BRITISH ASTRONOMICAL ASSOCIATION

VARIABLE STAR SECTION

CIRCULAR 20

OFFICERS OF THE VSS

Director:	J E Isles, 292 Caledonian Road, London N1 2BA Tel: 01-607 0459
Secretary:	D R B Saw, 12 Taylor Road, Aylesbury, Buckinghamshire HP21 8DR
Chart Curator:	S J Anderson, 20 Bloomfield Avenue, Luton LU2 0PS Tel: Luton (0603) 23360

BINOCULAR GROUP

Coordinator:	D A Pickup, 38 Brockwood Avenue, Penicuik, Midlothian EH26 9AN Tel: Penicuik 72098
Assistant Coordinator:	A L Smith, 11 Lerryn Road, Gosport, Hants, PO13 0YG Tel: Fareham (032 92) 4677
Recorder:	A E J Forno, 92 Crockford Park Road, Addlestone, Surrey KT15 2LR Tel: Weybridge (0932) 44668

ECLIPSING BINARY PROJECT

Coordinator:	J E Isles
Predictions:	J C Smith, 18 St. James' Close, Hanslope, Buckinghamshire

NOVA SEARCH PROJECT

Coordinator:	C V Borzelli, 12 Corbin Avenue, Jersey City, New Jersey 07306, USA

T Tauri Stars. R W Forrest, of Hatfield Polytechnic, hopes to observe some T Tauri stars spectroscopically on the 36 in. telescope at Herstmonceux, and requires simultaneous visual observations. The photographic ranges of the stars concerned vary from 9.2 to 12.1 at maximum, and from 11.5 to 15.6 at minimum. T Tauri stars are of considerable interest in connection with the theories of the formation of planetary systems, as they appeared to be losing mass into extended envelopes. From the high dispersion spectrograms it is possible to estimate the sizes and densities of these envelopes by examining the emission lines. Visual light-curves may then show whether the irregular light variations are due to intrinsic variations in the stars light output or to the varying obscuration by the envelope material. Observers wishing to take part in this project are invited to contact the Director.

X Persei. Dr. J B Hutchings, Dominion Astrophysical Observatory, has been studying the spectrum of X Per, and has found a period of 580 days in the radial velocity of the star, possibly implying the existence of a massive companion. Also, the spectrum changed considerably in Nov - Dec 1973. Accordingly, Dr. Hutchings recently wrote to the Director Inquiring if any associated features were evident in the visual light-curve.
X Per has been observed by the BSS (now the Binocular Group) since 1967, and monthly means show long-term changes with an amplitude of 0.4m and possible length 2 - 4 years. Unfortunately, the 580d period does not show up in the light-curve and the magnitude has been fairly steady since March 1973.
As this star's identity with the X-ray source 2ASE 0352+30 has been suggested, interest has been shown by professional astronomers in BSS observations of this object, which, according to Dr. P Murdin of Herstmonceux, are the only reported observations of modern times. At the request of Dr. Y Kondo of NASA, Alan Pickup is preparing a report on our results for publication in a Circular of the Coordinated Campaign for Observations of X-ray Binaries arranged by IAU Commissions 42 and 44.
Until 1972 we had no idea that X Per was anything other than a normal Ina variable, and observers should be encouraged to know that their work can suddenly become of importance, even for stars which have been known for almost a century.

International RV Tauri Project. Charts are now available for the RV Tauri stars between 12^h and 24^h RA, and may be ordered from Steve Anderson. The numbers of sheets in each set are as follows: EQ Cas 3, DF Cyg 3, V360 Cyg 2, AH Her 2, EG Lyr 3, EP Lyr 3, TT Oph 3, TX Oph 2, UZ Oph 3, V564 Oph 4, R Sge 3, V Vul 3. The 9° chart for TT Oph doubles for TX Oph. The charts and sequences for EQ Cas, V360 Cyg, EG Lyr, NP Lyr and V564 Oph are 'preliminary', the others are 'final', but the Director will welcome comments on the accuracy of the charts and sequences for all the RV Tauri stars, including those between 0^h and 12^h RA.

