Fraser, Markham, Shanklin, Smeaton, Srinivasan, Swain, Tanti & Taylor

GO Peg (7.1-7.8, Lb, M4)
Magnitude 7.8-8.0 in Jan., and May to Aug. Brighter, at 7.8 in September with a fade to 8.1 the 8.1 to 7.8 to end of year. 93 estimates by: Albrighton, Fraser, Hufton, Isles, Markham, Middlemist, Ramsay, Taylor & Worraker

RW Vir (7.0-8.2, Lb, M5)
Jan. to May 7.3/7.5 and about 7.5 during December. 33 estimates by: Albrighton, Fraser, Markham, Srinivasan & Worraker

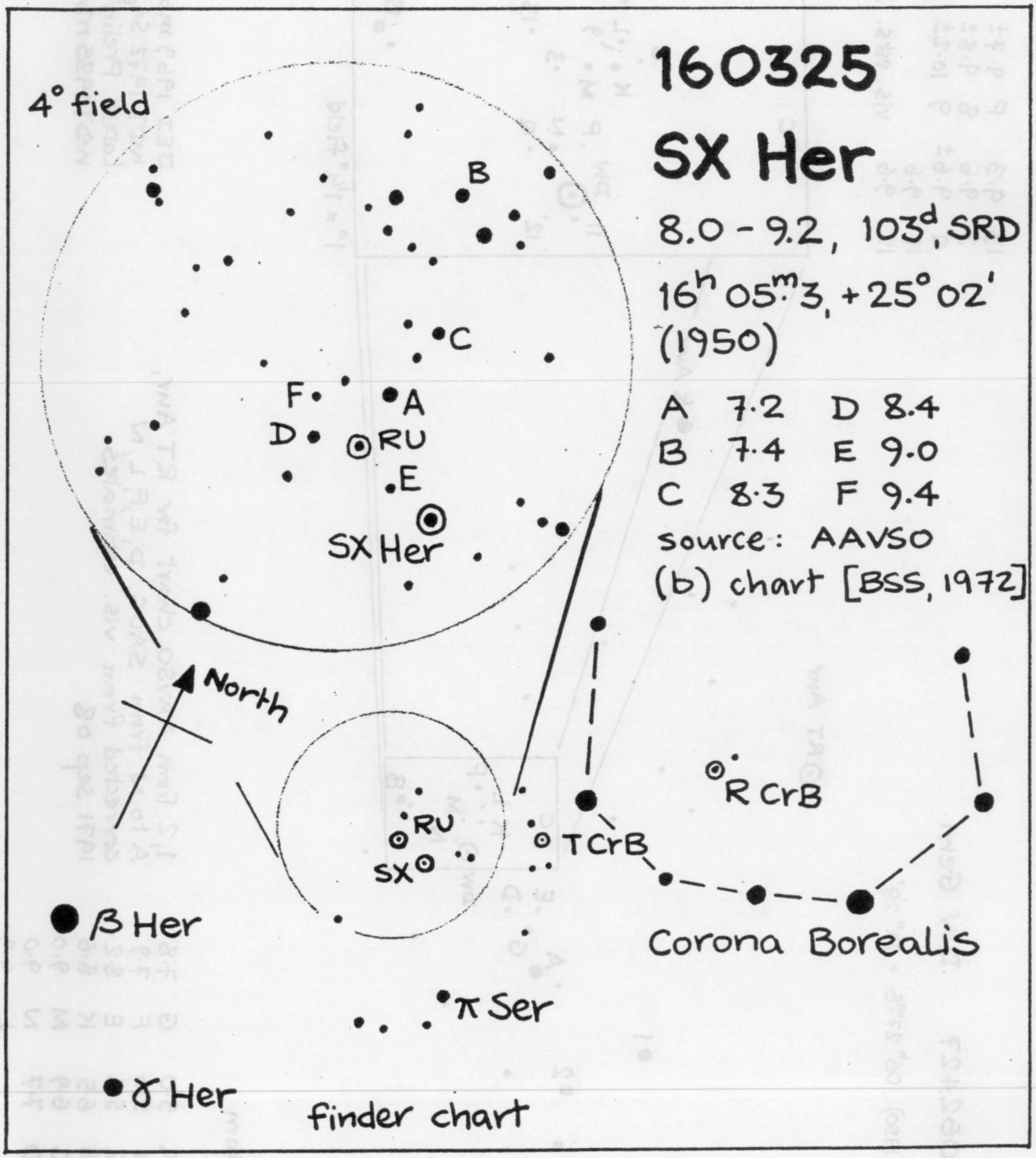
SS Vir (6.0-9.6, M, 355 d, N)
Well-observed fade from 7.3 in Jan. to 9.8 early Jun. No observations Jly to Nov. Mean mag. 7.5 in Dec. 44 estimates by: Albrighton, Fraser, Markham, Srinivasan & Worraker

BK Vir (7.9-8.7), SRb?, 150 d?, M7)
Fading, 8.0 in Jan. to 8.4 in April, and then possible rise to 8.2 in May. Mean mag. 8.5 in December. 41 estimates by: Albrighton, Fraser, Markham, Srinivasan & Worraker

The above 'red' variables have been less well-observed over the years. Sometimes results are difficult to interpret, especially when few estimates are available, or if several observers have not contributed a continuous set of consistently produced estimates. It is notoriously difficult to make estimates of 'red' variables, and there are methods that will minimize observational errors. The practice of using an instrument that does not allow strong star colour to be seen is sound advice. (A large aperture may be reduced in size by using a set of card 'caps' in which smaller apertures than that of the instrument have been cut. Use the 'extrafocal' method of estimation, whereby both variable and comparisons are put out of focus, and a fractional estimate is made in the usual way. First and foremost, to use a consistent mode of estimation: 'quick glance' or 'slight stare', and bring the stars into the centre of the field for estimation purposes.) Also use one particular instrument for a certain star. Consistent use of the same comparisons is to be preferred to 'experimenting' with several. Some careful and experienced observers utilize a fractional estimate in conjunction with step estimate(s) in order to check their observed mean reduced magnitude.

Any members willing to follow one to two of the above stars are invited to do so. As may be seen from the number of estimates used, the VSS needs good-quality observations - and many more than submitted for 1986. Charts for the above may be obtained from Melvyn Taylor. A redrawn version of the SX Herculis chart, a grossly under-observed SRd-type variable, is shown for the benefit of potential observers. Another grossly under-observed star is DW Gem. In this case the existing chart is unsatisfactory and is scheduled to be redrawn. It is, however, shown here together with a section of a photograph of the region, taken specially for us by Charles Scovill.

The data given in parentheses above describe the range from max. to min, (generally V or m magnitude), the type of variation, the period in days (if known), and the spectrum. This information is derived from that given in the 1976 or 1986 editions of the GCVS and from VSS data.

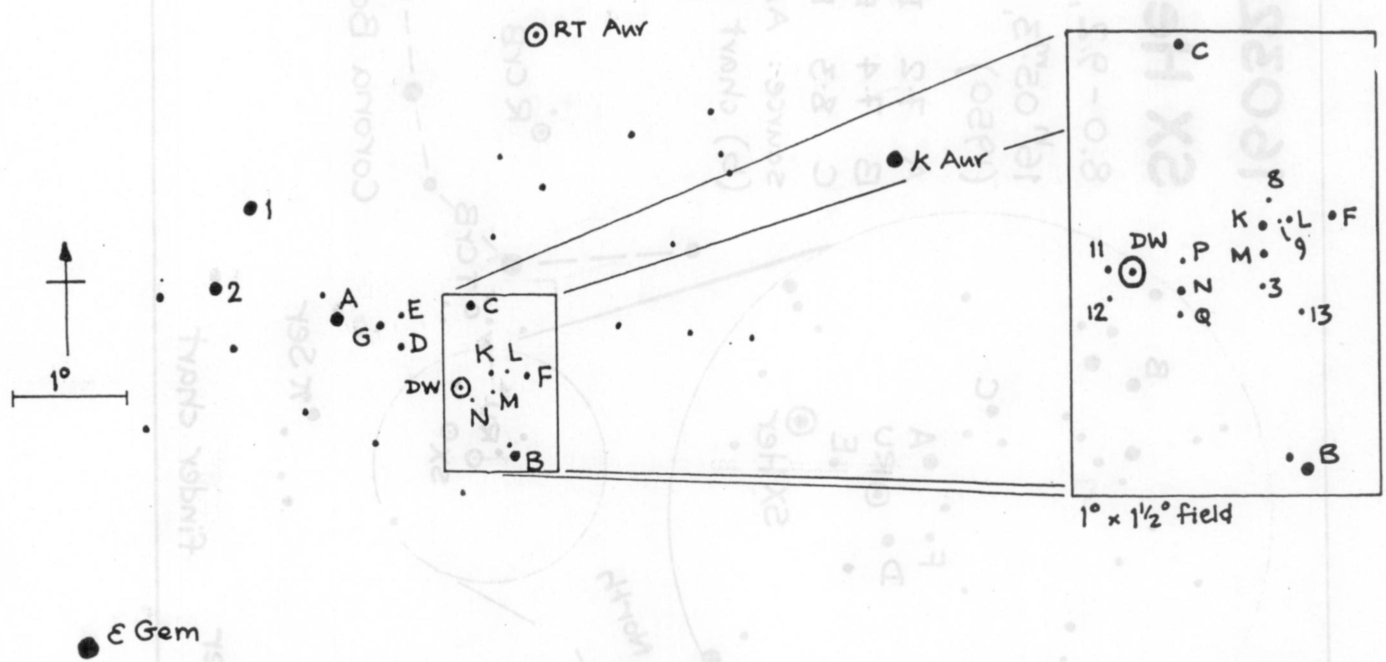

160325
SX Her
8.0 - 9.2, 103d, SRD
16h 05m.3, +25° 02'
(1950)
A 7.2
B 7.4
C 8.3
D 8.4
E 9.0
F 9.4
source: AAVSO
(b) chart [BSS, 1972]
4° field
B
C
F
A
D
RU
E
SX Her
North
RU
SX
T CrB
R CrB
β Her
π Ser
γ Her
Corona Borealis
finder chart

