The British Astronomical Association

VARIABLE STAR SECTION

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VARIABLE STAR SECTION
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Submission of observations

Observers are asked to make sure they send in all outstanding observations for 1987 to reach the correct person no later than the end of February. Binocular and Telescopic results should be sent to Melvyn Taylor. Eclipsing binary results, and any observations of the naked-eye variables not on the binocular or telescopic programmes (Eta Aql, Beta Peg, Delta Cep, Zeta Gem, Eta Gem, Alpha Her, Beta Lyr, Kappa Oph, Alpha Ori, Rho Per) should be sent to John Isles in Cyprus, but bulky reports (we hope there are many of these) may be sent to Mrs Elizabeth Isles in London, for forwarding to Cyprus. The addresses are given opposite.

Late submission of observations causes considerable problems for the Section officers. For example, one member sent some 1986 observations as late as 1987 November. By that time, processing of data for several stars had been completed, a report on them had been written for the Journal, and had already been accepted for publication. This report was withdrawn by the Director and is now being partly rewritten to include the late results. Any member who sends in his observations late will be responsible for delaying the publication of results, and wasting time that might be spend on producing more reports.

Future Objectives for the VSS - John Isles
(based in part on a message read to the Meeting of the Variable Star Section at Swansea, 1987 September 11)

The VSS has a unique position within the BAA. Most of the other Sections find it hard going to do any work of genuine scientific value, in the face of competition from large telescopes, orbiting observatories, and space probes. I am not trying to run down the other Sections - I wish things were otherwise, and there are important exceptions - but it has to be said that a great deal of their work is recreational. We too study variable stars for pleasure, but we are doing work of greater scientific value than the whole of the rest of the BAA lumped together.

If you doubt that, take a look at any professional journal, such as the Monthly Notices of the Royal Astronomical Society. You will find that amateur observations of variable stars are frequently referred to, but amateur observations of anything else are hardly ever mentioned. In fact, the demand from professional astronomers for amateur observations of variable stars has grown considerably, while other observing Sections have experienced the opposite trend.

The reasons for this are, briefly, that variable stars are now one of the main fronts of astronomical research; that space probes cannot go there; and that continuous monitoring over many years of many hundreds of objects is work that it seems can only be done by a team of amateur astronomers.

I believe this means my job is different from those of many

other Section Directors. Although several other Sections can attempt some research work, they are often mainly concerned with providing a means of communication between hobbyists with similar interests. We also try to do this in the VSS, and no doubt we could do it better; but my top priority must be to maximise the value of the scientific work of the Section.

There are three ways in which our work can become of scientific value.

First, there is the statistical analysis of the past behaviour of stars over many years. The VSS is the world's oldest variable star organisation, with nearly a century's continuous records on some stars. Although we have so far never managed to analyse all the observations that come in, they are all carefully filed for possible use in the future. The advent of personal computers enables us to look at the data in ways that were not practicable before, such as Fourier analysis to identify the multiple periods of semiregular variables. Our reports are second to none. I intend that there should be many more of these published in the future.

Melvyn Taylor's recent report on RX Boo was the first in a series of reports on the binocular stars, for which we have a unique set of data for the past twenty years. An obstacle to producing such reports in the past has been the need to sort out the observations on monthly report forms which the VSS inherited from the Binocular Sky Society. However, David Swain has now made great progress in computerising these, and the reports should begin to flow soon.

Observations of novae and supernovae ought to be published as soon as possible after their outbursts, and Guy Hurst has undertaken to compile reports on the recent ones for which we have unpublished data, and on all future ones. His job title, which has been changed from Nova/Supernova Search Secretary to simply Nova/Supernova Secretary, reflects the extra burden he has taken on!

To keep members in touch with this work, we propose to give short summaries in these Circulars of the reports that are submitted to the Journal.

A second way in which our observations become valuable arises when observers discover outbursts or other unusual activity in the stars we are monitoring. These discoveries need to be communicated to the astronomical world immediately. We are planning to add a number of objects to the main programmme that are worth monitoring for this purpose, particularly old novae, nova-like objects and Z Andromedae stars. There is also a supplementary programme of recurrent objects, run by Guy Hurst as part of his Nova/Supernova work. This has not been publicised before, but Guy Hurst has written about it in this Circular.

We are, in addition, introducing an alert network within the Section, in collaboration with the magazine "The Astronomer", or "TA", which already has such a network, using special Circulars, the telephone, and electronic mail. Details of the new alert

arrangements, and of some of the proposed additions to the programme, are given in this Circular.

Finally, professional astronomers will want to use our data for research or as background information for planning or interpreting their own observations. Although we have always been pleased to make our data freely available to anyone who wants them, many more requests go to our sister association in America, the AAVSO, because their data base is larger. At the moment, the two groups are strictly independent. Observers may not report their work to both organisations. However, I think we should now seriously consider working more closely with the AAVSO, and communicating at least some of our data to them regularly. This would result in increased use of our members' work, without diminishing the value of our own published reports.

A word about the future. For monitoring the behaviour of many variable stars, visual observation by a widely spread network of observers remains the best method, and will remain the best method for years to come. Estimates by eye may only be accurate to within a few tenths of a magnitude, but this is often good enough; and they can be made in conditions that are impossible for photography or photo-electric photometry. If better methods do come along, I have no doubt the amateur astronomer will be able to use those. Even so, visual observations made now will remain of value in the future, for historical analysis. There is no need to be ashamed of using low technology, especially if it happens to be the best for the purpose.

Photo-electric photometry is still a pioneering field for the amateur. Those who are breaking new ground here know that their work is of great value, both in the results obtained now, and for the new scope it opens for work by others in the future. Of the 70-odd types of variable star now recognised in the catalogue, many are beyond the reach of other methods of photometry, but all are open to photo-electric work. Countless new phenomena await discovery.

Photography offers many potential advantages. One exposure provides an impersonal, permanent record of the brightnesses of many hundreds of stars, which can be examined at leisure during the daytime or on cloudy nights. Despite the large number of amateur astro-photographers, very few use it for serious work on variable stars. The regular photography of Milky Way fields for novae is, however, undertaken by some amateurs, with considerable success. But such photographs contain a mine of information about the behaviour of bright variable stars of all types that is seldom exploited, perhaps because the work is less glamorous than 'discoveries'. I wonder whether there is any possibility that BAA members who are not active observers themselves could be given desk work using old patrol photographs.

I have mentioned some of the areas where the Section's policy is under review. But it is your Section, and we would like your comments. Please send them either to me, or to Storm for possible publication.

Observational programmes for 1988

We hope to publish shortly a list showing the latest catalogue data for all stars on the Section's programmes (with a short account of the abbreviations now used for the main types), and showing what charts are available for them (apart from eclipsing binaries, for which the Eclipsing Binary Handbook gives full information). The present notes record only the changes proposed for 1988, as compared with the lists given for binocular stars in the last Circular, and for telescopic stars in this one. The programme of recurrent objects, and the latest new eclipsing binary charts, are also listed elsewhere in this Circular.

The binocular programme has its origin in the programme of the Binocular Sky Society, which was absorbed into the VSS in the 1970s. The telescopic programme has its origin in the original VSS programme before that merger. The programme titles are possibly misleading. The "telescopic" list includes several naked-eye and binocular variables, while the "binocular" list includes several stars that are really too faint for binoculars. The distinction between these two programmes is really only an administrative one, in that the processing of "binocular" results is organised by Melvyn Taylor and John Toone, while Doug Saw looks after the "telescopic" stars.

We would therefore encourage owners of small telescopes to take on some of the fainter so-called binocular stars. Charts for two of these, DW Gem and SX Her, were given in the last Circular. Other objects that would benefit from such attention include most of the stars particularly discussed by Melvyn in the last issue, plus AQ And, BZ And, V Ari, TU Gem, SU Per, AD Per, PR Per, W Tri and RX Vir. We hope to prepare better charts more suitable for use at the telescope, but in the meantime most of the available binocular charts will be found fully adequate.

Binocular Programme changes

The stars listed below are to be dropped because if they vary at all their ranges are too small for effective visual observation. The list includes all the suspected variables. Most of these have been observed visually for almost 20 years, without any clear evidence of variation emerging, and it is clearly time to redirect effort to stars that are certainly variable. Any estimates of any of these stars made in 1987 should nevertheless be reported, and photo-electric observations of these objects would still be of interest in the future.

. Dropped stars: SAO 37607 And, NSV 12088 Aql, AE Aur (GCVS range 5.78-6.08), NSV 2537 Aur, VZ Cam (4.80-4.96), +61° 668 Cam, NSV 21 Cas, NSV 436 Cas, NSV 650 Cas, SAO 21020 Cas, OV Cep (5.00-5.07), NSV 13656 Cep, NSV 13729 Cep, NSV 14680 Cep, T Cyg (4.91-4.96), V1351 Cyg (6.33-6.55), V1624 Cyg (4.91-4.97, type SXARI), NSV 12247 Cyg, NSV 12439 Cyg, NSV 13874 Cyg, NSV 13857 Cyg, +47° 2801 Cyg, NSV 13150 Del, Fl 69 Dra, +23° 1192 Gem, NSV

14213 Lac, NSV 14260 Lac, NSV 3597 Lyn, Delta^2 Lyr (4.22-4.33), S Mon (4.62-4.68), NSV 2917 Ori, NSV 1280 Tau, NSV 1702 Tau.

Two stars with small ranges in the GCVS, but to be retained in the programme, are BN Gem (6.75-6.85) and V2048 Oph (4.55-4.85). They are both Gamma Cas stars, so they might show larger changes some time. Members' estimates of BN Gem do suggest that the range may be considerably greater than given in the catalogue, while V2048 Oph has been reported to show flares, with an amplitude up to 1.8 mag.

Even with the omission of these objects, the programme contains more than enough stars to keep even the most active observer busy; and as the last Circular made clear, many stars on the programme are seriously under-observed. For the moment, it is intended to confine any additions to the programme to eruptive variables. The following stars are currently being piloted by the Director, and he would welcome further suggestions from members.

Possible additions to Binocular Programme

Star	R.A. (1950)	Dec.	Range	Type	Chart
	h m	° '	m m		
EG And	00 41.9	+40 24	7.08 - 7.8 V	ZAND	AQ And
V1294 Aql	19 30.1	+03 39	6.82 - 7.23 V	GCAS	V450 Aql
FS CMa	06 26.0	-13 01	7.55 - 8.58 V	GCAS	JEI
HI CMa	07 10.5	-15 25	7.6 - 8.0 p	GCAS	JEI
SS Lep	06 02.8	-16 29	4.82 - 5.06 V	ZAND	JEI
Chi Oph	16 24.1	-18 21	4.18 - 5.0 V	GCAS	JEI

Telescopic Programme changes

The only immediate change is to drop DZ And. This was formerly listed as an R CrB star, but its spectrum shows no bands or lines of carbon and cyanogen, characteristic of this type. Moreover, the 1985 GCVS says that according to Rümmler (1978) the star was bright near the times of minimum light originally reported by Cragg (1961).

The optically variable galaxies Markarian 421, NGC 4151 and 3C 273 remain on the programme, although members will have noticed that the Deep-Sky Section now also has a programme on active galaxies. Discussions are currently taking place on optically variable objects that would be of interest to observers in both Sections, with a view to arranging joint co-ordination and publication of the work. We hope to say more about this shortly.