Orion Nebula Variables. Following and merger with the BSS, the following telescopic variables in the region of M42, hitherto on the BSS programme, are being added to our 'main' programme:

Star	Desig.	Range	Type	Sp
T Ori	053005	9.5 - 12.6	Inas	A3
IU Ori	052905	8.8 - 10.0	E?	K2
KX Ori	053004	7.1 - 8.3	Ina	B3
KS Ori	053005	9.9 - 10.9	Ina	A0
LP Ori	053005	8.0 - 9.4	Inas	B2
MX Ori	053005	9.5 - 10.5	Inb	G0
NU Ori	053005	6.5 - 7.8	Inas	B1
NV Ori	053005	9.5 - 11.3	Inbs	F6
V359 Ori	053004	7.1 - 10.0	Inas	B3
V361 Ori	053005	7.8 - 9.6	Inas	B4
V372 Ori	052905	7.4 - 8.1	Ina	A0
V566 Ori	053005	9.9 - 10.5	Inas	A0
CSV 100567 Ori	053005	7.8 var?	-	B8
Var No 2 Ori	053105	8.0 var?	-	A0

A four sheet chart set covers all 14 variables. The classification of I-type variables is explained in the Binocular Chart Catalogue distributed with VSSC 19. The stars with the suffix 's' under 'Type', which show rapid variations, can usefully be observed more than once a night.

Supernova in NGC 4414. Further to the note in VSSC 18 regarding the supernova in NGC 4414, as this has proved to be brighter and more widely observed, than was expected at that time, it is hoped to produce a report in due course. Anyone who has made visual or photographic observations is asked to submit them in the usual way to Doug Saw at the end of the year. (But see postscript!)

1973 Observations. (The following report on observations of stars on the 'main' programme has been prepared by the Secretary.)

In 1973, the sections active membership was 96, compared with 63 in 1972. The number of observations reported was 24,208, more than double the number for the previous year. One member, O J Knox, made 3554 estimates. Four others made over 1000, eight others over 500 and 22 others over 100. The 'prize list' appears below.

Paterson's positive estimates of faint stars were especially useful, whilst the early-morning observations of Knox and Young were invaluable in enabling light-curves of many stars to be extended. One young observer, P Hornby, on Dec 16th, was the first to report the latest fall of the R CrB.

The 28 eruptive variables were observed on average 474 times each and 55 pulsating variables 199 times each. However, the coverage was very uneven; although more than 100 estimates each were made of Gamma Cas, Rho Cas, R CrB and SS Cyg, less than 200 estimates were made of the following stars still on the programme: R Aql, UU Aql, U Boo, V Boo, S Cas, Omicron Cet, S CrB, SS Her, RS Oph, S Per, WZ Sge, T Tau, RV Tau, SW UMa; and less than 100 of UW Aql, V Cam, W CrB, S Cyg, BC Cyg, BI Cyg, R Hya, RS Per, BU Per.

The observers were as follows:

	Obs.	Principal Instrument
O J Knox	3554	32 cm Spec.
P J Young	2206	30 cm OG
D R B Saw	2040	35 cm Spec.
R A H Paterson	1438	32 cm Spec.
I D Howarth	1417	30 cm Spec.
J A Bailey	976	22 cm Spec.
A K Porter	899	16 cm Spec.
C Pezzarossa	739	15 cm Spec.
G P Hawkins	725	25 cm Spec.
C R Munford	612	30 cm Spec.
P A Moore	575	32 cm Spec.
S F Burch	550	20 cm OG
D P Griffin	550	20 cm OG
P W Hornby	497	25 cm Spec.
M J Gainsford	417	21 cm Spec.
R J Livesey	391	22 cm Spec.
W E Pennell	376	31 cm Spec.
N Reid	368	8 cm OG
D Vest-Askew	291	22 cm Spec.
K M Sturdy	290	15 cm Spec.
B J Beesley	288	15 cm Spec.
L A Mathews	274	22 cm Spec.
R D Pickard	266	21 cm Spec.
I Middlemist	265	10 cm Spec.
M D Taylor	262	8 cm OG
G Broadbent	261	22 cm Spec.
D Hufton	253	16x 50 B.
T Brelstaff	230	6 cm OG
G H Spalding	213	15 cm Spec.
A L Smith	211	15 cm Spec.
I Miller	185	12x 65 B.
S J Anderson	138	30 cm Spec.
T A Robinson	114	25 cm Spec.
J Mason	105	30 cm Spec.
J A Roberts	102	16x 50 B.
61 others	2129	various