062427 DW Gem

(1950) $06^h\,27^m\!.8$ $+27^\circ\,29'$

13	9.3	P	9.7±
3	9.6	8	9.8±
Q	9.6±	9	10.2±
11	9.6		
12	9.6		

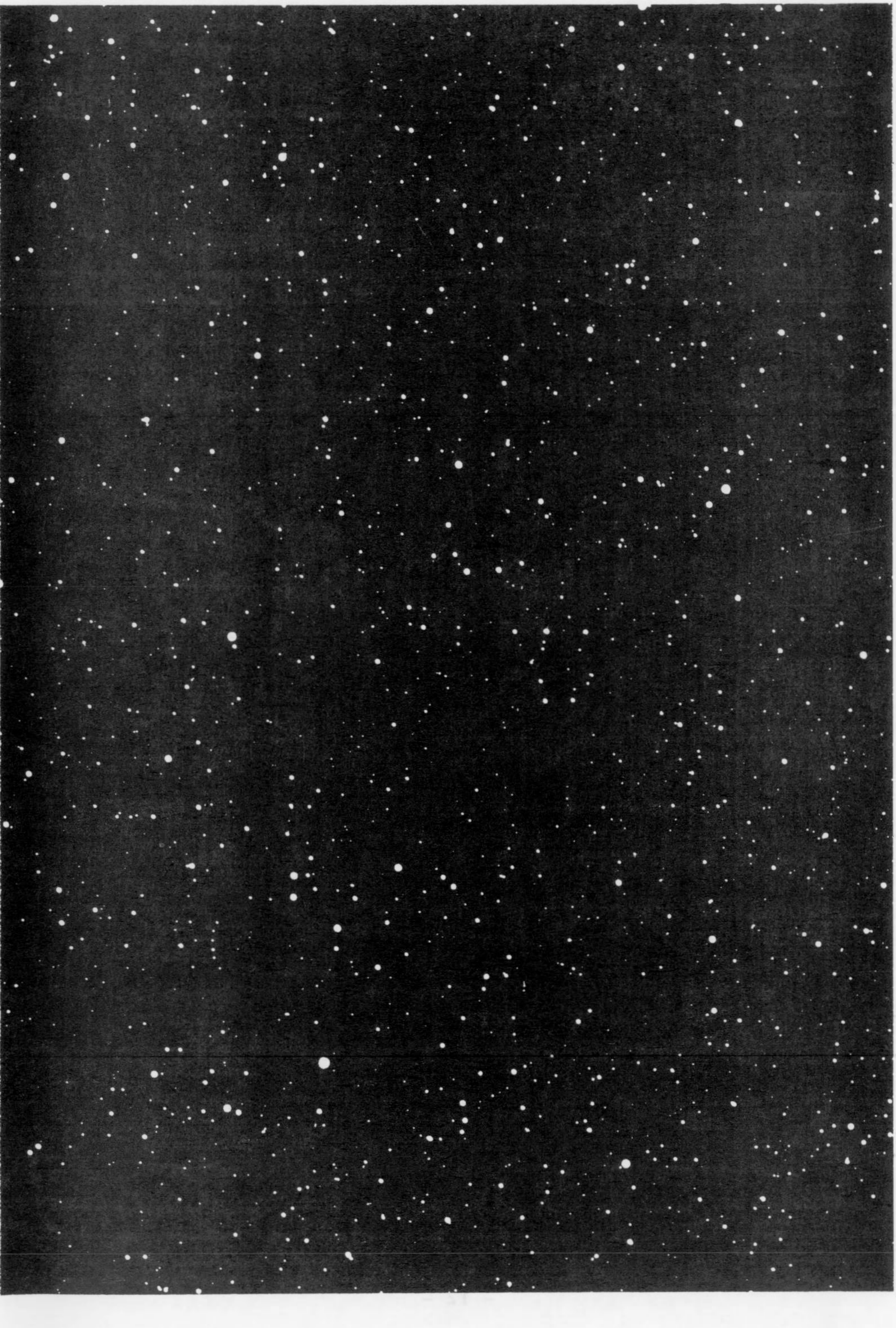
vis. ests. JEI/GC



A	5.0	G	7.8
1	5.6	F	7.9
2	5.8	E	8.2
B	6.5	K	8.6
C	6.9	M	9.0
D	7.7	N	9.0
		L	9.3

1, 2 from AAVSO chart for RT Aur,
A to N from SAOC., D, E, F, L, N
corrected from vis. estimates.
1971 Sep 08

JEI 1969 May 09
MDT 1972 Sep 09
Latest Preliminary:
MDT 1985 Mar 18



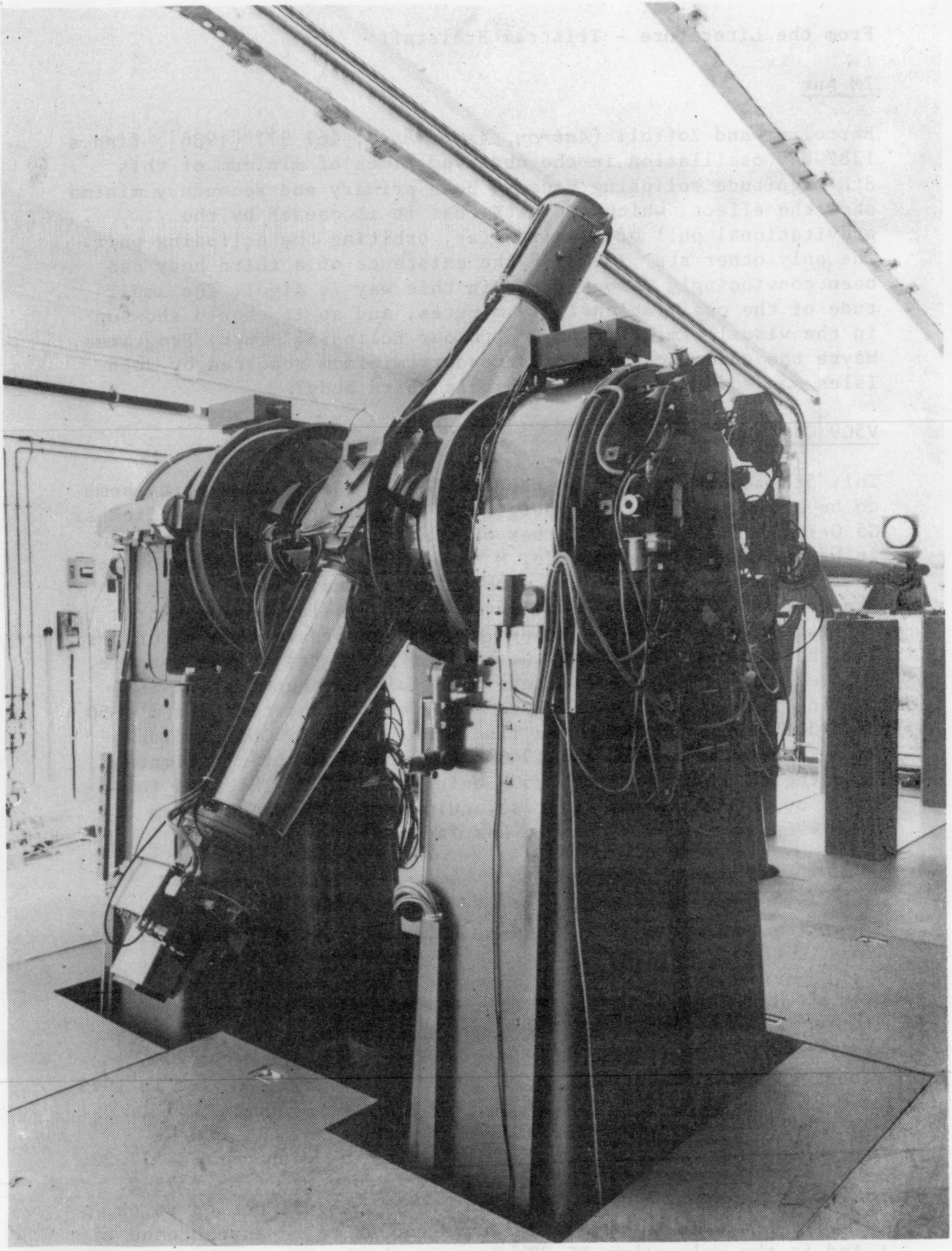
A cautionary tale

Some months ago, the Assistant Director was contacted by Dr R.C. Smith of Sussex University, who asked whether anyone had detected an outburst of HR Del. Dr Smith had devised a method of using the Carlsberg Automatic Transit Circle at the Rocque de las Muchachos Observatory on La Palma to check the magnitude of eruptive variables. As members will probably know, this instrument (opposite), which has a 180-mm OG, is fully computer-controlled. It is programmed to anticipate a transit, move to the correct declination, obtain the time of transit electronically, and then move to the next star on its schedule. Although obviously not equipped for accurate photometry, it is able to monitor the positions of eruptive objects and give an indication of when these brighten.