Some possible additions to the telescopic programme currently being piloted by the Director are listed below. These are mainly in the equatorial region, but northern stars should also be included, among them the Z And star AG Dra. We shall have more to say about the individual stars as charts suitable for issue become available.

Possible additions to Telescopic Programme

Star	R.A. (1950) h	m	Dec. °	'	Range m	m	Type	Chart
Z And	23	31.2	+48	33	8.0 - 12.4	p	ZAND	AAVSO/Burnham
AE Aqr	20	37.5	-01	03	10.4 - 12.5	B	XP	AAVSO/Burnham
TT Ari	02	04.2	+15	03	10.2 - 14.5	v	UGZ	AAVSO/RASNZ
TX CVn	12	42.3	+37	02	9.2 - 11.8	p	ZAND	AAVSO
BF Cyg	19	21.9	+29	35	9.3 - 13.4	p	ZAND	AAVSO
V1057 Cyg	20	57.1	+44	04	10.3 - 16.5	B	INT(FU)	AAVSO
YY Her	18	12.4	+20	58	11.1 -[14.0	B	ZAND	AAVSO
AM Her	18	15.0	+49	51	12.3 - 15.7	v	AM+XR+E	TA
V443 Her	18	20.1	+23	25	11.42- 11.72	V	ZAND	AAVSO
MV Lyr	19	05.7	+43	56	12.2 - 18.0	B	NL	AAVSO
BX Mon	07	22.9	-03	30	9.5 - 13.4	p	unique	AAVSO
FU Ori	05	42.6	+09	03	9.6 - 16.5	p	FU	AAVSO
V451 Ori	05	28.7	+10	59	8.5 - 9.5	p	GCAS	JEI
AX Per	01	33.1	+54	00	10.8 - 13.0	p	ZAND	AAVSO
V Sge	20	18.0	+20	57	9.5 - 13.9	v	NL+E	AAVSO/Burnham
SV Sge	19	06.0	+17	33	11.8 - 16.2	p	RCB	AAVSO
FG Sge	20	09.7	+20	11	9.45- 13.7	B	unique	AAVSO
V348 Sgr	18	37.3	-22	58	10.8 - 17	p	unique	AAVSO
UX UMa	13	34.7	+52	10	12.7 - 13.8	0p	EA(NL)	AAVSO

Alert arrangements for the VSS

Professional astronomers need to be alerted to activity detected by our members such as the outbursts of novae, recurrent novae, long-period dwarf novae and Z And stars; the fades of R CrB stars; and anything else unusual that our stars may do. At the same time, members will also want to be alerted themselves to such activity, to ensure that good observational coverage is secured. Thanks to the good offices of "The Astronomer" magazine, we now have an alert network for the VSS.

"The Astronomer", or "TA", is a monthly magazine which publishes reports of astronomical observations, usually the month after they are made. The Editor is our Nova/Supernova Secretary, Guy Hurst, and our member Tom Saville compiles the variable star column. TA is independent of the BAA, and includes reports from many countries; but all VSS members are encouraged to subscribe to it and contribute their observations. The annual subscription is £11.00 in the UK; £14.00 for Eire and the rest of Europe (all-up rate of postage); and for the rest of the world, £15.00 by air mail and £11.00 by surface mail. Subscription enquiries should be sent to John Colls, 177 Thunder Lane, Norwich, NR7 0JF. Remittances should be payable to "The Astronomer".

TA also issues Early Warning Circulars (EWC), Observers' Bulletins (OB), Variable Star Circulars (VSC) and Nova/Supernova Patrol Circulars (NSPC). EWCs give details of discoveries of novae, comets, supernovae, minor planets and other objects brighter than mag 11.0. OBs report similar discoveries in the magnitude range 11-14. VSCs report variable star discoveries, suspected variables, flares, unusual activity, chart and sequence notes. NSPCs give follow-up details of novae and supernovae, patrol news, charts and sequences. As well as variable star news from IAU Circulars or reported by observers, the TA Circulars will in future carry occasional announcements on behalf of the VSS, and the preliminary charts for novae and supernovae they give are identical with the official VSS charts for these objects.

The subscription rates per half-year are as follows. UK: £3.00 each for EWCs and OBs, £2.50 each for VSCs and NSPCs. Europe: £3.00 each. Rest of world: £3.50 each, which covers air mail postage.

TA also runs a telephone alert network. The subscription rates for alerts on objects reported in EWCs, OBs and VSCs are £2.50 each for UK subscribers, and £5.00 for Europe. You must also be a subscriber to the relevant circulars to enrol in the telephone alert network. TA also issues electronic circulars to those who have suitable computers and modems. There are about 70 such circulars a year, issued via Telecom Gold. The subscription rate to these is £10.00 per half year.

Enquiries and subscriptions for TA circulars, telephone alerts and electronic circulars should be sent to Guy Hurst (address on inside front cover). Remittances should be payable to "The Astronomer".

This is not a new service; what is new is that it is now open to all VSS members, and it will be used to carry VSS announcements that are too urgent to leave until the next VSS Circular. Such announcements will often be given in BAA Circulars as well, but as these have a large circulation they generally do not reach observers quite so quickly.

If you detect a possible nova, or other variable star activity that others should be alerted to, you should telephone a member of the TA team, which runs the official IAU clearing house for amateur discoveries in Europe. The following numbers are available up to 11 pm for variable star alerts, and all night for possible novae.

Guy Hurst - 0256 471074
Alan Young - 0435 882102
Graham Keitch - 0934 862924
Denis Buczynski - 0524 68530

You do not nave to subscribe to any of these services before you can report a discovery! A future VSSC will give more detailed guidance on what events are most likely to be worth urgent reporting. In the meantime, if in doubt, report it.

Eclipsing Binary Programme

New charts are available for the stars in the accompanying list. UV Leo and UZ Leo are contained on a single chart, as are TY and TZ Men. These charts are based on field sketches and sequence estimates by Tristram Brelstaff, Jack Ells, Colin Henshaw, John Isles and Melvyn Taylor. Observers who tackle new objects, and supply with their reports a sketch of the field that can be made the basis of a new chart, help greatly in expanding the programme.

Please note that eclipsing binary charts should be ordered not from John Isles but from Mrs Elizabeth Isles at the address given on the inside front cover. Please list clearly the stars you want; these should include only stars for which there is an asterisk in the "Chart" column on pages 10-28 of the 1988 Eclipsing Binary Handbook.

The 1988 Eclipsing Binary Handbook is now available and may be ordered from Storm Dunlop or from the BAA Office at Burlington House. The price is £1.25 post free to members in the UK, and £1.50 overseas (direct sale price £1.00). This 48-page booklet contains a general account of observing techniques, a catalogue of bright eclipsing binaries, predictions for all the Algol stars for which the Section has issued charts, and a selection of charts covering objects suitable for observation by beginners with small telescopes. The data have been revised to take account of work by VSS members and of recent literature, including Volume III of the GCVS, which covers constellations Pav-Vul. The predictions have been expanded to include the Algol stars among the newly charted systems listed here.

The report on minima observed in constellations Pav-Vul in 1985 is being held over in order to include O-C values against the elements of the new volume of the GCVS. A combined report for years 1985 and 1986 will be given in a future Circular.

Forthcoming VSS Reports

(The full text of these reports will be published in the BAA Journal.)

Eclipsing binaries, Cygnus to Hydra, in 1972-1985 (J. E. Isles)

Photoelectric and visual observations of 40 known and suspected eclipsing binaries are discussed. Revised light elements are derived for WZ Cyg, V1425 Cyg, TW Dra and V450 Her. The period of V450 Her should possibly be doubled from about $0^d.9$ to about $1^d.8$. Secondary minimum has been detected in DI Hya.

Mira Stars - II: R Cam, R Cas, W Cas, S Cep, T Cep, U Cyg and S Del (J. E. Isles and D. R. B. Saw)

Some 52 000 visual observations of seven Mira stars, observed for between 10 and 74 years, are analysed, and the results are

compared with catalogue data. A number of interesting correlations are found among features in the light curves. S Cep and U Cyg are found to vary slowly in their mean brightness, while R Cam, T Cep and U Cyg vary slowly in amplitude. The mean period of T Cep is confirmed to show evidence of variation, but those of R Cam and U Cyg are not found to vary.

Eclipsing binaries, Lacerta to Orion, in 1969-1986 (J. E. Isles)

Photoelectric and visual observations of 36 known and suspected eclipsing binaries are discussed. Revised light elements are derived for HP Lyr, V839 Oph and V530 Ori. WZ Leo is probably constant. Both of the alternative periods given in the literature for UW Ori appear to be incorrect.

New eclipsing binary charts

Star	R.A. (1950) h	m	Dec. °	'	Range m		m		Min II* m	Type	Period d	D* h
SW Lac	22	51.4	+37	40	8.5 -	9.4	V		0.8	EW	0.32	
VX Lac	22	38.8	+38	04	10.9 -	13.0	p			EA	1.07	3.9
AW Lac	22	16.1	+54	13	10.6 -	11.3	p			EB	1.14	
CM Lac	21	58.1	+44	19	8.2 -	9.2	V		0.4	EA	1.60	4.2
RT Leo	09	42.6	+20	08	10.3 -	11.6	p			EA	7.45	23
UV Leo	10	35.7	+14	32	8.9 -	9.6	V		0.6	EA	0.60	2.6
UZ Leo	10	37.9	+13	50	9.6 -	10.2	V		0.5	EW	0.62	
AP Leo	11	02.5	+05	25	9.3 -	9.9	V		0.6	EW	0.37	
Del Lib	14	58.3	-08	19	4.9 -	5.9	V			EA	2.33	13
GG Lup	15	15.6	-40	36	5.5 -	6.0	B		0.3	EB	2.16	
NSV 4031	08	19.5	+45	37	8.0 -	8.8	v			E?	?	
TT Lyr	19	26.0	+41	36	9.3 -	11.4	V			EA	5.24	18
TZ Lyr	18	14.2	+41	06	10.9 -	11.9	V			EB	0.53	
UZ Lyr	19	19.4	+37	51	9.9 -	11.0	v			EA	1.89	6.8
HP Lyr	19	20.0	+39	50	10.5 -	11.0	p		0.5	EB	139.5	
TY Men	05	31.8	-81	37	8.1 -	8.6	V		0.4	EW	0.46	
TZ Men	05	39.8	-84	49	6.2 -	6.9	V			EA	8.57	8.2
DN Ori	05	57.7	+10	13	9.8 -	11.1	p			EA	12.97	25
ER Ori	05	08.8	-08	37	9.3 -	10.0	V		0.7	EW	0.42	
EY Ori	05	28.8	-05	44	9.4 -	10.1	V			EA	16.79	23
FO Ori	05	25.5	+03	35	9.5 -	10.3	p			EA	18.80	9.0
V530 Ori	06	02.1	-03	12	10.6 -	11.3	p			EA	6.11	8.8
V640 Ori	05	52.6	-09	23	11.2 -	13.5	p			EA	2.02	5.3
V643 Ori	06	04.5	-02	55	10.7 -	11.5	p			EA	52.42	126

* Min II = depth of secondary minimum, if at least 0.3 mag.
D = duration of eclipse in hours.

Eclipsing Binary Handbook - 1988

Observers are reminded that the new edition of the Eclipsing Binary Handbook is now available. Catalogue details include information from Volume III of the latest edition of the GCVS. Many new systems (24) are included in the predictions. Two new charts, covering three systems are also given. Copies are available, from Storm Dunlop, or the BAA Office at Burlington House, price £1.50 for U.K. members and £1.75 for those living overseas. (Price £1.25 if collected from Burlington House.)