The results are distributed among the programme stars as indicated below:

Star	Obsns.	Obsrs.	Star	Obsns.	Obsrs.
R And	305	24	AB Dra	410	11
RX And	701	18	R Gem	164	13
R Aql	181	17	U Gem	480	17
UU Aql	174	11	T Her	277	14
UW Aql	63	5	U Her	137	10
R Ari	130	8	SS Her	144	15
R Aur	101	3	AH Her	241	9
X Aur	322	20	R Hya	37	9
SS Aur	709	24	R Leo	326	26
R Boo	156	10	X Leo	303	20
S Boo	80	4	R Lyn	102	6
U Boo	155	14	W Lyr	137	10
V Boo	159	9	AY Lyr	278	7
V Cam	69	2	U Mon	241	20
X Cam	259	11	RS Oph	121	8
Z Cam	989	17	U Ori	255	17
AF Cam	107	5	CN Ori	214	13
R Cas	184	10	CZ Ori	218	11
S Cas	182	12	R Peg	128	8
T Cas	319	20	RU Peg	538	24
W Cas	206	10	R Per	68	2
HT Cas	78	7	S Per	157	13
Gamma Cas	1014	37	RS Per	73	2
Rho Cas	1074	41	TZ Per	549	16
S Cep	148	16	UV Per	334	10
T Cep	453	23	BU Per	73	3
Omicron Cet	189	19	WZ Sge	105	5
R CrB	1632	44	R Sct	604	28
S CrB	104	16	R Ser	220	17
T CrB	258	14	T Tau	118	5
W CrB	73	8	RV Tau	184	10
R Cyg	269	17	SU Tau	462	19
S Cyg	77	8	R Tri	127	8
U Cyg	223	66	R UMa	339	17
W Cyg	710	40	S UMa	352	14
SS Cyg	1169	31	T UMa	304	13
BG Cyg	77	3	SU UMa	386	16
BI Cyg	81	4	SW UMa	181	11
Chi Cyg	309	16	CH UMa	335	14
S Del	85	10	S UMi	304	14
HR Del	221	15	S Vir	97	14
R Dra	290	15			

1973 Light-curves. The following notes, continued from VSSC 18, summarise some of the principal results obtained in 1973, extracted from the plots prepared by the Secretary. Observers should note carefully which stars require most attention and when.

S CrB: Unobserved until Mar 24 (8.1), fell to min (12.8) in Sep, rose to 7.2 by Dec 31. Needs more attention Jan - Mar.

T CrB: Variations with an amplitude of 0.2^{m} and a period 114d continuing, with maxima (9.9) occurring close to the predicted dates of Mar 31, Jul 23, Nov 14 (see Journal, 1974 Apr, p.204). Considerable interest in VSS results has been shown by Dr. B Warner (Cape) and Dr. M W Feast (Radcliffe), to whom up-to-date light-curves have been communicated.

W CrB: Unobserved until Feb 22 (13.8), rose to max (8.3) at beginning of May, fell to min (12.5) in Sep, rose to max (8.9) in Dec. Underobserved for most of the year.

R Cyg: Fell from 9.7 on Jan 1 to min (13.8) in Jul, rose to max (7.4) in Dec.

S Cyg: No positive observations until Apr 2 (14.0), rose to max (10.3) in Jun, fell to 14.4 on Sep 25 after which no positive observations were made. Needs more attention at all phases, but especially when below 14m.

U Cyg: Rose from 8.7 on Jan 1 to max (7.5) in May, fell to min (11.7) in Dec.

SS Cyg: Maxima occurred about Jan 29 (anomalous), Apr 3 (long), Jun 3 (long), Aug 2 (long), Sep 16 (short), Oct 14 (short) and Nov 28 (long). During Jan and Feb the minimum was disturbed, subsidiary rises to 11m occurring about Jan 3 and Feb 15, but thereafter the star was rarely seen brighter than 11.7 outside of the maxima. The 'spring gap' lasted 15 days, from Apr 13 to 28, during which only one negative observation was made, but no maxima were missed. The mean period in 1973 comes to 50.5d.