HR Del was, of course, the famous slow nova that erupted in 1967, and fluctuated markedly both before and after its maximum (3.7) on JD 2 443 9838. The news that it had reached a magnitude of something like 8.5 in 1986 - less than twenty years after outburst - was startling and very exciting. (Novae are not supposed to behave like that!) Moves were immediately put in hand to check with potential observers, although it was thought rather surprising that no-one had reported any outburst. Just as a full-scale alert was about to be announced, a rather crestfallen message arrived - human error had misidentified the star concerned. What had been detected was an outburst of SS Cygni. As in other instances, this serves to emphasize the importance of thorough checking before any announcement of variation is made. However, the technique obviously has considerable potential, although for other reasons, the Carlsberg Transit Circle is not ideal for its implementation. Have we found a use for those finely made, but now largely redundant, transit instruments that were once such an essential part of every observatory, large or small? With computer control on their single axis, and suitable photometers, they could check variables as they crossed the meridian.

Data Protection Act

Under this well-intentioned, but sublimely idiotic piece of legislation, we must inform all members that their names and addresses are held on computer, together with a code number (indicating which publications are received), and information on the number of remaining issues. This list is only ever used for purposes of mailing the *Circulars* and reprints, and is not made available to anyone outside the VSS and the Executive Officers of the Association. Anyone who objects to their name being held in this way should contact Storm Dunlop immediately. [If 'idiotic' seems too strong a word, consider the recent, well-informed opinion that holds that it is illegal to use the computer file to correctly address an individual letter.]



CARLSBERG TELESCOPE

From the Literature - Tristram Brelstaff

IM Aur

Bartolini and Zoffoli (*Astron. Astrophys.*, 167 377 [1986]) find a 1382-day oscillation in the observed times of minimum of this 8th-magnitude eclipsing binary. Both primary and secondary minima show the effect, which suggests that it is caused by the gravitational pull of a third star, orbiting the eclipsing pair. The only other star in which the existence of a third body has been convincingly demonstrated in this way is Algol. The amplitude of the oscillation is 19 minutes, and so it should show up in the visual timings reported to our Eclipsing Binary Programme. Maybe the changing depth of secondary minimum reported by John Isles has something to do with this third body?

V509 Cas

This 5th-magnitude star on the Cas-Cep border is thought by some to be a highly luminous hypergiant. Its spectrum is classified as G5 0-Ia and, if it is a member of the Cep OBI association, then it has an absolute magnitude, M = -9. Such stars are thought to be relatively unstable and, with this in mind, Zsoldos (*The Observatory*, 106 157 [1986]) reviews all available photometric estimates from the 19th-century onwards. Approximate corrections have been applied to bring the earlier estimates to the V-scale. Before 1850 the star could have been fainter than 6 as it is missing from several catalogues compiled at that time. From 1850 to 1900 there was possibly a rise from 6 to 5.5. Observations were then scarce until the 1940's when photoelectric estimates made their appearance with V509 being at 5.36 V. This was followed by a slow, irregular rise, culminating in the maximum of 4.61 V in 1976. Since then it has faded slightly.

RS CVn-type variables

These are late-type binary stars, not necessarily eclipsing, which suffer from star spots. They typically show sinusoidal light variations with ranges of a few tenths of a magnitude and periods of a week or more. Though the periods are reasonably stable, the amplitudes can vary quite a lot from year to year. For example, Busso *et al.* (*Astron. Astrophys.*, 156 106 [1986]) report an increase in the amplitude of UX Ari from 0.03 V in 1979 to 0.28 V in 1984. Poretti *et al.* (*Astron. Astrophys.*, 157 1 [1986]) find that photoelectric estimation of AY Cet can be explained as the combination of 3 sine curves with periods 77.22, 79.36 and 1820 days. The total observed range was 5.43-5.73 V. Spectroscopic observations have shown the orbital period to be only 57.1 days so the rotation would appear to be asynchronous. λ And is the only other RS CVn star in which this has been found.

P Cyg

Van Gent and Lamers (*Astron. Astrophys.*, 158 335 [1986]) reanalyse all available radial-velocity and photoelectric data on this star and find no clear confirmation for any of the suggested periods. However, they do suggest that the radial-velocity variations can be accounted for by repeated shell ejections at irregular intervals on a timescale of 50-100 days.

4 Dra

Reimers (*Astron. Astrophys.*, 142 L16 [1985]) reports the discovery of a faint blue companion to this otherwise unremarkable red-giant star. UV spectra from IUE suggest that the companion is a magnetic white dwarf similar to the cataclysmic binaries, old novae and AM Her stars.

88 Her

Barylak and Doazan (*Astron. Astrophys.*, 159 65 [1986]) give a light-curve for this low-amplitude γ Cas-type star, covering the years 1967-1983, which might be of interest to those observing similar objects on the Binocular Programme. This star showed a slow rise 6.76-6.70 V in 1967-76 and then it faded relatively suddenly to 6.90 in 1977. This was accompanied by the onset of a a shell ejection. There then followed a slow recovery, which brought it back to 6.70 V in 1986.

BX Mon

This star is often quoted as holding the record for the Mira star with the longest period. However, there is now a general consensus that the red-giant in the system is *not* the source of the variations. Spectroscopic studies by Iijima (*Astron. Astrophys.*, 153 35 [1985]) and Viotti *et al.* (*Astron. Astrophys.*, 159 16 [1985]) both come to this conclusion. The former even quotes AAVSO observations for 1979-83, which directly contradict the Mira-type classification. It will probably have to be classified as a symbiotic variable in which the blue component contributes most to the variations.

Rapid Dark-Adaption: Does it Work for You?

The BAA Office at Burlington House recently received an intriguing suggestion from Vic Stryker, Mt Lemon, Arizona as to a rapid method of achieving dark adaption. He claims that a mere few seconds suffice to produce the degree of dark adaption that normally takes 30-45 minutes. This seems almost too good to be true, but we in the spirit of scientific enquiry we pass the method on for members to try.

What is this wondrous method? To quote: "Look down at your feet - while standing - and then blink as hard and as rapidly as you can for a count of 15 seconds. If there is no stray white light contamination about you will become totally dark adapted in just 15 seconds, and ready for your night's observations - to say nothing of being able to quickly find a good seat in a dark theatre!' He cautions people who wear contact lenses to be careful not to dislodge the lenses while using this technique.

Does it work? Initial results, from an admittedly small sample of people, show equivocal results. The accepted theory of vision holds that the pigment rhodopsin is bleached by the action of light and that the reverse reaction is quite slow. Fast blinking presumably could increase the blood supply to the retina, but one would hardly expect this to change to such a degree that any process should be accelerated by some 120 times (or more). But does it work for you? Let us know.

Suspected Variables - Andy Hollis

The list of suspected variables is large, although there are also many variable stars given in the General Catalogue which are now considered to be constant in brightness. VSSC 64 mentions that the criterion for a star to be accused of variability may be no more than that one observer (or perhaps two) may suggest it.

Many of the comparison stars selected by the VSS have been subsequently rejected on this basis, and the note about τ Cas is a typical example.

Perhaps there is a case for vetting the brighter 'rogue' stars photoelectrically. John Percy's comments about τ Cas suggest that no variation could have been observed visually (0.05 mag is well below detectability). Stars brighter than 10 m would be very easy to check with 250-mm- to 300-mm-aperture telescopes.

Although it is relatively easy to prove variability, it is impossible to disprove it. All that can be shown with confidence is that during the period of observations there was no detectable variation. This does not preclude variation at another time - RU Cam stopped varying in the 1960s - or isolated outbursts like those of flare stars. There are also stars that appear constant in visual wavelengths but vary in infrared or short wavelengths.

Might I suggest that the suspected variable comparisons brighter than 10th magnitude are referred to observers equipped for photographic or photoelectric photometry for investigation. The Section would be able to isolate real variability in the stars from errors in observation, and perhaps also identify the type and period, if any, of such variation.