More observers of these stars are required, so why not obtain a copy of the booklet and include some on your programme?

Period-searching - Patrick Wils

I would like to make some comments on the paper by M.D. Houchen that which appeared in VSSC 65. First of all, trial periods should always be taken with a constant step in frequency, and not in period as Table 1 suggests. See a paper by R.F. Stellingwerf (*Astroph. J.* 224, 953 (1978), for this. The computation time of the different methods largely depends on the machine used, and of the sorting method. I have written a program in Turbo Pascal for an IBM-compatible PC, which is able to perform Fourier analysis, the Dworetsky, Renson, and Stellingwerf methods. Sorting is done by the Quicksort method (in cases where it is needed, namely Dworetsky and Renson), probably the fastest sorting method.

Fourier analysis is by far the slowest method, because it needs to calculate trigonometric functions, which take a lot of time. It takes about twice the time of the Dworetsky method, which is itself about a factor of two slower than the Renson method. Both methods are basically the same (observations need to be sorted), but the Dworetsky method is slowed down because of the use of the square root. The performance of the sort method could perhaps be improved, by taking into account that the observations are always nearly sorted: phase differences are not that large when going from one trial period to the next. However, I have not yet experimented on this. The Stellingwerf method is probably the fastest and best and it doesn't need sorts or trigonometric functions, and it has the advantage that, as opposed to the Fourier method, no assumptions are made about the shape of the light-curve. The run-time is essentially almost independent of the choice of N_b (see Stellingwerf's paper for definition), and with $N_c = 1$, it takes only about half the time of the Renson method. With $N_c = 2$, it is slowed down about a factor of 1.5 (Stellingwerf prefers $N_b = 5$, $N_c = 2$). The θ-curves are a lot smoother than with Dworetsky or Renson methods, and statistical information is more easily obtained. I therefore think it is a pity the Stellingwerf method is not mentioned in the paper by Houchen. If anyone should be interested in obtaining a copy of the program they can always contact me.

K. Marxstraat, 1 B-2640 Niel, Belgium

New and revised charts - Telescopic Programme

The following new or revised charts are available from John Toone.

VY Aqr: 9° field drawn by Stephen Lubbock; 1° and 10' fields by Guy Hurst, based in part on a photo by M. Mobberley and the Palomar Sky Survey. Original sequence a-t relettered A-T, and fainter comparisons added to 15.5 m.

PW Vul (Nova 1984 No.1): 20' field by Guy Hurst, from a photo by A. Young, sequence to 15.6 m. Chart No. N007.01.

Nova Vul 1987: 9° and 1.7° fields by Guy Hurst, based in part on photos by D. McAdam and H. Ridley. Sequence to 10.6 m. Chart No. N008.01. (Provisional magnitudes in BAA *Circular* 673 have been amended as follows: C 7.7, E 8.55, F 9.4). The 9° chart serves also for NQ Vul (Nova 1976) and PW Vul.

Erratum - VSSC 65

On page 6 of VSSC 65 an error occurred in one of the subheadings. For 'W Cam' please read 'W CMa'.

Charges for Circulars and charts

We regret that increasing costs have forced us to increase the charges for both the *Circulars* and for charts. The former will now be £4 for United Kingdom residents, and £5 for overseas members. This charge is for 4 issues (plus any special number containing light-curves that may be published). It is our aim to publish 4 *Circulars* per year, but this greatly depends upon the material to hand, and the Assistant Director's work-load. We hope that members will continue to feel that the *Circulars* are good value for money, most especially if they look back over earlier volumes and note how the number of pages is slowly increasing, as well as the standard of presentation.

The revised charges for charts are given on the inside back cover. Again, charges have been held stable for many years, and the charges now introduced only cover the cost of production and mailing.

Revised report forms

We are pleased to advise members that new report forms are now being introduced. Although these remain in the same general format as the 'computer' forms, they no longer require single letters and numbers to be entered into individual boxes, and the resulting forms appear less formidable and should be easier to complete. We do, however, ask members to enter their address, as the lack of this has caused problems in the past.

The new forms, and notes on how to complete them, are now available from Melvyn Taylor.

We would, however, remind members that if they have their observations in machine-readable form, on their own computers, we are happy to consider receiving their reports on disk or tape. But please contact Melvyn Taylor before submitting observations in this manner, as arrangements have to be made for the material to be read on appropriate machines, and then converted to a common format.

An index to the Circulars?

We would very much like to produce an index to the *Circulars*, as one is long overdue. Unfortunately, Storm Dunlop has been unable to undertake this, as he had hoped, so we should like to appeal for volunteers to carry out this important task. If anyone is prepared to help, please contact Storm, who will let them have guidelines as to way in which the index should be prepared. If anyone is able to enter the information on computer - a word-processing program is probably more suitable than an indexing program - this would help with later reproduction, but if you are prepared to have a go with 'old-fashioned' file cards, don't hesitate to let us know.

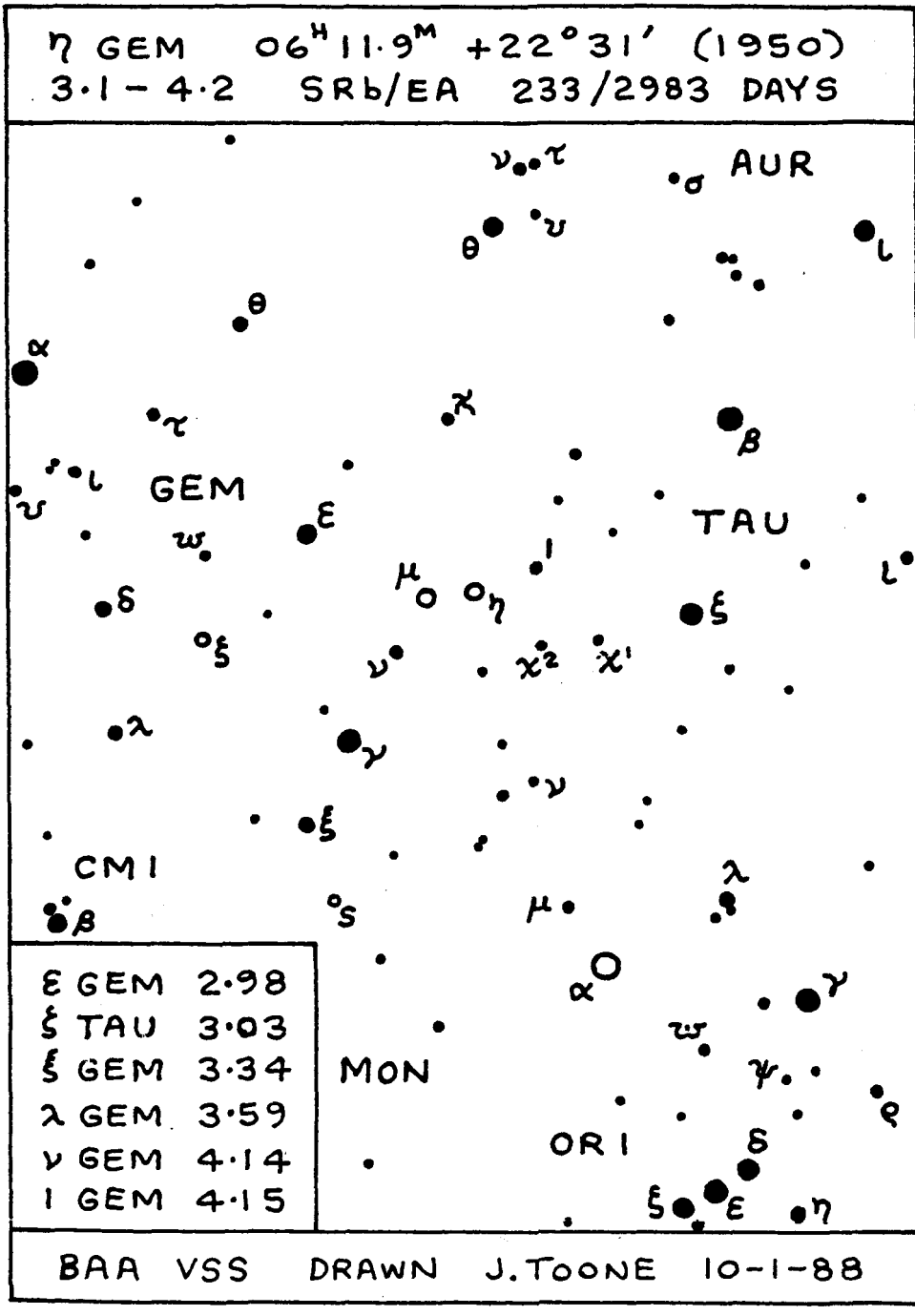
Eta Geminorum - John Toone

Eta Geminorum was found to be variable by Julius Schmidt in 1844. The star is classed as a SRb red giant, with an extreme range of 3.1-4.2 in an average period of 233 days. It is also a spectroscopic binary with a period of 2983 days. An analysis of the light-curve since the 19th century indicates that deep minima repeat at the same phase of the 2983-day period. Thus it now seems certain that the pair of stars form an eclipsing system.

The most extensive and recent study of this eclipsing system is 'On the Enigma of Eta Geminorum' by Colin Henshaw, published by the NWAVSO in 1981. This work presented data on the two most recently observed eclipses in 1971 and 1979/80. In 1971 the star faded to magnitude 4.1, and the duration of the eclipse was measured as 30 days. In 1979/80 the star faded to magnitude 3.9 with a duration of 30 days, as in 1971. The decline towards minimum and the rise back to maximum, however, appeared to cover a total of 150 days.

According to the revised elements in Henshaw's work, the next eclipse minimum is scheduled for JD 244 7253, 1983 April 1. Therefore all VSS members are urged to make observations Eta Gem until the star is lost in the twilight in May. The accompanying chart lists suitable comparison stars and all observations made should be submitted in the usual manner to Melvyn Taylor in July, along with all other Jan.-Jun. observations, and on the normal report sheets.

The next two eclipses of Eta Gem are unfavourable because they occur in the months of June and August. The next fully observable eclipse is not until 2012 October 2.


η GEM 06H 11.9M +22° 31′ (1950)
3.1 – 4.2 SRb/EA 233/2983 DAYS
AUR
GEM
TAU
CMI
MON
ORI
ε GEM 2.98
ζ TAU 3.03
ξ GEM 3.34
λ GEM 3.59
ν GEM 4.14
ι GEM 4.15
BAA VSS DRAWN J. TOONE 10-1-88

UK Nova/Supernova Patrol Report - Guy Hurst

A revised list of those objects on the 'Recurrent Objects' section of the patrol is given below. The general criteria for the inclusion of an object is that it is north of declination -10 and has a maximum of 14.0 or brighter. However for those living further south, details of additional objects can be supplied. Most objects have either no known period or one of 200 days or more. A few objects may be classed as 'rank outsiders' but the success on VY Aqr by Robert McNaught and DO Dra by Stephen Lubbock shows that this part of the patrol has already contributed valuable data.

By way of explanation, the 'charts' column is subdivided into three. The first lists 'A' charts, which are finders, the second 'B' charts for general telescopic use, and the third 'C' for high-power use. Although the 'N' means 'no chart yet issued', preliminary finders can be supplied for most objects on request, and by the middle of 1988 charts for all these objects should have been issued. The cost of charts is 10p for each chart, to which should be added 50p for post and packing. Please make remittances payable to 'G.M. Hurst'.