Chi Cyg: Rose from 6.4 on Jan 1 to max (4.7) at beginning of Feb, fell to min (13.8) in Oct, rose to 10.0 on Dec 31.

S Del: Unobserved until May 26 (9.0), then fell to min (11.6) in Sep, rose to max (9.0) in Dec.

HR Del: Gradual fall from 10.3 to 10.9 during the year. Unobserved from Jan 5 to Feb 24.

R Dra: Min (12.3) at beginning of Feb, max (7.0) at beginning of May, min (12.5) at beginning of Oct, rose to 7.6 on Dec 31.

R Gem: Fell from 13.1 on Jan 1 to min (13.8) in Feb, rose to 7.3 on May 19. Unobserved until Aug 24 (8.2), fell to 12.4 on Dec 31.

U Gem: Two long maxima observed about Apr 17 and Dec 16. No positive observations were made between May 5 and Aug 23, and a short max was probably missed in Jul or Aug. Observers should make every effort to keep the summer gap as short as possible, and the value of negative observations should not be underestimated.

T Her: Unobserved until Jan 30 (9.0), fell to min (12.8) at end of Mar, rose to max (8.0) in Jun, fell to min (12.4) at end of Aug, rose to max (7.5) in Nov, fell to 10.5 on Dec 31.

U Her: Unobserved until Feb 16 (8.5), fell to min (12.8) at end of Sep, rose to 11.5 on Nov 26, the last observation.

SS Her: Unobserved until Mar 30 (13.0), when the star was near min. Rose to max (8.7) in May, fell to min (13.3) in Jul, rose to max (9.6) in Sep, fell to min (13.0:) in Oct/Nov, rose to max (9.0:) in Dec. There was a hump at 11.2m on the rise to the second max. Needs more attention Nov - Mar.

AH Her: Maxima (11.4 - 11.9) probably occurred about the following dates (hypothetical maxima in brackets): Jan 30?, Feb 10?, Feb 24, (Mar 16), Apr 1, (Apr 16), May 1, May 22, Jun 5, Jun 21, Jul 8, Jul 26, Aug 15, Sep 4, Sep 22, Oct 11, Oct 28, Nov 16, Dec 1, (Dec 23). No standstills were observed; the mean period comes to 17.2d. Minimum mag. 13.9 - 14.2. Needs more attention throughout the year.

R Hya: Fell from 5.0 on Jan 16 to 8.5 on Jun 9, unobserved until Dec 1. Observations at the end of the year scatter 5.1 - 6.7. This object urgently needs more attention by observers in southern and low northern latitudes, especially between Jun and Nov.

X Leo: No positive observations before Feb 8. Maxima were observed about Feb 9 (L), Mar 2 (S), Apr 5 (L), Apr 25 (S), May 14 (S?), Jun 6 (?). There is room for missing maxim Mar 16 (probable short) and May 27 (possible short). No further positive observations before Nov 4. Fragmentary observations at the end of the year; a max occurred about Nov 20. This star needs much more attention.

R Lyn: Rose from 11.2 at beginning of Jan to max (8.8) in Mar, fell to min (13.9) in Oct, rose to 11.3 on Dec 31.

W Lyr: Rose from 9.1 on Jan 1 to max (8.1) at beginning of Feb, fell to min (12.3) in May, rose to max (8.3) in Aug/Sep, fell to min (11.4) in Dec.

RS Oph: Probable erratic variations 11.5 - 12.1, but underobserved.

R Peg: At max (7.6) in Jan. Unobserved from Feb 14 (7.9) to June 4 (11.4), then min (13.0) in Aug. Rose to 9.6 on Dec 31.

R Per: Rose from 13.0 on Jan 1 to max (8.6:) in Apr. Unobserved from May 1 (9.0) to Jul 22 (13.0). Min (13.3) at beginning of Aug, rose to max (8.5) at beginning of Nov, fell to 10.3 on Dec 23.

RS Per: Discordant observations but minima (8.3) in Mar and Nov, and max (8.1) in Jul are possible. The GCVS period of 152d does not seem right, but the amplitude is too small to be certain. More observations are especially needed Apr - Jul.