Method

The magnitudes are normalized according to Dworetsky's criterion, equation (10), by using

$$m'_i = (m_i/2\cdot(m_{min} - m_{max}) \quad (13)$$

and the phases calculated using

$$\phi = (t_i - t_0)/P - INT(t_i - t_0)/P \quad (14)$$

where INT = 'integer part of', and t_0 is the zero phase to which all other phases are referred. Although the choice of $t_0 = m_{min}$ would seem the most appropriate and is used for the final graphical display of the phase diagram, the value of t_0 needed for the minimization of numerical errors is the mean value of t, calculated from

$$t_0 = \sum_{i=1}^{n} (t_i/n) \quad (15)$$

The values of are sorted so that all the observations are correctly ordered in phase and trial periods are tested with equal frequency-steps (Table 1) and a value of θ calculated for each step using

$$\sum_{i=2}^{n} [m_i - m_{i-1})^2 + (\phi_i - \phi_{i-1})^2]^{\frac{1}{2}} + \\ + [(m_1 - m_n)^2 + (\phi_i - \phi_n + 1)^2]^{\frac{1}{2}} \quad (16)$$

The smallest value of θ being taken as the most likely period.

The trial periods are chosen so that the maximum difference between the true period and the trial period does not produce a phase error, $\Delta\phi$, between the first and last observations, which produces a significant change in θ. This is arranged by ensuring that

$$\Delta\phi = (t_n - t_1)\cdot\Delta P/2\cdot P^2 < 0.1 \quad (17)$$

As can be seen from equation (17) some compromise is needed between $(t_n - t_1)$ and P in order to keep $\Delta\phi$ sufficiently small. With the values of ΔP given in Table 1 it is advisable to ensure that $(t_n - t_1) < 100$ days when searching for a period in the range 1 to 10 days.

In order to reduce the amount of computer time used, some limit where $e_1, e_2 \ldots e_n$ are independent and identically distributed random errors, and $f(t_i)$ is an unknown periodic function of time:

$$f(t \pm k \cdot P) = f(t) \tag{5}$$

for all values of t where k is an integer and P = period. The phase is given by:

$$\phi(t_i, P) = t \bmod P \tag{6}$$

or the fractional part of $(t_i)/P$ (where $i = 1, 2 \ldots n$) (7).

The test parameter θ measures the dispersion of the observations about a light-curve corresponding to the trial period P. Different methods of PDM techniques differ only in the definition of θ. Lafler and Kinman (1965) use

$$\theta = \sum_{i=1}^{n-1} (m_i - m_{i+1})^2 / \sum_{i=1}^{n} (m_i - \bar{M})^2 \tag{8}$$

where $\bar{M} = \sum_{i=1}^{n} m_i/n$ and n = number of observations.

Burke, Rolland and Boy (1970) use

$$\sum_{i=1}^{n-1} [(m_{i+1} - m_i)^2 + (\phi_{i+1} - \phi_i)^2]^{\frac{1}{2}} \tag{9}$$

This is a true 'string-length' method but Renson (1978) criticized the use of the Euclidean metric on the phase diagram as the coordinates of the points have different units, i.e. magnitude or km/s and unit = trial period. Dworetsky (1983) states that this objection can be overcome by scaling the observations so that

$$m'_{max} - m'_{min} = 0.5 \tag{10}$$

thus giving equal weight to magnitudes and phases in equation (9) for variations consisting of linear rises and falls of equal duration, as

$$\Delta m = \Delta\phi \text{ when } |dm/d\phi| = 1 \tag{11}$$

In order to achieve this, Dworetsky uses

$$m'_i = (m_i - m_{min}/2\ (m_{max} - m_{min}) - 0.25 \tag{12}$$

[As this question is important, we propose to reprint in a later issue John Isles' item, first published some years ago, about the way in which observers may check whether suspected variability is real, before making any public announcement of their suspicions. Visual observers should, however, continue to report any problems to the Secretary, who will be able to check whether others have experienced difficulty with the same object. In many instances, problems may be caused by differences in colour between comparisons, Position-Angle effects, and other known sources of error that affect visual estimates.

RU Cam is a W Virginis star - i.e. a pulsating star, similar to the classical δ Cephei stars, but fainter and belonging to Population II - with a range of 8.10 to 9.79 V and a nominal period of 22 days. Prior to 1964 its amplitude fluctuated by a factor of about 2, but in mid-1964 it suddenly dropped to 0.4 mag and subsequently even less. Changes did not cease entirely, but were just on the limit of photographic (NB: not photoelectric) detectability. From 1967 the amplitude increased. Various suggestions have been advanced to explain this behaviour - such as it being a binary with two pulsating components varying out of phase - but there is still no very convincing explanation of the changes that took place. However, it is now generally accepted as a being single object.)]

Observations of some bright eruptive variables - Tony Markham

This report summarizes my observations in 1985 and 1986 of some eruptive variables that are observable with 10 x 50 binoculars. The observations were carried out in order to compare the catalogued magnitude ranges with actual visual observations. Since these stars typically have small amplitudes and vary quite slowly, it is not possible to draw conclusions about how (if at all) the stars have varied during the two-year period. The table overleaf summarizes my results.

There are several factors that might explain the discrepancies between the mean observed magnitudes and the catalogued magnitude ranges. These include:
(1) The choice of comparison stars and the magnitudes used for these stars - catalogues frequently disagree about the magnitudes of individual stars.
(2) This is a comparison of instrumental magnitudes with magnitudes estimated by the human eye. A photometer's sensitivity to different wavelengths of light can only approximate that of the eye. In any case, it is often the case that some observers will see a particular variable as being systematically brighter or fainter than will other observers (Personal Equation).
(3) True variation - the variable may have faded or brightened to move outside its catalogue range.

Star	RA (2000.0) hr min	Dec ° '	Range	Type	Obs.	Scatter	Mean	SD	Chart
EG And	00 44.6	+40 41	7.08-7.8	Z And	13	7.4-7.6	7.48	0.06	TS
KK And	23 07.1	+50 12	6.93-7.05	γ Cas	22	6.7-7.2	7.07	0.10	2000
KY And	23 09.3	+49 39	6.71-6.90	γ Cas	22	6.5-6.8	6.63	0.10	2000
o And	23 01.9	+42 20	3.58-3.78	γ Cas	17	3.3-3.5	3.43	0.07	2000
o Aqr	22 03.3	-02 09	4.68-4.89	γ Cas	19	4.3-4.8	4.49	0.16	2000
π Aqr	22 25.3	+01 23	4.42-4.70	γ Cas	23	4.2-4.5	4.42	0.09	2000
V923 Aql	19 30.5	+03 27	6.04 U (0.12 V)	γ Cas	42	6.0-6.3	6.16	0.09	V450 Aql[1]
V1294 Aql	19 33.6	+03 46	6.82-7.23	γ Cas	51	6.7-6.8	6.75	0.05	V450 Aql
V1295 Aql	20 03.0	+05 44	7.87 U (0.02 V)	unq.	14	7.7-8.0	7.81	0.08	2000
V1339 Aql	19 50.3	+07 54	6.33-6.52	γ Cas	24	6.0-6.4	6.19	0.09	2000
BK Cam	03 20.0	+65 39	4.78-4.89	γ Cas	12	4.1-4.8	4.34	0.18	2000
ε Cap	21 37.1	-19 28	4.48-4.72	γ Cas	19	4.0-4.2	4.13	0.07	2000
V509 Cas	23 00.1	+56 57	4.75-5.5	SRd[2]	13	5.2-5.5	5.37	0.10	RW Cep
V566 Cas	23 48.8	+62 13	5.34-5.45	α Cyg	38	5.7-6.2	5.99	0.12	2000
κ Cas	00 33.0	+62 56	4.22-4.30B	α Cyg	12	4.1-4.4	4.23	0.11	2000
o Cas	00 44.7	+48 17	4.50-4.62	γ Cas	19	4.5-4.9	4.78	0.11	2000
V337 Cep	21 37.9	+62 05	4.69-4.78	α Cyg	45	4.4-4.7	4.56	0.06	JAS μ Cep[3]
V568 Cyg	20 42.4	+35 27	6.40-6.68	γ Cas	17	6.2-6.4	6.28	0.09	Y Cyg
V832 Cyg	20 59.8	+47 31	4.49-4.88	γ Cas	62	4.6-4.9	4.78	0.08	Coeli
CU Dra[4]	13 51.4	+64 43	4.46-4.94	LB:	16	4.6-5.0	4.76	0.11	2000
V771 Her	17 58.9	+45 29	6.4 U	[5]	47	5.9-6.3	6.09	0.11	OP Her
o Her	18 07.5	+28 46	3.81-3.90 B	γ Cas	21	3.5-3.9	3.75	0.15	2000
EW Lac	22 57.1	+48 41	5.0 -5.3 p	γ Cas	16	4.5-4.7	4.55	0.06	2000
χ Oph	16 27.0	-18 27	4.18-5.0	γ Cas	27	4.1-4.4	4.18	0.08	2000
KX Ori	05 35.1	-04 44	6.9 -8.1 p	Ina?	26	7.2-7.6	7.40	0.11	Burnhams
NU Ori	05 35.5	-05 16	6.83-6.93	Inas?	51	7.1-7.6	7.43	0.09	Burnhams
V372 Ori	05 34.8	-05 34	7.94-8.05	Ina	23	7.8-8.2	7.99	0.11	Burnhams
ω Ori	05 39.2	+04 07	4.40-4.59	γ Cas	27	4.3-4.9	4.59	0.17	2000
MX Per	04 08.7	+47 43	4.00-4.10	γ Cas	39	3.8-4.0	3.94	0.06	2000
φ Per	01 43.7	+50 41	4.03-4.11	γ Cas	27	3.7-3.9	3.82	0.06	2000

Class 3 observations have been excluded. The ranges and types are taken from Sky Catalogue 2000 Volume 2.