To join the patrol, please write to me for a patrol application form. A full catalogue of recurrent objects with further notes is also available for £1 post paid.

Join us now and help us to learn more about these obscure objects.

Recurrent Objects List as at 1988 Jan 1

Variable	RA (1950)	DEC	Mag Range	Type	Charts			Seql	Q	Rev
HP And	00 16.5	+41 11	10.5-(14.5p	UG:	N	N	N			
LS And	00 29.5	+41 42	11.7-20.5p	N?	N	N	N			
LL And	00 39.2	+26 21	13-(17v	UG:	N	N	N			
V452 Cas	00 49.4	+53 36	14-17.5:	UGSS	N	N	N			
HT Cas	01 07.0	+59 48	11.9-(16v	UG?	N	N	C	16.6	3	850120
XY Psc	01 07.6	+03 17	13.0-(18.5p	UG:	N	N	N			
FN And	01 19.3	+34 59	13.5-17.5p	UG	N	N	N			
UV Per	02 06.7	+56 57	11.0-17.5v	UGSS	BAA	VSS		16.5	1	016.03
UW Per	02 08.9	+56 52	13.5-18.8p	UG?	N	B	C	16.0	2	871026
NSV 00895	02 39.0	+43 09	11.7-(20p	UG?	N	N	C	16.2	3	860824
GK Per	03 27.8	+43 44	0.2-14.0v	N	BAA	VSS		15.2	2	7708..
HW Tau	05 00.6	+26 19	11.5-(17p	UGSS	N	N	N			
PG0818+513	08 18.9	+51 15	14.6-15.8B	UG?	N	N	N			
SW UMa	08 33.0	+53 39	9.7-16.5v	UGSU	BAA	VSS	N	14.7	1	019.02
PG0834+488	08 34.8	+48 19	14.8?	UG?	N	N	N			
BZ UMa	08 49.9	+58 00	10.5-15.3B	UG	N	N	N			
AK Cnc	08 52.6	+11 30	13-(17p	UG	N	N	N			
TU Leo	09 27.0	+21 37	11.7-15.2B	UG:	N	B66	N	13.8	2	871221
CY UMa	10 54.0	+49 57	11.9-17p	UG	N	B	C	F	4	871029
RZ Leo	11 34.8	+02 06	11.7-15.2B	UG:	N	N	C	15.0	2	871226

Recurrent Objects List (continued)

Variable	RA (1950)	DEC	Mag Range	Type	Charts			Seq	Q	Rev
DO Dra	11 40.8	+71 58	10.6-15.1B	UG?	N	B	N	12.4	3	860118
BC UMa	11 49.6	+49 31	10.9-18.3B	UG	N	N	N			
AL Com	12 29.9	+14 37	13.1-20.0p	UG	N	B3	N	19.5	2	830403
GO Com	12 54.2	+26 53	13.1-20p	UGSS	N	N	N			
HV Vir	13 18.5	+02 09	11.0-19p	N?	N	N	N			
PG1346+082	13 46.4	+08 12	13.0-17.0v	UG?	N	B11	N	F	4	850323
UZ Boo	14 41.7	+22 13	11.5-(16.1v	UG	N	N	N			
SS UMi	15 51.3	+71 55	12.6-17.6	UG	N	N	N			
T CrB	15 57.4	+26 04	2.0-11.3p	NR	BAA	VSS	N	10.5	1	025.01
V592 Her	16 28.8	+21 23	12.3-21.5p	UG?	N	N	N			
RS Oph	17 47.5	-06 42	4.3-12.5v	NR	BAA	VSS	N	13.8	1	024.01
PR Her	18 06.5	+38 47	14.0-18.5p	UG	N	N	N			
Nova Sct81	18 44.2	-05 00	8.0v-(22?	N?	A	B	N	11.9	3	810726
CI Aql	18 49.5	-01 32	11.0-15.6p	UG/N	N	N	N			
DM Lyr	18 56.8	+30 12	13.6-18p	UG	N	N	N			
V1113 Cyg	19 21.4	+52 38	14-(17p	UGSS	N	N	N			
HN Cyg	19 31.7	+28 49	13.3-16.0p	UG:	N	N	N			
V795 Cyg	19 32.6	+31 26	13.4-(17.9p	UGSS	N	N	N			
V542 Cyg	19 48.3	+58 22	13.0-18.3:	UGSS	N	N	N			
V1454 Cyg	19 51.8	+35 11	13.9-(17.0p	UGSS	N	N	N			
EY Cyg	19 52.7	+32 14	11.4-15.7p	UGSS	N	B	C	15.7	2	870704
V725 Aql	19 54.3	+10 41	13.7-16.2p	UG	N	N	N			
AW Sge	19 56.3	+16 33	13.8-(17.5p	UG	N	N	N			
V1028 Cyg	19 59.8	+56 48	13.0-18p	UGSS	N	N	N			
WZ Sge	20 05.3	+17 34	7.0-15.5B	UGSU	BAA	VSS	N	14.9	1	023.01
TY Vul	20 39.6	+25 25	14-19:p	UG	N	N	N			
UY Vul	20 53.7	+26 29	13.0-(16.0p	UG:	N	N	N			
UZ Vul	20 54.6	+23 23	14-(16p	UG:	N	N	N			
V1060 Cyg	21 05.8	+37 02	13.5-18p	UGSS	N	N	N			
VY Aqr	21 09.5	-09 02	8.0-16.6p	UG?	N	B	C	15.5	2	871025
EF Peg	21 12.7	+13 52	10.7-(17p	UG	N	N	N			
V632 Cyg	21 33.9	+40 12	12.6-17.5p	UGSS	N	N	N			
V1251 Cyg	21 39.0	+48 26	12.5-(15p	UG:	N	B6	N	15.2	3	820411
Scovil Cyg	21 40.8	+31 20	12.8-?	UG?	N	B7	N	14.8	3	860118
EG Aqr	23 22.7	-08 35	14.0-18.5p	UG	N	N	N			
V630 Cas	23 46.5	+51 11	12.3-17.1p	UG?	N	N	C	17.3	3	860825

'Variable Stars' by Hoffmeister/Richter/Wenzel

All VSS members who indicated an interest in obtaining copies of this book at a greatly reduced, special price should have received a note recently informing them that the shipment had arrived and that the final cost (including postage) was £26.60, rather than the normal selling price of £50. Anyone wanting a copy is urged to contact Storm Dunlop as soon as possible, because if orders for copies are not taken up, the books will be offered for sale elsewhere.

Unfortunately, contrary to the previous agreement by Council, the Treasurer has refused to accept the invoice for the shipment, so Storm Dunlop has had to arrange payment personally. Members are asked to note that payments MUST be made out to 'S.R. Dunlop' and NOT in the name of the Association.

NGC 4151, Markarian 421 & 3C-273 - John Toone

When the NWAVSO merged with the BAA VSS in 1981, the three extra-galactic objects NGC 4151, Markarian 421 and 3C-273 were added to the VSS Main Programme. These variable galactic nuclei were not previously monitored on a regular basis by amateur astronomers, so the main objective was to establish what form of variation each displayed.

It is still too early for a full-length paper discussing these objects, but a little background on my observational experience of them may stimulate further interest. I first observed NGC 4151 and Markarian 421 in 1977 using the 45-cm reflector at Salford Observatory. It was not until 1981, however, that I started to make magnitude estimates of these two objects, plus 3C-272, on a regular basis. New charts were drawn to aid in identification and visual sequences added from the following sources:

NGC 4151 - M.J. Penston, M.V. Penston and A. Sandage as quoted in the May 1978 issue of Sky & Telescope

Markarian 421 - J.S. Bailey from a photo by W.E. Pennell, 1976

3C-273 - M.J. Penston, M.V. Penston and A. Sandage from Proceedings of the Astronomical Society of the Pacific, 83, 783 (1971).

NGC 4151

This Seyfert galaxy has shown mainly irregular variations between magnitudes 11.3 and 11.9. It is obviously nebulous and this frequently makes magnitude estimates difficult. Sometimes the object has to be treated like a comet by making the estimate while the telescope is defocussed.

Estimates should be made of the galaxy's nucleus only, not including the diffuse peripheral regions, which are not subject

to variation. This is often difficult because, as with all galaxies, the amount of detail visible is determined by seeing conditions, not just aperture.

Although NGC 4151 can be followed all the year round from the UK, observations in the period July to October often suffer from the low altitude. A non-stellar object such as NGC 4151 is more susceptible to extinction than comparison stars. Consequently unless great care is taken in making the estimates, it can appear 'faint' during the late summer and early autumn.

The principal minima exhibited on the accompanying light-curve have all occurred during the times when the galaxy was low in the sky. So it is possible that some of the variation shown could be accounted for by low-altitude extinction effects.

There are 197 observations plotted on the light-curve, all of which were made with a 20-cm Schmidt-Cassegrain, apart from one single observation, which was made with a 6-cm refractor.

Markarian 421

Markarian 421 has shown the greatest and most interesting variation of the three extragalactic objects included in this report. It is, however, usually fainter than the other two and is normally to be found between magnitudes 13 and 14.

A most interesting event took place in April 1982, when a sharp, brief rise to magnitude 12.5 was observed. Markarian 421 faded back to magnitude 13 within a month and I have not seen similar eruptive-type activity since.

The magnitude was steady at 13.1 throughout 1981 to 1983, apart from the outburst in April 1982 just mentioned. There was a steady fade during the spring of 1984 and the magnitude fluctuated between 13.5 and 13.9 for the following 3 years. The 1987/8 apparition has begun, however, with Markarian brighter, at magnitude 13.3.

Unlike NGC 4151, this object is stellar in appearance and magnitude estimates do not suffer in the same way from extinction effects. Observations are difficult or impossible, however, during the months of July, August and September from the UK.