We hope to conclude this preliminary discussion of 1973 results in the next Circular.

POSTSCRIPT:

1. Binocular charts: When ordering these from the Chart Curator, please quote the name of the variable (the first in RA order if there are two or more), not the numbers given in the Catalogue under “Chart” which vary from one edition to another.

2. SN in NGC 4414: The publication of this report is being brought forward, and those who observed it should contact the Director at once. So far, results have been received (mainly via Ian Howarth) from Messrs Bailey, Black, Burch, Cooke, Griffin, Howarth, Hurst, Hynes, Loose, Matthews, Pennell, West, Young.

3. This VSSC has been held up by holidays, the paper shortage, duplicating ink shortage and food poisoning. Our next should go out in December; how about some letters from you to go in it? - to me by Nov 15.

John Isles

Published by the Variable Star Section and the Instruments and Observing Methods Section of the British Astronomical Association.

Editor: D C Salter, 16 Moor Lane, Plymouth PL5 1UA.

In PEPS2, John Isles asked for reports of 'live' photometric work, i.e. work at the telescope rather than from photographic records, to be sent to me. Thank you, to those people who did write; information exchange is essential! Graham Winstanley is still trying to achieve uniform illumination with his micro-photometer, but is only reading 30 to 60 microamps on his meter when using the Darlington chip in the circuit I suggested in PEPS2. He is going to experiment with the optical arrangement I also suggested in PEPS2. Still with photographic work, Geoffrey Lindop, (Horse and Jockey, Cardurnock, Kirkbride, Carlisle CA5 5AQ) writes: 'I think I can avoid the use of a densitometer by simply measuring the diameter of the black spot by projecting the image of the negative on to graph paper, and comparing the variable star with that of nearby comparison stars.' He admits that accurate results will be difficult to obtain, but is prepared to try it. I drew his attention to Mr. Pennell's paper referred to later - great skill is needed to obtain consistent results. Now to 'live' photometry: John Mason ('Astral Wood', 11 Orchard Way, Fontwell, Arundel, Sussex BN18 0SH) very kindly offered to help out with complicated circuit stencils which we may require for future issues of PEPS, and also said: 'I am at present building a photoelectric photometer system using and EMI type 9524B with S-11 cathode. At present the 1.2 kV power supply has been constructed and the DC amplifier is now being devised. I shall prepare a report in due course for the PEPS' - which I for one will look forward to! He also wanted information about inexpensive pulse-counting devices. Now, you can either pay quite a lot and record weak pulses using a semiconductor system, or use a current amplifier and a simple electromechanical counter. Those interested in either of these should write for the 120-page catalogue of Electroplan Ltd, P.O. Box 19, Orchard Road, Royston, Herts. SG8 5HH.

I was very pleased to hear from somewhere less plagued with bad weather: M D Overbeek, of 60, Edward Drive, Glendower, Edenvale, Transvaal 1610, kindly sent me a photocopy of his paper on the photoelectric observation of occultations, published in the Monthly Notices of the ASSA, Vol. 33, No. 122, February 1974. The telescope used was a 310 mm Cassegrain supplying an RCA 931A photomultiplier, and the account of the work and results achieved is most interesting. I hope that Mr. Overbeek will send us more detailed information about the equipment and circuitry.

A useful address is that of Photain Controls Ltd, Randalls Road, Leatherhead, Surrey KT22 7TD, who supply LDRs and photovoltaic cells. A much more interesting device is made by Integrated Photomatrix Ltd, of The Grove Trading Estate, Dorchester, Dorset DT1 1SY. This is the IP113, which gives minus 20 volt pulses, 1 microsecond long, the frequency of the pulses depending on the light intensity falling on the end-window of the T0-18 can in which the device is encapsulated. There is an article in 'The Observatory', Vol. 90, pages 249 and 250, December 1970, describing how this device was tested as a stellar photometer by focusing the light of Betelgeuse onto it using a 51 cm telescope. The beauty of this device is the digitised rather than analogue nature of the output, giving a potential for great accuracy. Unfortunately it seems that the device is not quite sensitive enough for use as a stellar photometer, although excellent for lunar work due to the very small sensitive area, permitting photometry of individual features. The greatest use of the device will however be in densitometry, in which the light shone through the negative can be arranged to give an acceptable count rate. Accuracy depends on counting rate, as it does with photomultipliers. Poisson statistics apply, and the error is proportional to the square root of the total pulse count, divided by the total time to accumulate that count. I am in the middle of correspondence with the Technical Manager of IPL about this device, and hope that it will be fruitful; a single device costs £4.85 at the moment, and is good value considering the potential applications. The data sheet is PX 102.