Notes:
1. Comparison B (mag. 6.04)
2. Previously catalogued as type γ Cas
3. = 9 Cephei (mag. 4.75)
4. = 10 Draconis (mag. 4.7 comparison for RR UMi)
5. OP Her chart gives 6.44-6.52, type γ Cas [GCVS α^2CVn]

Charts:
- Burnhams = Chart in Burnham's Celestial Handbook
- Coeli = Comparison magnitudes taken from Atlas Coeli Catalogue
- TS = Chart supplied by Tom Saville
- 2000 = Comparison magnitudes taken from Sky Catalogue 2000 Volume 1

Period Search by Phase-Dispersion Minimization - M.D. Houchen

Introduction

Observations of variable stars often consist of randomly-spaced measurements made several periods apart. In order to obtain a composite light-curve it is necessary to reduce all the observations onto one complete cycle of the period. This can only be done if the period is known in advance. In the case of well-observed stars and eclipsing binaries, periods can be determined to a high degree of accuracy, as shown below. However, where the number of observations is less than 30, provided these have been made at random times over several periods, then Phase-Dispersion-Minimization techniques offer a reasonably fast, conceptually straight-forward method of period-determination.

Eclipsing Binaries

The period of an eclipsing binary can be defined as the interval between two successive instants of mid-eclipse of the same component. The accuracy to which the period can be determined depends primarily on the accuracy of the timing of the individual minima. Let us assume that minima have been observed at times t_1 and t_n with standard errors e_1 and e_n and that t_n is separated from t_1 by N periods, then

$$N \cdot P = t_n - t_1 \pm (e_n^2 + e_1^2)^{\frac{1}{2}} \quad (1)$$

if $e_1 = e_n = e$, then

$$N \cdot P = t_n - t_1 \pm e\sqrt{2} \quad (2)$$

and

$$P = \frac{t_n - t_1}{N} \pm \frac{e\sqrt{2}}{N} \quad (3)$$

In principle, therefore, a period can be determined to any degree of accuracy by observing enough minima over a long enough period.

Phase-Dispersion-Minimization Techniques

Phase-Dispersion-Minimization (PDM) techniques have been in use for several years and use a method of minimizing the sum of the difference in ordinates between successive points on a phase diagram, for a given trial period.

It is assumed that a star's magnitude varies according to the model:

$$m_i = f(t_i) + e_i \qquad (i = 1, 2 \ldots n) \quad (4)$$

must be placed on the number of periods tested. Table 1 gives details of a search that will cover the ranges specified in a reasonable time on a small microcomputer using a BASIC interpreter. Even so the computing time can still be several hours for a machine like the Texas TI-99/4A on which the program was originally written.

Table 1

Range (Days)		ΔP	Number of searches in range
100 to 1000		1	900
10 to 100 or last min. -45 to +45		0.1	900
1 to 10 or last min. -4.5	to +4.5	0.01	900
last min. -0.45	to +0.45	0.001	900
last min. -0.045	to +0.045	0.0001	900
last min. -0.0045	to +0.0045	0.00001	900

The table assumes that the period is known to fall into one of the three starting ranges specified, therefore a danger could arise when starting in the range 100 to 1000 days when P < 10 days. In this case the program could converge to a local minimum, usually a harmonic of the true period.

The significance of the period determined by the algorithm is usually apparent from visual inspection of the light-curve produced. Linnell Nemec & Nemec (1985) state that the shape of the mean light-curve and the dispersion of points about that curve is the single most important indication that the true period has been found. When displaying the light-curve, t_0 is chosen as the lowest minimum magnitude found in the data.

Applications to cases in the literature

The algorithm was tested using the observations of 67 short-period Cepheids listed in Eggen (1985) and the results given in Table 2. Observations of AC Her and R Sct by Cardelli (1985) were also used along with observations of longer-period Cepheids by Eggen (1983) in order to test for periods longer than 10 days; the results of these tests are shown in Table 3. As can be seen the results are in fairly good agreement with the published periods given in *Sky Catalogue 2000.0 Vol.2* and most of the spurious periods are multiples or sub-multiples of the 'true' period.

Conclusions

It would appear from the results that phase-dispersion-minimization techniques are useful in estimating periods from a number, i.e. less than 30, of observations and can be of use in fore casting expected times of minima when the period is in doubt. Although Dworetsky (1983) states that 'one might be able to deduce the correct period uniquely with as few as 15 observations' it is apparent from Tables 1 and 2 that a good estimate can be made with far fewer observations, provided these are accurate and made at random times.

BASIC Program

For reasons of space the BASIC program is not given here. However, the author will be pleased to supply copies of either the TI99/4A version, or a standard BASIC listing, on receipt of an A4 SAE (24p, second class). Please state which version is required, and write to:

M.B. Houchen, 93 Enfield Chase, Guisborough, Cleveland TS14 7LN

[References appear on p.27]

[Some comments from the Director] - Using a similar program on a faster machine, I find the run time is excessive with a moderately large data set, especially when investigating periods that are a fraction of a day, as large numbers of periods must be tested. Fourier analysis is much quicker as it cuts out sorts; but is equivalent to fitting a sine wave. The method discussed makes no assumption about the shape of curve, only that it is periodic; so it should perform much better on Algol stars for example.

The program would be more efficient by minimising the number of periods tested. If investigating periods in the range P_1 to P_2, the test periods could be $(t_n - t_1)/K$, where K has a range from $(t_n - t_1)/P_2$ to $(t_n - t_1)/P_1$. K could be varied in steps of 0.1 initially, but even with initial steps of 1 it seems to find the right period. Probably 0.5 is adequate if the curve is roughly a sine wave: this gives a maximum error of 0.25 in phase at each end of the data, compared with the middle. The user could vary the step? By varying the interval according to the timespan, one would avoid testing a very close set of periods when $t_n - t_1$ is relatively short, and also provided $K < 1$ one would avoid the danger of missing the true period when $t_n - t_1$ is large.

Table 2

Name	Number of Observations	$t_n - t_1$	Period Sky Cat. 2000		Period Calculated
T Ant	19	1417	5.89771		5.89790
U Aql	19	1494	7.02393		7.02027
FM Aql	12	699	6.11423		6.11400
FN Aql	13	269	9.48151		9.48024
V496 Aql	5	311	6.80703		6.80470
V1162 Aql	19	839	5.3761		5.37695
V1344 Aql	14	697	7.47803		7.38998
RT Aur	6	17	3.728115		3.71991
RY CMa	16	1085	4.67825		4.67910
VZ Cma	14	169	3.12626	*	3.12548
V Car	13	1098	6.69668		6.69661
SX Car	8	106	4.5622426		4.48427
UX Car	23	1418	3.682246		3.68230
UY Car	16	1036	5.543726		5.54376
UZ Car	11	325	5.20466		5.11603
AQ Car	28	660	9.76896		9.7264
ER Car	17	2531	7.71855		7.71799
GI Car	16	753	4.43061		4.43112
HW Car	23	1036	9.2002		9.19906
IT Car	13	1419	7.53320		7.53147
V Cen	13	219	5.493839		5.50805
AY Cen	12	348	5.30975		5.30944
AZ Cen **	16	753	3.21068		6.36940
V339 Cen	19	388	9.4672	*	9.46688
V419 Cen	15	754	5.5071	*	5.50730
V553 Cen	12	127	2.06051	*	2.06079
V659 Cen	23	1607	5.62180	*	5.62179
V737 Cen	14	218	7.06585	*	7.07446
V351 Cep	9	18	2.80591	*	2.81640
AV Cir **	18	730	3.0651		6.13070
AX Cir	15	1294	5.273268		5.27316
BP Cir **	19	1080	2.3984		1.70999
S Cru	12	1104	4.68997		4.68990
BG Cru	13	1247	3.3428		3.32995
DT Cyg **	6	20	2.499140		1.65311

* Eggen (1985) ** See Table 4

Table 2 cont.