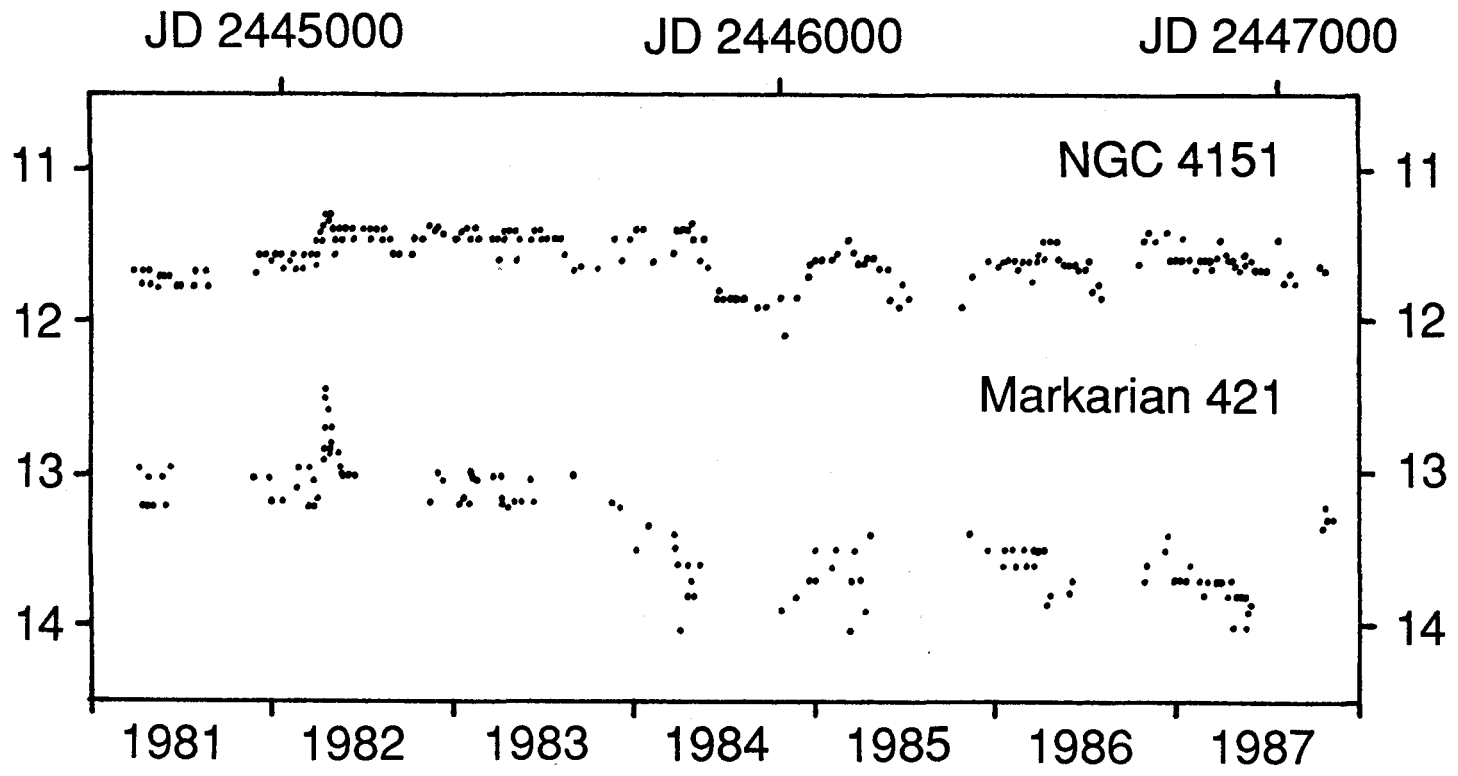
Markarian 421 is a very easy object to locate, being found just 2' Sp the 5th-magnitude star 51 UMa.

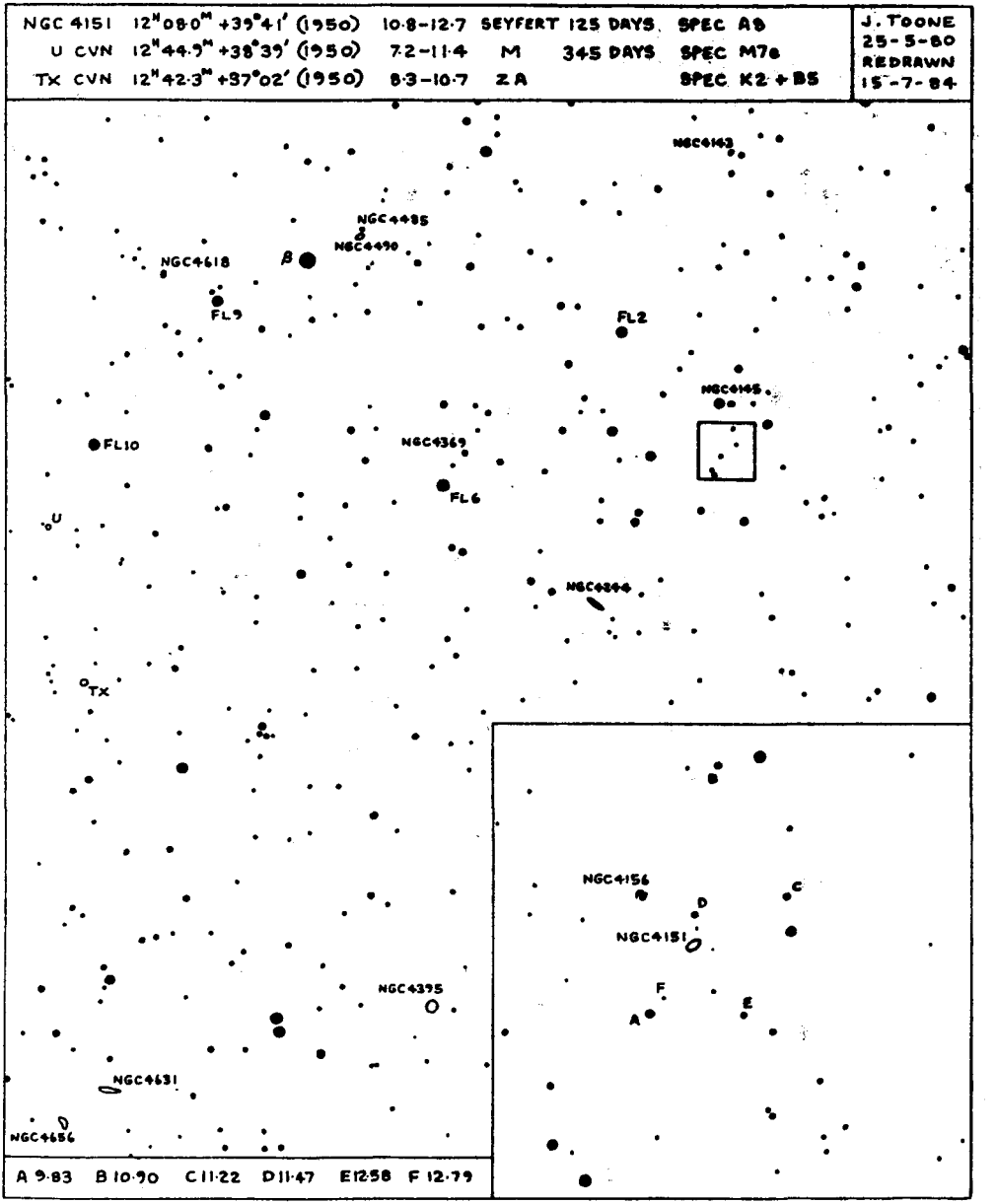
The light-curve plots 127 observations, of which 117 were made with a 20-cm Schmidt-Cassegrain, and the others with a 41-cm reflector.