In the PEPS2 John Isles referred to 2 papers in the Journal dealing with photometry, and so I thought that I should give you a bibliography to chew over during these light summer evenings when you don't really want to work in the garden; here is the result of a search through the BAA Journal back to and including Vol. 48, (1937-38) for all papers relating to instrumental, rather than visual, photometry.

<u>Photometry at the telescope:</u>

1. 'Photoelectric Photometry' H W Cox, 58, 3, 101-4, 1947-8; includes a list of references as to April, 1948; see also the discussion on this paper on pages 90-92.
2. 'A Photoelectric Stellar Photometer' S Archer, 68, 8, 264-6, 1957-8. See also the discussion on pages 251-2; this design uses an EHT of 900 V.

8. ‘A Simple but Accurate Photoelectric Photometer’ R W Evans, 81, 3, 199-203, 1971. This paper is very interesting indeed and I would urge you to read it.
9. A paper to be printed in the Journal at some future date, by Mr. H K Robin, about his photoelectric photometer - see John Isles’ note in PEPS1

Photographic Photometry:

3. ‘A Simple Photoelectric Microphotometer’ S Archer, 70, 4, 183-4, 1959-60.
4. ‘A Combined Microdensitometer and Plate Measuring Machine’ D S Brown, 72, 1, 3-14, 1962. This is an excellent paper and much improves the work of Archer.
5. ‘The Photographic Observation of Variable Stars’ D S Brown, 73, 8, 340-4, 1962-3. Also good but possibly superseded by (7) below.
6. ‘Some Experiments in Photographic Photometry Using Comparison Prisms’ D S Brown, 75, 2, 78-87, 1964-5: a rather more advanced technique.
7. ‘Use of Modern 35mm Panchromatic Films for Magnitude Determination’ W E Pennell, 80, 5, 371-3, 1970. Essential reading for anyone interested in photographic photometry; Mr. Pennell is very well known for his photographic work.

Other references which may be of interest are:

‘The Observatory’ 93, 992, 9-13, 1973 and 93, 996, 207-8, 1973 dealing with image devices at the telescope.

J B Sidgwick, “Amateur Astronomer’s Handbook”, pages 542-3, giving a thorough but greatly outdated bibliography of photometric information up to about 1954.

‘A Wide-Range Photoelectric Photometer’, W R Bradford, in ‘Astronomical Optics and Related Subjects’, Ed. Z Kopal, North-Holland publishing company, 1956.

‘Observation in Modern Astronomy’, D S Evans, English Universities Press, 1968: see particularly pages 60 to 68 dealing with modern photometric techniques.

‘Photometry’, J W T Walsh, Constable, London, 1958. This book is rather out of date now, but the techniques described are still in use, and this book is a classic in its field.

I hope that somehow it will be possible to convey the essential contents of the previous photometric papers in the Journal, without requiring those interested to denude the BAA of its stocks of past Journals; perhaps I will have time to condense them into a review article for PEPS, but the simplest - and unfortunately most expensive method would be to reprint them, possibly edited where necessary. I hope to consult the Section Directors about this, since until you are all ‘clued-up’ on photometry the valuable new work cannot go very far. However, keep those letters coming in, and PLEASE include more technical details.

Best wishes for the summer holidays,
David Salter

(I am sure Mr. Pennell would agree that his paper referred to above - which should be read in conjunction with his letter in 80, 500, 1970 - complements but does not supersede D S Brown’s earlier papers. The simplified method of measurement of stellar disks using a dynameter is sufficiently accurate given the coarse grain of Tri-X; Brown's method, using Ilford R30 and R40 plates, gives more accurate results for a proportionally greater effort and expenditure. - John Isles)