Name	Number of Observations	$t_n - t_1$	Period Sky Cat. 2000	Period Calculated
Dor	18	1412	9.84200	9.94240
GH Lup	23	1550	9.285	9.27722
V473 Lyr **	7	633	1.49107	4.83279
UY Mon	19	402	2.39813 *	2.39833
R Mus	23	1598	7.47665 ***	7.51104
S Mus	21	1560	9.66011	9.66020
RT Mus **	11	770	3.08608	1.47319
BF Oph	17	1044	4.06784	4.06818
RS Ori	21	1833	7.56681	7.56697
GQ Ori **	14	1417	8.61566	1.17759
V440 Per	10	16	7.572	7.48400
AT Pup	12	317	6.6650	6.66468
MY Pup	12	293	5.6952	5.69647
U Sgr	21	1347	6.744925	6.74533
X Sgr	15	1120	7.01225	7.01282
Y Sgr	12	747	5.77335	5.77399
YZ Sgr	11	793	9.55345	9.55245
AP Sgr	11	430	5.05793	5.05699
BB Sgr	16	1102	6.63699	6.63752
V350 Sgr	15	1136	5.15424	5.15547
RV Sco	18	1446	6.06133	6.06084
V482 Sco	11	438	4.52786	4.52755
V500 Sco	23	651	9.311665	9.31467
V636 Sco	22	1492	6.79671	6.79687
SS Sct	13	1436	3.671253	3.67125
R TrA	13	647	3.389287	3.38928
S TrA	19	1247	6.32344	6.32332
RT TrA	9	797	1.94610 *	1.94610
V Vel	11	269	4.370991	4.22994
T Vel	13	716	4.63974	4.63863
ST Vel	15	1155	5.8584249	5.85822
T Vul	7	20	4.435572	4.48066

* Eggen (1985) ** See Table 4 *** 1985 GCVS gives 7.510211

Table 3

Name	Number of Observations	$t_n - t_1$	Period Sky Cat. 2000	Period Calculated
SZ Aql	11	328	17.237939	17.13895
TT Aql	20	99	13.7546	13.75931
V340 Ara **	7	797	20.8090 *	13.87148
SS CMa **	24	700	12.361	24.70893
U Car	22	936	38.7681	38.7883
WZ Car	13	424	23.0132	23.02258
XX Car	12	722	15.71624	15.70827
XY Car **	17	712	12.43483	39.92
XZ Car **	14	776	16.6499	33.290
YZ Car	18	714	18.1631	18.1647
X Cyg **	12	18	16.3866	15.99299
CD Cyg **	9	29	17.0751	16.98000
T Mon **	18	1015	27.0205	26.9201
SV Mon	12	736	15.2321	15.23689
UU Mus	17	514	11.63641	11.63778
U Nor	12	503	12.64133	12.66060
Y Oph **	17	768	17.12413	16.7129
SV Per	11	19	11.12875	11.56759
VX Per	10	18	10.89364	10.79736
X Pup **	20	729	25.9610	12.98201
RS Pup	21	755	41.3876	41.52500
VZ Pup **	14	331	23.11640	46.3351
AD Pup	17	683	13.5940 *	13.59521
AQ Pup	33	665	29.8568	30.0221
WZ Sgr	22	463	21.849708	21.83400
KQ Sco	10	431	28.6896	28.66400
Z Sct	15	325	12.9014	12.90452
RU Sct	10	396	19.69767	19.70485
RY Vel **	12	719	28.1270	21.09806
SV Vel	12	779	14.09707	14.09568
DR Vel	22	797	11.2000 *	11.19860

* Eggen (1985) ** See Table 4

Table 3 cont.

Name	Number of Observations	$t_n - t_1$	Period Sky Cat. 2000	Period Calculated
SV Vul	20	98	45.035	44.67941
AC Her **	26	144	75.4619	37.233
R Sct	23	144	140.05	137.6779

** See Table 4

Table 4

Name	Notes
V340 Ara	Insufficient data
SS CMa	P(Calc.) = P(True) x 2
XY Car	?
XZ Car	P(Calc.) = P(True) x 2
AZ Cen	P(Calc.) = P(True) x 2
AV Cir	P(Calc.) = P(True) x 2
BP Cir	P(Calc.) = P(True) x 0.5
X Cyg	Period varies *
CD Cyg	Period varies *
DT Cyg	Period varies *
AC Her	P(Calc.) = P(True) x 0.5
V473 Lyr	If of Population I this is the shortest-period classical Cepheid known in the Galaxy *
T Mon	Period changes may be light-time effect **
RT Mus	P(Calc.) = P(True) x 0.5
Y Oph	Light-curve not typical Cepheid *
GQ Ori	?
X Pup	P(Calc.) = P(True) x 0.5
VZ Pup	P(Calc.) = P(True) x 2
RY Vel	?

* Sky Catalogue 2000.0 Vol.2 ** 1985 GCVS

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'The Three Associations' - Storm Dunlop

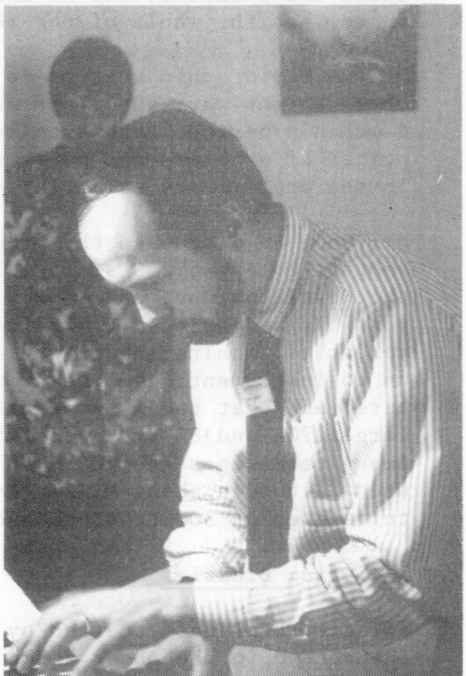
Wearing two hats, as President of the BAA and Assistant Director of the VSS, I recently attended I.A.U. Colloquium 98: 'The Contribution of Amateur Astronomers to Astronomy', which was held as part of the celebrations of the centenary of the Société Astronomique de France. There were a number of items on the programme of particular interest to variable-star observers, and I hope to discuss some of these in a later issue of the *Circular*.

It was a particular pleasure to have the chance to meet so many variable-star enthusiasts from all over the world, many of whom were previously only known by name or by correspondence. (Regrettably, only the New Zealand variable-star group appeared to be unrepresented.) One notable evening was when 27 observers - only a small part of the variable-star contingent, be it noted - invaded a restaurant on the Champs-Elysées for dinner.

Naturally much discussion centred on greater contact and co-operation between the various organisations, and this can only be of benefit to all the groups concerned. One main topic covered was the computerization of observational records, which is a problem for many of the organisations. Full details have subsequently been received of the methods used by the Association Française d'Observateurs d'Étoiles Variables (AFOEV) and by the Dutch Werkgroep Veranderlijke Sterren (WVS). The latter, in particular, have developed an interesting method whereby observers with home computers are able to use the BASICODE standard to prepare data tapes that can be read by what would otherwise be incompatible machines. Although using cassette tapes may seem a step backward in technology, it may prove to be a very useful method of exchanging data both within our Section and also between national organisations.

But for the people concerned, the real highlight came when Dominique Proust of the AFOEV and his wife Brigitte invited some friends to dinner. Not only were Janet Mattei of the AAVSO and myself there, but it was historic for the AFOEV, as it was the first time ever that all their officers had been together: Emile Schweitzer (President), Joël Minois (Treasurer), Dominique Proust and Michel Verdenet (Secretaries). Michel Verdenet, who is, of course, a dedicated observer, had actually been tempted away from his beloved telescopes (and horses and donkey) at his country home in Bourbon-Lancy. Regrettably, Michel still proved somewhat elusive, because his was the only photograph that was not successful.

Such a pleasant - and let us hope auspicious - occasion could not go unmarked, so is it surprising that the champagne glasses were raised to the toast of 'The Three Associations'?



Above left:
Janet Mattei, Director of the AAVSO

Above right:
Emile Schweitzer, President of the AFOEV

Right:
Dominique Proust, entertaining his guests with an organ recital, which included one of William Herschel's original compositions.

(Photographs by Joël Minois)

Variable Star Section Meeting, 1987 Sept. 11 - Shaun Albrighton

The meeting at University College, Swansea, was opened by Howard Davies, President-Elect of the Swansea Astronomical Society, who welcomed the Section to Swansea. He was thanked by Melvyn Taylor, the Section Secretary, for the invitation and for the local society's assistance in organizing the meeting.

The Section's Programme

Melvyn then read out a letter from John Isles, the Section Director, who had been unable to make the trip to the meeting from Cyprus, where he is now living. In the letter John stated that he had recently had 96 consecutive clear nights. (The laughter from local Swansea astronomers apparently indicated that they regarded these as poor figures!)