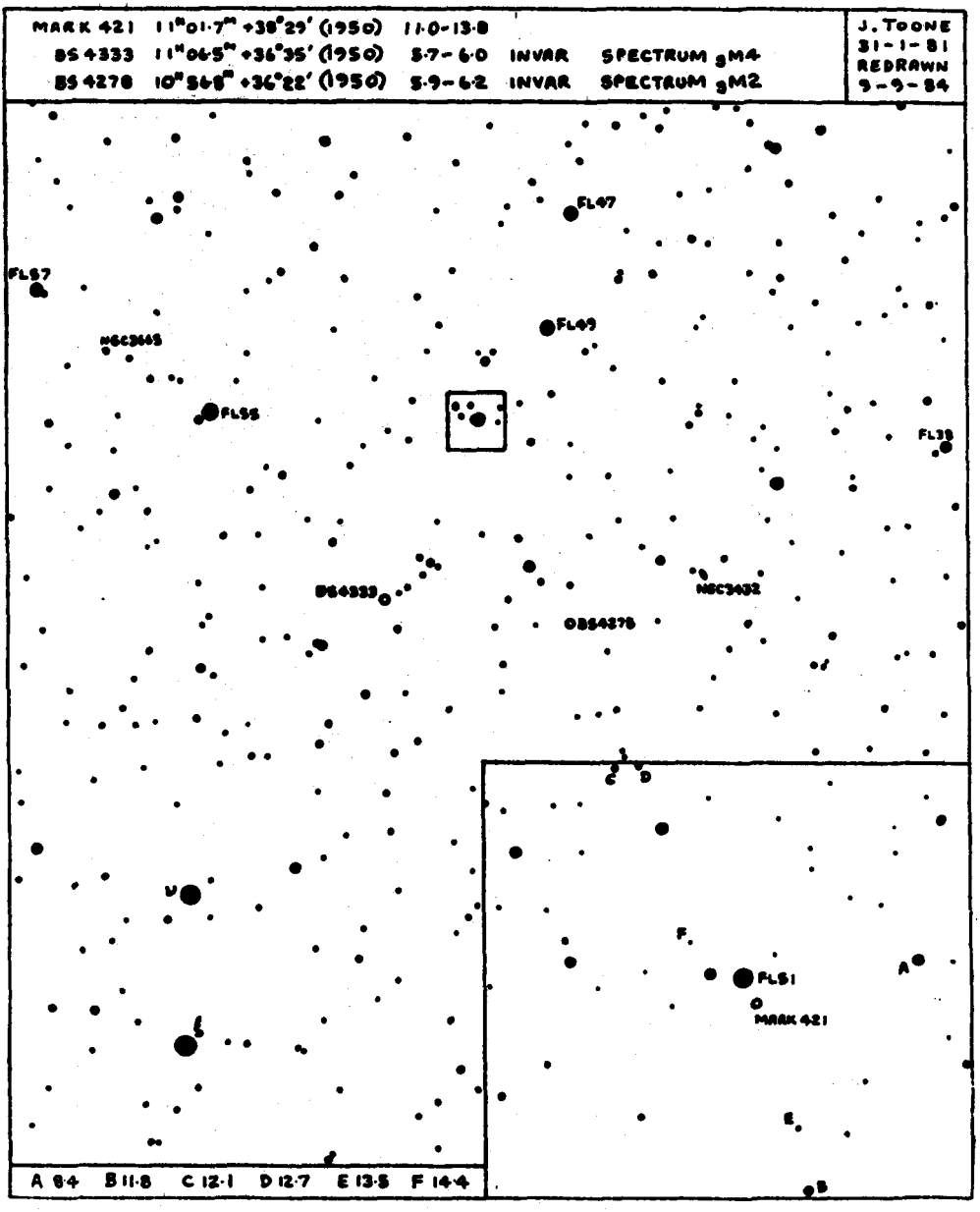
3C-273

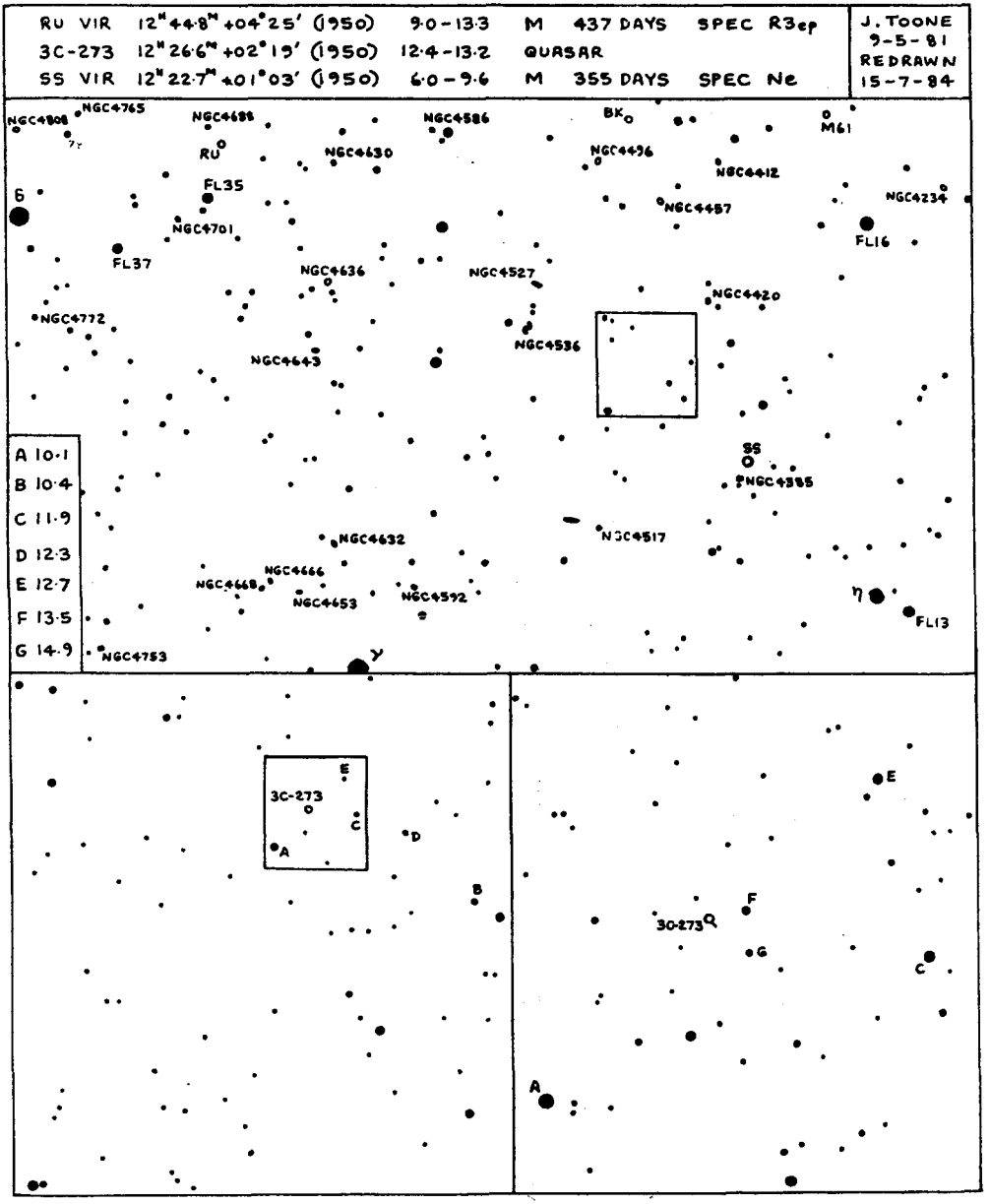
This famous quasar cannot be observed from the UK during the months of July through to and including October; and although definitely variable, has shown less activity that NGC 4151 and Markarian 421.

(continued on page 22)


JD 2445000
JD 2446000
JD 2447000
NGC 4151
Markarian 421
11
12
13
14
1981
1982
1983
1984
1985
1986
1987


NGC 4151 12ᴴ08·0ᴹ +39°41′ (1950) 10·8–12·7 SEYFERT 125 DAYS SPEC A9
U CVN 12ᴴ44·9ᴹ +38°39′ (1950) 7·2–11·4 M 345 DAYS SPEC M7e
TX CVN 12ᴴ42·3ᴹ +37°02′ (1950) 8·3–10·7 Z A SPEC K2 + B5
J. TOONE
25-5-80
REDRAWN
15-7-84
NGC4143
NGC4485
NGC4490
NGC4618
B
FL9
FL2
NGC4145
FL10
NGC4369
FL6
U
NGC4244
TX
NGC4395
NGC4631
NGC4656
NGC4156
NGC4151
A 9·83 B 10·90 C 11·22 D 11·47 E 12·58 F 12·79


MARK 421 11h01.7m +38°29' (1950) 11.0-13.8
BS 4333 11h06.5m +36°35' (1950) 5.7-6.0 INVAR SPECTRUM gM4
BS 4278 10h56.8m +36°22' (1950) 5.9-6.2 INVAR SPECTRUM gM2
J. TOONE 31-1-81 REDRAWN 9-9-84
FL47
FL57
FL49
NGC3445
FL55
FL38
BS4333
NGC3432
BS4278
A 9.4 B 11.8 C 12.1 D 12.7 E 13.5 F 14.4
FL51
MARK 421


RU VIR 12ᴴ44·8ᴹ +04°25′ (1950) 9·0 – 13·3 M 437 DAYS SPEC R3ep
3C-273 12ᴴ26·6ᴹ +02°19′ (1950) 12·4 – 13·2 QUASAR
SS VIR 12ᴴ22·7ᴹ +01°03′ (1950) 6·0 – 9·6 M 355 DAYS SPEC Ne
J. TOONE 9-5-81 REDRAWN 15-7-84
NGC4808
NGC4765
NGC4685
NGC4586
BK
M61
RU
NGC4630
NGC4496
NGC4412
FL35
NGC4487
NGC4234
NGC4701
FL16
FL37
NGC4636
NGC4527
NGC4420
NGC4772
NGC4536
NGC4643
SS
NGC4535
NGC4632
NGC4517
NGC4666
NGC4668
NGC4653
NGC4592
FL13
NGC4753
A 10·1
B 10·4
C 11·9
D 12·3
E 12·7
F 13·5
G 14·9
3C-273
A
B
C
D
E
F
G

Because 3C-273 is a zodiacal object, observations are hampered each month by the Moon (the quasar was originally identified from a series of lunar occultations in 1962).

During the period covered by the preliminary report, 91 observations have been included, of which 86 were made with a 20-cm Schmidt-Cassegrain and the rest with a 41-cm reflector.

Because 3C-273 was less well-observed than the other objects and because the variations noted were long-term, a light-curve has not been drawn. Instead, yearly means were produced and these are as follows:

1981	12.79	(9 observations)
1982	12.98	(21 ")
1983	12.92	(12 ")
1984	13.24	(11 ")
1985	13.05	(11 ")
1986	12.92	(16 ")
1987	12.85	(11 ")

From the above list it appears that 3C-273 faded slightly from magnitude 12.8 in 1981 to 13.2 in 1984, but later recovered to its original brightness by 1987.

There is much work that can be carried out by variable-star observers in the field of variable galactic nuclei. For the most part (NGC 4151 being the exception) they are stellar objects and should be treated in a similar way to Mira stars with observations being made on a weekly basis. Markarian 421 has show eruptive tendencies and deserves more frequent monitoring.

Many good-quality observations are required over the next few years by several observers to see if the preliminary results shown here can be substantiated. A 10-cm telescope is sufficient for NGC 4151 and a 20-cm will allow the observer to cover both Markarian 421 and 3C-273.

Professional astronomers tend to use the large telescopes at their disposal for short observing runs on active galaxies fainter than those included in this report. The only continuous data on these objects, as in many aspects of astronomy, will be provided by amateur astronomers with medium-size telescopes.

The Deep Sky Section is currently organizing a photographic monitoring network for active galaxies and quasars, but the best visual results will continue to be made by experienced variable-star observers.

This is one area of astronomy which is relatively new and in which the VSS can play a leading part.

Useful references and further reading:

D. Whitehouse: *Light Curve*, 4, (1), 9, (April 1979)
E.R. Craine: *A Handbook of Quasistellar and BL Lacertae Objects*, Pachart 1977
C. Hoffmeister: *Variable Stars*, 1985, pp.236-239

Telescopic Programme Summary, 1986 - D.R.B. Saw

Forty-eight observers made over 22 400 observations in 1986 of stars on the telescopic programme. Dave Stott (3443), Stephen Lubbock (3310), Shaun Albrighton (2100), John Toone (1997), Mike Gainsford (1780), Robert Paterson (1710) and Len Brundle (1119) each made more than 1000 observations, whilst twenty other observers made more than 100 observations each. The full alphabetical list is:

Albrighton, S.	2100	Isles, J.E.	31	Paterson, R.	1710
Bone, N.M	87	Kendall, R.A.	65	Pickard, R.D.	6
Brundle, L.K.	1119	Kennedy, I.H.	71	Poyner, R.D.	543
Chambers, R.H.	11	Kiernan, N.S.	527	Ramsay, G.	139
Collinson, E.H.	55	Kimber, A.	20	Shanklin, J.D.	112
Dryden, R.C.	569	Knight, N.F.H.	144	Smeaton, A.	7
Duncan, H.L.	94	Livesey, R.J.	16	Srinivasan, S.	119
Ells, P.E.	18	Lubbock, S.	3310	Stott, D.	3443
Fraser, R.B.I.	241	Maris, G.	21	Swain, D.	272
Gainsford, M.J.	1780	Markham, A.	402	Tanti, A.	322
Houchen, M.B.	85	Mettam, P.	163	Taylor, M.D.	316
Howard-Duff, I.	71	Middlemist, I.	682	Thorpe, J.	9
Howarth, J.J.	186	Middleton, R.	44	Toone, J.	1997
Hufton, D.	124	Moore, P.A.	31	Wheeler, P.J.	200
Hurst, G.M.	279	Munden, B.R.	60	Worraker, W.J.	93
Hutchings, A.	333	Nicholls, M.J.	377	Youngs, E.J.	25

Star totals: 1986

R And	211	XX Cam	513	W Cyg	439	SU Lac	158
W And	278	U CVn	8	SS Cyg	629	X Leo	283
RW And	172	S Cas	140	BC Cyg	201	RY Leo	48
RX And	428	T Cas	193	BI Cyg	203	U LMi	18
DZ And	218	UV Cas	338	CI Cyg	374	W Lyn	7
VY Aqr	91	γ Cas	537	Cyg	315	AY Lyr	358
R Aql	231	ρ Cas	558	HR Del	359	U Mon	284
UU Aql	104	o Cet	157	T Dra	130	RS Oph	284
UW Aql	85	R CrB	1071	AB Dra	410	U Ori	272
V603 Aql	18	S CrB	257	U Gem	384	CN Ori	252
SS Aur	483	T CrB	446	IR Gem	344	CZ Ori	285
U Boo	125	V CrB	168	RU Her	154	RU Peg	315
V Boo	157	W CrB	205	SS Her	164	S Per	225
V Cam	160	R Cyg	160	AC Her	472	RS Per	276
X Cam	231	S Cyg	167	AH Her	369	TZ Per	517
Z Cam	513	V Cyg	248	R Hya	71	UV Per	464

(Star totals: 1986 continued)

BU Per	259	RV Tau	207	CH UMa	440	3C 273	74
GK Per	235	SU Tau	244	V Vul	321	NGC 4151	177
WZ Sge	252	T UMa	323	PU Vul	248	Mark.421	51
R Sct	474	SU UMa	388	PW Vul	40	N.Cyg'86	286
R Ser	168	SW UMa	425	QU Vul(N2)	157	N.And'86	115

The Director wishes to make some changes to the programme [see the discussion on pages 5-6 of this issue], so details of the stars are not discussed here. May I thank observers of large-aperture instruments for covering the fainter stars very well, and at awkward times of the year. As well as the U Gem types, this includes the Miras at minimum, which cannot be seen by observers with smaller instruments.

As always, R CrB and SS Cyg are very well-observed. In fact, it could be said that there are too many observations of these stars, especially during the late summer and early autumn; consequently many observations are redundant. Perhaps observers of these stars would like to try their hand in the spring and early summer, at observing some of the stars from about 7 to 14 hrs RA, which are, at present, badly under-observed? In the meantime, congratulations to all on the splendid total for the year and keep up the good work.

Telescopic programme stars: notes for 1986

R And Rising to max. 5.9, Jan.24. Fall to min. 14.6, Oct.16. Rising to 11.3 at end of year.

W And Falling from 12.1 to min. 14.8, Apr.10. Rise to max. 8.7,, Sep.09. Falling to 12.4 at end of year.

RW And Rising from 14.4 to max. 6.9, Mar.29. Fall to min. below 14.8 late in Nov. Rise to 14.2 by end of year.

RX And Maxima in range 10.7-11.0 on Jan.02, Jan.17, Jan.31, Feb.13, Mar.06, Mar.22. Unobserved until maxima on Jun.11, Jun.25 and long max. centred on Jly 20. Gap until further maxima on Sep.15, Oct.09, Oct.24, Nov.07, followed by standstill in range 11.6-11.9. Fall to min. 13.6, Dec.23, followed by rise to max. 10.8, Dec.29.

DZ And Steady in range 10.0-10.2 until Mar.06, when lost. Recovered at 10.1 early in July. Possible rise to 10.0 by late Oct., then possible fall to 10.1 at end of year.

V1 Aql Outburst; caught rising at 11.7 on Apr.30. Max. 10.8, May 06 then fall to 14.9 by May 21. Possible one-day rise to 12.4 on May 24, but fainter than 14.8 on May 26 and also for remainder of year.

R Aql Rising from 11.6 to max. 7.0, Apr.28. Fall to min. 11.5, Sep.25, rising to 8.4 by Dec.22.

UU Aql Outbursts at 12, Apr.30; 11.8 centred on Jly 18. Bright max. 11.0 on Oct.08, falling to 12.8 by Oct.16. No further positive observations.

UW Aql First observation 8.8 on Mar.02. Possible fall to 9.2 by mid-August. Last observation 9.2 on Dec.20.

V603 Aql Spasmodic observations in range 11.2-11.8 from May 03 to Oct.03.

SS Aur Outbursts at 11.0, Feb.06 and 10.9 centred on May 07. Lost from end of May until mid-July. Then 11.1, Aug.28; 11.0, Oct.09; 11.0, Nov.13.

U Boo Rise from 11.0 to broad max. 10.7 about Mar.10. Fall to min. 11.3 about May 20, rising to max. 10.5 about Jly 01. Fall to 11.1 about Aug.10; rise to 10.9 about Sep.19. Fall to 11.2 about Nov.17, then rise to 11.0 at end of year.

V Boo Fall from 8.4 to min. 9.2, Apr.24; rise to max. 8.3, Jun.23; fall to 8.9 by Aug.27. Range 8.7-9.1 for remainder of year.

V Cam Rise from 13.4 through 12.0 on Feb.28 to max. 8.9, Apr.01. Steady fall to 14.6 at end of year.

X Cam Falling from 10.0 to min. 13.2, Feb.16; rise to max. 8.0, Apr.25; min. 13.4, Jly 9; max. 8.3, Sep.9; min. 12.8, Nov.29 followed by rise to 10.1 at end of year.

Z Cam Standstill in range 11.5-11.8 until May 03; fall to min. 13.5, May 17; max. 11.0 centred on May 25; min. 13.5, Jun.08; max. 10.9, Jun.15 followed by standstill, irregular range 11.4-11.8 until Sep.14, then irregular fall to min. 13.6, Oct.03. Normal behaviour resumed, with maxima centred on Oct.14, Nov.05, Nov.28 and Dec.28.

XX Cam Probably constant, but possible rise from 7.6 to 7.4 through year.

U CVn Badly underobserved, but max. 9.9, Jun.04.

S Cas Falling from 12.8 to 14.5 in mid-April, then negative observations for the remainder of the year.

T Cas Fall from 9.0 to min. 12.1, May 22. Rise to very flat max. 8.5, Oct.30.

UV Cas Steady at about 10.7 throughout year.

γ Cas Steady in range 2.1-2.3 throughout year.

ρ Cas About 5.2 until very early Sep., then rise to 4.9 by the end of October and 4.7-4.8 by end of year.

o Cet Rise from 8.7 to 3.6 on Mar.09, then lost. Recovered on Jly 17 at 7.5, falling to min. of 9.0, Oct.04. Rise to 6.0 at end of year.

R CrB Fell from 6.3 on Jan.11 to min. of 7.3, Mar.3. Rise to 6.5 at end of March, 6.2 in late April, then steady at 6.1 from end of May to end of year.

S CrB Falling from 7.2 to min. 12.4, Aug.07. Rise to 7.0, near max. at end of year.

T CrB Steady at 10.2-10.3 throughout the year.

V CrB Falling from 10.9 to min. 11.6, Mar.11. Rise to max. 8.8, Jly 23, then fall to 11.8 by end of year.

W CrB Min. 13.6, Jan.27, rise to max. 8.9, May 19. Fall to min. 13.8, Sep.21, rising to 8.6 at end of year.

R Cyg Fall from 10.4 to min. 14.4, Jun.23. Rise to max. 8.1, Nov.30, then falling to 8.9 by end of year.

S Cyg Fall from 14.1 to 14.4 on Jan.19, then lost. Recovered rising at 14.3 on May 27 to max. 9.8, Sep.19. Falling to 14.5, Dec.20, then lost.

V Cyg Rising from 11.4 to very flat max. 8.9 extending from Mar.09 to May 18. Slow decline to 10.1 by Aug.13, then faster fall to 13.1 by end of year.

W Cyg Rise from 6.4 to 6.1, Feb.07. Fall to 6.4, Mar.27. Slight rise to 6.2, Apr.27, then fall to min. 6.6, Jun.03. Rise to max. 5.7, Jly 24; fall to min. 6.6, Oct.11. Rise to 6.2, Nov.29, then fall to 6.4 at end of year.

SS Cyg At 10.9, falling from max. Outbursts centred on the following dates: 8.5, Feb.11; 8.5, Mar.30 (short); slow rise, 8.4, May 20; 8.5, Jly 18 (short); 8.3, Sep.21; 8.5, Nov.27 (short).

BC Cyg Rise from 10.3 to broad max. 9.8, centred about May 24. Slow fall to 10.3 early in December.

BI Cyg Steady at 9.8 until mid-May. Possible rise to 9.6 by mid-June, then steady until end of year.

CI Cyg Very slow fall 10.7 to 11.3 through year.

Cyg Rise from min. 13.9, Feb.01 to max. 4.3, Aug.07. Fall to 11.3 on Dec.26.

HR Del Possible slight fall from 11.8 to 11.9 through year.

T Dra Rise from 10.4 to max. 9.5, Apr.06. Fall to min. 13.1, Nov.12. Rise to 12.9 by end of year.

AB Dra maxima in the range 12.7-13.0 about following dates: Jan.12, Jan.22, Feb.08, Feb.19, Mar.03, Mar.13, Mar.24, Apr.01, Apr.13, Apr.24, May 03, May 13, May 28, Jun.07, Jun.17, Jun.25, Jly (06), Jly 19, Jly 30, Aug.09, Aug.18, Aug.28, Sep.06, Sep.16, Sep.25, Oct.03, Oct.11, Oct.20, Oct.28, Nov.07. Mean interval 10.0 days. Slow fall to 14.4 by Nov.19, then irregular rise to 14.1 by Dec.03. Rise to max. 13.0, Dec.06, followed by fall to 13.8-13.9 only over period Dec.11 to Dec.26. Rise to 13.6 at end of year.

U Gem Outbursts with maxima as follows: 10.3, Jan.04; 10.0, May 13; 9.9, Oct.02. Fall to about 14.0 for remainder of year.

IR Gem Rising at 12.4 on Jan.11 to max. Maxima of 11.1, Feb.10; 11.0, Mar.25; 11.0, Apr.26. Falling at 12.2, May 03, then lost. Recovered at 12.5 on Aug.18, falling from max. Max. 11.0, Oct.22. Observed falling from maxima as follows: 12.9 on Nov.20, 12.5 on Dec.06 and 12.7 on Dec.25.

RU Her Falling from 10.7 to min. 13.8, Jly 03. Rise to 10.7 by Nov.09, steady until Dec.07, rise to 8.9 at end of year.

SS Her Min. 12.7, Jan.09; max. 9.1, Mar.10; min. 13.0, May 08; max. 9.1, Jun.18; min. 12.8, Aug.29; broad max. 9.2 centred on Oct.17; min. 12.5, Dec.12.

AC Her Primary min.(1) and secondary min.(2) alternating throughout year. Min.(1) 8.4, Jan.03; max. 7.4, Jan.20;

min.(2) 7.8, Feb.10; max. 7.3, Mar.02; min.(1) 8.4, Mar.20; max. 7.3, Apr.07; min.(2) 7.9, Apr.30; max. 7.3, May 15; min.(1) 8.5, Jun.08; max. 7.2, Jun.26; min.(2) 7.9, Jly 13; max. 7.2, Aug.01; min.(1) 8.3, Aug.19; max. 7.2, Sep.11; min.(2) 7.8, Sep.30; max. 7.3, Oct.16; min.(1) 8.3, Nov.05; max. 7.2, Nov.24; min.(2) 7.9, Dec.12; max. 7.2, probably about Dec.31. Mean double period 76.5 days.

R Hya Falling from 7.7 to min. 8.9, Apr.29. Rising to 6.2 on Aug.08, then lost. Falling from 6.8 on Dec.05 to 7.4 at end of year.

SU Lac First positive observation on Apr.09 at 14.9. Rising to max. 10.8, Jly 25. Fall to 15.3 on Dec.20.

X Leo Outburst maxima of 12.7, Jan.09; 12.3 (long), Feb.16; 12.4, Mar.12; 12.3, Mar.28; 12.2 (long), Apr.16; 12.4, May 03; 12.4, May 19; 12.2 (long), Jun.06. Gap until 12.3 (long), Oct.05; 12.4, Oct.25; 12.4, Nov.10; 12.3 (long?), Nov.29; 12.4, Dec.17; 12.3, Dec.31.

RY Leo Fall from 10.1 to min. 11.6, Mar.08. Rise to max. 9.9, Apr.30. Fell to 10.4 on May 24, then lost. Falling from 9.7 on Oct.06 to 10.6 on Dec.11.

U LMi Falling from 11.1 to min. 12.8, Apr.19; rising to 12.5 on May 03, then lost. Four observation only from late Oct. (11.5) to early Dec. (12.1).

W Lyn Max. 9.6, Jan.17. Falling to 11.9, Mar.01. No further observations.

AY Lyr Falling at 13.6, Jan.03. Falling at 14.1, Mar.01. Max. 13.2, May 14. Long max. from 12.2 on Jly 03 to 13.3 on Jly 15. Falling at 14.2, Jly 17. Further max. 13.4, Sep.27; 13.1, Nov.15; 12.9, Dec.14.

U Mon Falling from 7.3 to min. 7.6, Feb.02. Rise to 7.2, Feb.24; fall to 7.5, Mar.18; rise to 7.1, Apr.09; fall to 7.6, May 06; rise to 7.1, May 22, then lost. Recovered at 6.8 mid-Sep. Min. 7.2, Nov.08; max. 6.1, Dec.01; falling to 7.2 at end of year.

RS Oph Scatter in observations. Mean curve rising from 11.5, mid-Jan. to 11.1, May 21. Further rise to 10.8, Jun.10, followed by slower fall to 11.2 early in Aug. Continuing at 11.2 until late in Nov.