John's letter went on to summarize the functions of the various Section officers and to highlight current activities and future objectives. [These will be discussed in greater detail in later issues of the *Circulars*.] The letter concluded with a somewhat controversial statement, which met with great approval from VSS members, but shocked intake of breath from the few non-VSS members who were (inadvertantly?) present: "We too study variable stars for pleasure, but we are doing work of greater scientific value that the whole of the rest of the BAA lumped together."

Melvyn Taylor then went on to ask members to ensure that their observations were submitted as soon as possible after each 6-monthly period. Late submission caused a very considerable number of problems and could mean that results were not included in the preliminary summaries and light-curves.

Melvyn than discussed the programme, stating that at present it amounts to about 240 stars (plus eclipsing binaries and those on the Nova/Supernova programme. He added that the programme might possibly be expanded to include more of the exotic eruptive variables, monitoring of which was such an important task. Moving on to instrumentation, he said that 50% of observers used binoculars, and that the most popular size was 10x 50 mm, although the larger 70- and 80-mm binoculars are becoming more widely used. Among telescopes the 200mm (8") Celestron is the most commonly used, although about half-a-dozen observers are employing telescopes of 300 to 450mm aperture.

Eclipsing Binaries

Tristram Brelstaff started by describing how he personally became interested in the observation of eclipsing binaries, and said that he was particularly attracted by the idea of being able to make observations of a complete minimum in one night. He illustrated his talk with a number of graphs showing his own observations of eclipsing binaries, pointing out how, quite frequently, the timings varied from the predicted minima, and in some cases, by very significant amounts, so that it was occasionally difficult to even locate a minimum.

He stated that one of his favourite stars was V523 Cas, a W-Ursae Majoris star, which has an interval of only about 3 hours between minima (P = 0.23369068 d), and in which he believed that there were variations in the brightness at maximum. [The GCVS notes that its period is variable.]

Tristram went on to say that observation of eclipsing binaries could only be carried out with the use of predictions for the times of minima. He recommended that anyone interested in the subject should obtain a copy of the Eclipsing Binary Handbook. The data that it contained would, in most cases, suffice to enable members to plan their observing sessions. If any star was found not to be obeying the predictions, it became all the more important to determine how its behaviour was changing.

Stars with long periods posed particular problems, because observations over one night were often insufficient to cover the total duration of eclipses. Tristram went on to show how observations made on individual nights could be combined to form a composite light-curve, defining the form of the eclipses and determining the periods. He then concluded his talk by showing his own personal light-curves for the two long-period objects η Geminorum [P = 232.9 d] and ϵ Aurigae [P = 9892 d].

In response to a question, Tristram said that the differences between the observed and calculated times of minima were the direct result of changes in the period of eclipsing binaries. These changes could arise in two main ways: a) mass-transfer between the two stars; b) the gravitational effects of a third star in the system. [Mass-loss from the whole system is another process that is thought to occur and which may cause period-changes in certain cases.]

Aspects of Photoelectric Photometry

After a break for tea, Roger Pickard began his talk by showing slides of some of the light-curves that he and his colleagues engaged in photoelectric work had obtained of various eclipsing binaries. He said that whereas visual estimates had an accuracy of about $\pm$ 0.1 or 0.2 mag. - but only on suitable stars - photoelectric devices could achieve an accuracy of $\pm$ 0.015 mag. without great difficulty, and even with the relatively unsophisticated equipment available to amateurs.

Roger then went on to outline the equipment that is needed to carry out photoelectric observations. He stated that although more-or-less any type of telescope could be used, it must be rigidly mounted and accurately aligned and driven. He then went on to discuss the mechanical and electrical configuration of a photoelectric photometer, before saying that although a simple computer could assist in the tedious reduction of estimates, it was by no means essential.

Roger then outlined the procedures used in making photoelectric observations, illustrating some of the results that could be obtained by showing slides of light-curves of further variables and minor planets. He concluded by mentioning the use of photo-electric photometers for occultation work.

Answering a question about future developments in variable-star photometry, Roger added that solid-state detectors would probably be refined and increasingly employed in future. He also pointed to the completely automated telescopes and photometers that were being developed in the United States, where both the telescope positioning and photometer readings were fully computer-controlled, and that this was undoubtedly one way in which considerable advances would probably be made.

An Observing Programme for Amateur Astronomers

Stephen Lubbock started his talk by saying that his main field of interest lay in observing the class known as interacting binary stars, where material is being passed from one component to the other. He outlined the evolution of these stars, before going on to show how variation in separation, mass of the components, and their state of evolution lead to different types of interacting binaries, namely: U-Gem-type stars - and their variants: SU-UMa and Z-Cam stars - recurrent novae and novae.

He pointed out that very frequently particular stars are wrongly classified because of insufficient data. This was typified by VY Aqr, which had been listed as a recurrent nova, but which now appears to be a long-period version of an SU-Ursae-Majoris star. From recent behaviour T Leo could now also be assigned to this particular sub-class. Other deviations occur, as with CH UMa, which is listed as having a period of 209 days, and yet which has been erupting every month for the past few months. Yet again, in UZ Ser, a standstill had recently been observed, and this was a completely new phenomenon for this star.

Stephen then went on to discuss the equipment needed to observe these stars and how to construct a balanced programme. As regards instrumentation, basically it was a case of 'the bigger the better'. Provided the optical quality was reasonable, the equipment did not need to be highly sophisticated, and the telescope could be regarded as a simple 'light bucket'. The mounting, too, need not be highly complex, and an altazimuth design had a lot to commend it on the grounds of simplicity, ease of construction and lesser cost than that of an equatorial design.

He recommended a mixed programme, consisting of a number of old novae, long-period eruptives - which may erupt on a 5- to 20-year basis - together with the shorter-period U-Gem, Z-Cam and SU-UMa types. Lastly he stressed the importance of recording all negative results, and also the need to pass details of any outbursts to professional astronomers as soon as possible.

The Nova & Supernova Search Programme

Storm Dunlop then gave a summary of the important scientific results achieved by the Nova/Supernova Programme He said that although these would be generally known to members, when gathered together they formed an impressive list. He reminded members that the programme had started as the British Photographic Sky Patrol, coordinated by *TA* with the aim of collecting regular photographs that could then be used to check later queries. The discovery of V400 Per (Nova Per 1974) led to the proposal that images should be checked for novae, and this work began in mid-1976, with the VSS nova search and that of *TA* being merged in 1977. Then the UK Photographic Supernova Patrol (started in 1978) was integrated into the programme in 1980.

[The summary of important results is given in Table 1 overleaf.]

VSS Data Processing

Storm then went on to mention some of the problems that the VSS encountered in dealing with the large number of observations submitted in the Main and Binocular programmes, the division into which was largely an historical accident. He said that the VSS officers viewed the observations as being of equal importance, and that they hoped to be able to provide more information in future on the behaviour of the brighter objects, typically observed with binoculars, and which might seem to have been somewhat neglected in recent years. Ideally, all the observations would be entered into a machine-readable form, which then allowed the rapid production of preliminary light-curves, which would at least show members the behaviour of the stars that they had been observing.

The problems of data-processing were obviously those of having to enter large quantities of data, but there was the possibility that some observers with small computers might be able to submit

Table 1

Nova/Supernova Patrol: Some Major Results

1975	
Jan.	Pre-discovery images (PDI) of V400 Per, photos by D. Jones 1974 Sep.
Jly.	PDI of V373 Sct, photos by M. Jaques 1975 Jun.
1976	
Dec.	PDI of HM Sge, colour photos by P. Birtwhistle 1976 May, Jun. and Jly
1977	
Jan.	Discovery of HS Sge (N.Sge 1977) by J. Hosty, Jan. 07.7
1978	
Sep.	Independent discovery (ID) of V1668 Cyg (N.Cyg 1978) by D. Rossiter & M. Verdenet, Sep. 11.82
Dec.	ID of outburst of WZ Sge by R. McNaught, Dec. 04.92
1979	
Apr.	PDI of PU Vul, photos by M. Swan, Apr. 03.17
1980	
Oct.	Rediscovery of CSV 101897 on photos by Hosty, Sep. 03
Oct.	SN in NGC 6946, later followed photographically down to mag. 18 by A. Young
1981	
Jan.	PDI of V1760 Cyg, photos by J. Grills, 1980 Nov. 02, showing object not a nova as previously thought
Apr.	Pre-announcement images (PAI) of SN 1980K in NGC 6946, photos by Swan, 1980 Oct.
1982	
Nov.	Outburst of VY Aqr found by McNaught on Papadopoulos Atlas
1983	
Nov.	First ever visual obs. of VY Aqr outburst, McNaught, Nov. 28
1984	
Aug.	PAI of PW Vul (N.Vul 1984 No.1), A. Merlin, Jly 28
Nov.	Analysis of variable object nr NGC 7184, photos by A. Young
1985	
Apr.	ID (photographic) of outburst of RS Oph by H. Mikuz, Jan. 31
Oct.	First ever visual obs. of DO Dra outburst, S. Lubbock, Oct. 28
1986	
Feb.	ID of SN 1986A in NGC 3367 (Feb. 04) by two patrol members: R. Evans & D. Greenwood
May	ID of VY Aqr outburst by two members of the patrol: Lubbock (May 01) & McNaught (May 03)
Nov.	ID of GK Per outburst by three members of the patrol: Verdenet, Lubbock & D. McAdam
Nov.	Discovery (photographic) of V842 Cen (N.Cen. 1986) by McNaught, Nov. 22
1987	
Feb.	PDI of SN 1987A in LMC by McNaught (Feb. 23)
Apr.	PAI of Nova And 1986 found on photo by N. James

their observations in a form that would enable them to be read, whatever their type of computer. Already some observers had indicated that they would be quite prepared to enter data, essentially as they made their observations. This would be ideal, as the observers could then have print-outs for their own records, they would be saved the task of completing report forms, and the Section would have data in a form that could be readily manipulated by computers. Storm said that he hoped to be able to make some trials very soon, so that the Section might at least begin to process current observations on a regular and up-to-date basis. Once such a state had been achieved, ways of tackling the problem posed by earlier observations could be devised.

Using IUE to study variable stars

Dr D. Stickland (Rutherford Appleton Laboratory) opened his talk by outlining the importance of ensuring that there was adequate contact between amateur and professional astronomers, so that the amateurs could act as an early-warning system to alert those using sophisticated ground-based or satellite equipment when any important event occurred. He emphasised the importance of this, and specifically encouraged members to report immediately any unusual activity, or outbursts, of a whole range of objects, particularly eruptive variables, such as those that had been mentioned earlier. The information would then be relayed at once to the Madrid ground-station, and IUE used to observe the object concerned. [The Section officers have the telephone numbers of these contacts, both at RAL and in Madrid, and should be informed in the first instance.]

He went on to say that as the Earth's atmosphere effectively blocks out nearly all radiation at ultraviolet wavelengths, it was essential to place telescopes in orbit to be able to monitor stars in these important spectral region. He described the equipment on the IUE - International Ultraviolet Explorer - satellite and how its observational data were relayed to the two tracking stations, one on the east coast of the U.S.A. and the other near Madrid. The satellite observes, and is monitored, 24 hours a day, 16 being allocated to the U.S. and the remaining 8 to the European investigators.

The visual fine-error sensor, which has the ability to record 14th-magnitude stars, is used to locate the object of interest. This sensor covered a field approximately 16 arc-minutes across, so this gave an idea of the positional accuracy required in the initial 'alert' information. The fine-error sensor also allowed a degree of photometry to be carried out. In general, however, it is used for precise alignment of the satellite and then the low-resolution spectroscope is brought into service, and used to make the initial determinations of the necessary exposure times that are likely to be required to show features of interest. The very high-resolution echelle spectrograms could then be obtained if they were considered necessary.

Dr Stickland then described how the results from the spectroscopes were interpreted, showing examples of both low- and high-resolution spectrograms of several objects. From these spectrograms the abundances of particular elements could be determined, together with the temperature of the emitting regions and any velocities associated with them.

He then mentioned some typical results for various classes of variable stars. In dwarf novae, the data yielded information about the state of the accretion disk at particular phases of their activity. Mira variables showed a continuum with strong absorption features at minimum but, in contrast, many emission lines at maximum. These were caused by shock waves that were reaching the surface layers at that stage of the stars' cycles, producing strong excitation of the atmospheric gases.

Dr Stickland concluded by re-emphasising the importance of amateurs informing the IUE team as soon as any unusual activity occurred. The the essential information to be passed on were the name of the object, its position - in 1950 coordinates - and the approximate magnitude.

In answering a question about supernova 1987A in the LMC, Dr Stickland showed light-curves comparing it with other earlier supernovae in both ultraviolet and visual wave-bands, and pointed out the different behaviour. He concluded by saying that, in some ways it was a shame that the SN was an oddity, but said 'It's been a good dummy run for a real supernova.'

General Discussion

To conclude the VSS meeting there was a general discussion of various matters concerning the programme and objects on it. Dick Chambers of the Crayford Manor House group described the results that had come from an examination of published observations of W Cyg, using a computer periodogram analysis. Results for the first five-year period showed a 240-day period with a range of 5.95 to 6.45, upon which a 139-day period with a smaller amplitude was superimposed. During the next five years the 130-day period was dominant, but 10 years later the 240-day period had reasserted itself. Dick said that although the total period of time covered was confined to those early observations that had been published, and the analysis did not consider later material, he hoped that this would show the value of such work, and how even the re-working of older material by modern, sophisticated methods could reveal new information about variable stars.

BRITISH ASTRONOMICAL ASSOCIATION
VARIABLE STAR SECTION

Extract from Circular 65

As Circular 64, has been completed, and is in the hands of the printers, this note gives some recent items of information.

Rho Cassiopeiae

Melvyn Taylor points out that Rho Cassiopeiae, which normally ranges between 4.8 and 5.1-5.2, has gone into an almost constant phase. From the reports that have reached us so far, this change started in 1986 January and the mean monthly magnitudes are:

Jan.	5.12	sd 0.17	Apr.	5.16	sd 0.13
Feb.	5.24	0.10	May	5.20	0.09
Mar.	5.22	0.10	Jun.	5.20	0.12

Most of the small variability lies between 5.1 and 5.3 (from 173 observations). Observers were: Brundle, Hufton, Hutchings, Fraser, Kiernan, Markham, Middlemist and Stott.

The GCVS extreme range of this object is 4.1-6.2 V. A peculiar fade began in 1945 November, and lasted for 165 days. A deep minimum of 320 days occurred, centred on 1946 September, but the star recovered normal brightness by 1947 July.

Just in case the present 'standstill' is a prelude to a further decline, observers may care to monitor this star, using the chart given overleaf. This is drawn from the standard VSS chart for Gamma & Rho Cas (sequence no. 064.01). Any significant fade should be reported to Melvyn Taylor.

John Isles: Change of Address

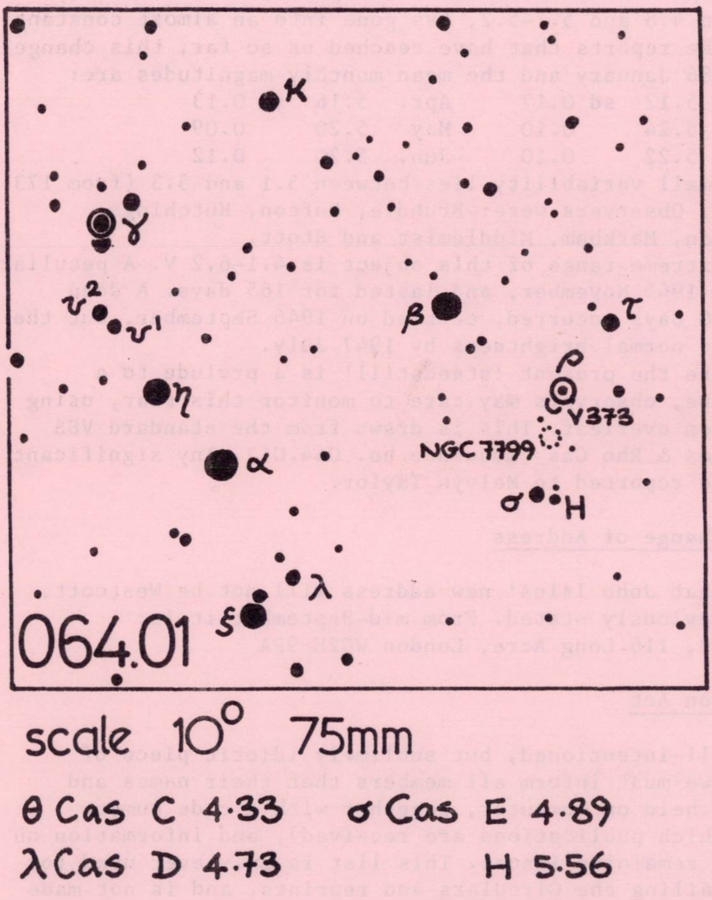
Please note that John Isles' new address will not be Westcott, Bucks., as previously stated. From mid-September it is:
Flat 3, 116 Long Acre, London WC2E 9PA

Data Protection Act

Under this well-intentioned, but sublimely idiotic piece of legislation, we must inform all members that their names and addresses are held on computer, together with a code number (indicating which publications are received), and information on the number of remaining issues. This list is only ever used for purposes of mailing the Circulars and reprints, and is not made available to anyone outside the VSS and the Executive Officers of the Association. Anyone who objects to their name being held in this way should inform Storm Dunlop immediately. [If 'idiotic' seems too strong a word, consider the recent, well-informed opinion that holds that it is illegal to use the computer file to correctly address an individual letter.]

234956 $23^h 54.2^m$ $+57°29'$ (2000)

Rho Cassiopeiae



scale 10° 75mm

θ Cas	C 4.33	σ Cas	E 4.89
λ Cas	D 4.73		H 5.56

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£1.50 (U.K.) or £1.75 (Overseas) each, including postage (Direct sale price £1.25)

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