U Ori Falling from 6.8 to 10.8, Apr.29, then lost. Recovered Aug.30 at 11.2, rising to max. 7.0, Nov.16. Falling to 8.2 on Dec.30.

CN Ori Maxima of 12.6, Jan.02; 12.3, Jan.16; 12.3, Feb.09; 12.2, Feb.25; 12.2, mar.13; 12.2, Apr.01; rising at 13.9, Apr.17, then lost. Maxima of 12.3, Sep.02; 12.4, Sep.21; 12.5, Oct.09; 12.3, Oct.29; 12.4, Nov.16; 12.0, Dec.06; 12.1, Dec.26. Mean interval 18.5 days.

CZ Ori Maxima of 12.2, Jan.09; 12.2 (long), Feb.03; 12.1, Mar.06; 12.2, Apr.01; 12.2 (long), Apr.26, then lost. Further max. of 12.1 (long), Sep.14; 12.3, Oct.25; 12.4, Nov.22; 12.3, Dec.19.

RU Peg Outburst max. 10.5, Feb.04. Few observations between mid-Feb. and Jun.03. Max. 10.3, Jun.26. Well-observed for remainder of year, the only outburst max. being 10.4, Oct.21.

S Per Observations range from 9.2 to 10.2, but probably steady at 9.6 throughout year.

RS Per Slow rise from 8.5 to 8.3 in late April, then steady until mid-June. Fall to 8.9 by late Sep. and continuing at 8.9 until end of year.

TZ Per Maxima of 13.1, Jan.10; 12.5, Jan.25; 12.8, Feb.08; 12.9, Feb.19; 12.9, Feb.28. Standstill 13.4–13.6 from Mar.04 until Mar.19, then fall to min. of 14.4 by Mar.25. Further max. of 12.5, Mar.31; 12.7, Apr.28; 12.9, May 13; 12.8, May 28; 13.0, Jun.16; 12.8, Jun.30; broad max. 12.9 from Oct.11 to Oct.24; 13.0, Nov.06; irregular between 13.3 and 13.7 for remainder of year.

UV Per Outburst seen at 13.6, Jan.29; negative observations for rest of year.

BU Per Rise from 9.9 to 9.5 by Mar.05. Slow fall to 9.8, Sep.20, then rise to 9.6 early in Nov. Possible fall to 9.7 by end of year.

GK Per At minimum about 13.1 until Nov.14, then rise through 11.5 on Nov.25 to max. of 10.4, Dec.14. Fall to 10.9 at end of year.

WZ Sge Negative observations (fainter than 14.3) until late August. Positive observations between 14.5 and 14.8 from Aug.28 until Dec.25.

R Sct Near minimum, rising from 7.4 on Jan.16 to max. of 5., Feb.19; secondary min. 5.7, Mar.24; max. 5.3, Apr.21; min. 6.7, Jun.04; max. 5.0, Aug.03; secondary min. 5.7, Sep.04; slight rise to 5.6, Sep.14; min. 7.6, Oct.27; max. 5.1, Dec.08.

R Ser Near min. 13.8 on Jan.07, rising to max. 6.5, Jun.06. Fall to 13.3 by Dec.30.

RV Tau Near max. 9.3 on Jan.03. Min. 10.2, Jan.26; max. 9.2, Feb.14; min. 10.1, Mar.06; max. 9.3, Mar.22; min. 10.3, Apr.15; rising to 9.4 on May 01, then lost. Recovered at 9.4 on Jly 31. Falling from 9.8 on Sep.03 to min. 10.6, Sep.24; max. 9.3, Oct.09; min. 10.3, Nov.01; max. 9.4, Nov.16; min. 10.6, Dec.08; max. 9.4, Dec.23.

SU Tau At maximum, 9.8 until Oct.20, then fall to 15.0 by Dec.03. Continuing at 15.0 until end of year.

T UMa Fall from 8.7 to min. 12.6, Apr.14. Rise to max. 7.5, Jly 28. Fall to 12.8 by end of year.

SU UMa Near max. 12.2, Jan.01. Seen bright at 12.5, Apr.05; 12.9, Apr.26; 12.7, Jun.10. Maxima of 12.0, Jly 18; 12.4, Aug.26; 12.0, Sep.09. Supermax. 11.5, Oct.09, falling to 12.5 by Oct.20 and 13.7 on Oct.28. Bright at 12.9, Nov.09 and 12.7, Nov.22. Maximum 11.9 on Dec.16.

SW UMa On March 3, rapid rise from below 14.0 to max. of 9.7. Slow fall to 11.8 on Mar.20, then more rapidly to 15.0 by

Mar.29. Not seen for remainder of year.

CH UMa Seen at minimum 15.1 until Oct.28, then rise to max. 11.5, Nov.05. Fall to 15.0 by Nov.14 and continuing at minimum for remainder of year.

V Vul All maxima 8.4-8.5 and primary min.(1) and secondary min.(2) alternating throughout year. min.(2) 9.0, Jan.09; max. Jan.20; min.(1) 9.4, Feb.11; max. Mar.06; min.(2) 8.8, Mar.20; max. Apr.04; min.(1) 9.6, May 03; max. May 20; min.(2) 8.9, Jun.10; max. Jun.24; min.(1) 9.4, Jly 15; max. Aug.01; min.(2) 8.9, Aug.17; max. Sep.03; min.(1) 9.2, Sep.25; max. Oct.14; min.(2) 8.9, Oct.30; max. Nov.16; min.(1) 9.5, Dec.11. Double period 76 days.

PU Vul Steady at 8.7 throughout year.

PW Vul (Nova Vul.1984, No.1) Fall from 12.0 to 14.1 through year.

QU Vul (Nova Vul.1984, No.2) Slow decline from 10.5 to Jly 21 (about 10.7), then faster decline to 11.7 by end of year.

3C 273 Steady at 12.9 throughout year.

NGC 4151 Steady at 12.3 through year.

Markarian 421 Scatter between observers, but probably 13.7 throughout year.

Nova Cyg 1986 Fall from 9.9, Aug.14 to 12.3 at end of year, with brightenings as follows: 10.2 on Sep.07; 10.7 on Sep.21; 10.2 on Oct.04; 10.4 on Oct.23; 11.7 on Nov.22; 12.1 on Dec.21.

Nova And 1986 Fall from 6.8, Dec. 8 through 8.6, Dec.20 to 9.1 on Dec.30.

Errata: Binocular Programme Summary, 1986

The following errors occured in the report in VSSC 65:
page 4, the number of variables observed by G. Ramsay is 69;
page 5, NO Aur is omitted from list. It had 107 estimates.

Exhibition Organiser: Volunteer wanted

Is there any member who would be prepared to act as Exhibition Organiser for the Section? It would help the Officers very greatly if someone could accept responsibility for receiving material - and chasing up items, if necessary - and setting up the exhibit on the actual day. If anyone is prepare to help (at least for this year, when the Exhibition Meeting is on June 18), would they please contact Melvyn Taylor.

Did you find DW Gem?

The photograph of the field around DW Gem in VSSC 65 (page 11), was not deliberately set as a puzzle. It does appear to have caused some members some distress, and has called forth the comment of 'I can't see that many stars from here!' In fact, the orientation of the photograph is the same as that of the chart

(of course), and the scale is almost identical to that of the field enlargement. Still need help? Then with north at top and the bottom left-hand corner as origin, X = 93 mm, Y = 53 mm.

That technique for seeing in the dark, and another tip

John Isles reports that the technique described in the last issue for rapidly adapting to the dark does not work for him, or at least is no superior to merely being in darkness for that length of time. (Neither does it work for Storm Dunlop, but whether this says anything about VSS Officers, we do not dare to speculate.) John also points out that there is no such word as 'adaption', so we should have spoken of 'dark adaptation'. True, it would probably be better English, but 'adaption' has existed since 1704. Mind you, the first recorded use was by Johnathan Swift, who was never adverse to making up a few words when it suited him.

Seriously though, we should be interested to hear members' comments about the subject of dark-adaptation, and the visibility of faint stars. Storm Dunlop has certainly found some improvement taking place as much as an hour after the 30-45 minutes normally quoted, if all light (even red) is avoided. (Which is fine if you can remember the sequences and can later decipher your notes.)

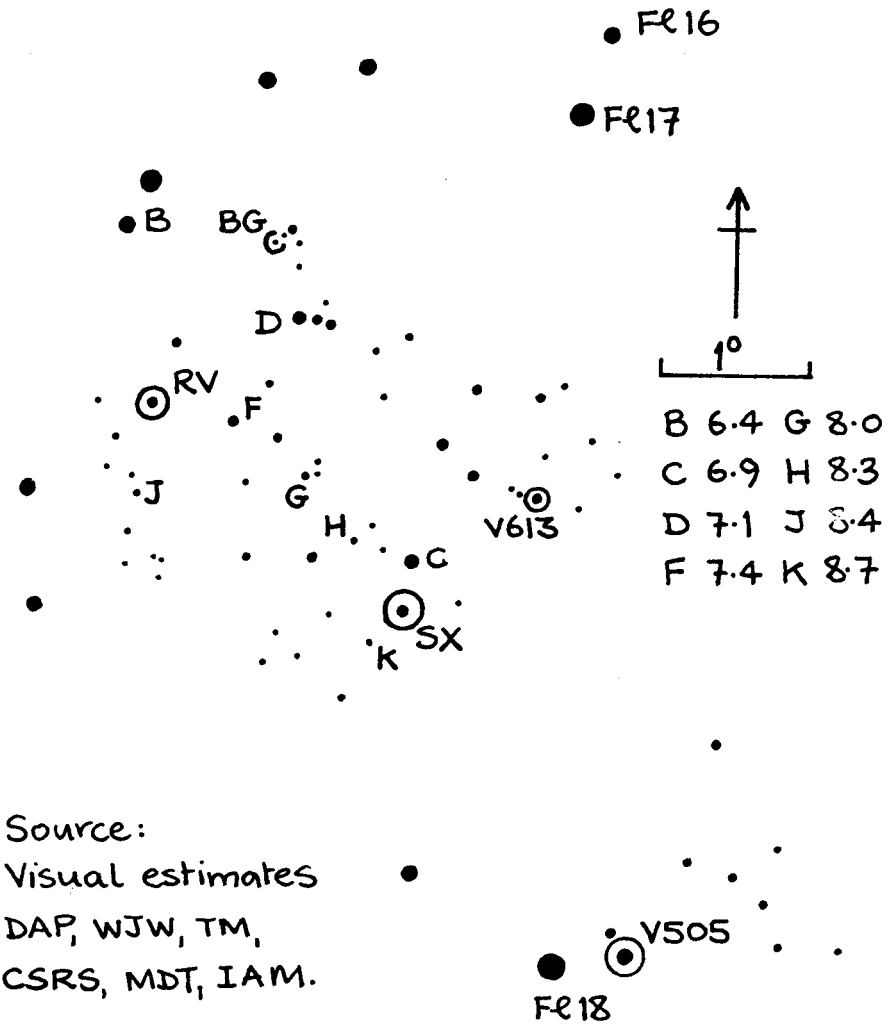
John Isles remarks that he sometimes finds himself craning his neck at an awkward angle to reach the eyepiece. He finds that if he then twists his head so that it is vertical, fainter stars can often be seen. The effect can be quite dramatic, with stars half a magnitude brighter 'popping out'. Presumably, this also has something to do with the blood supply to the retina. It may not work for everyone, but seems a technique worth trying.

A revised chart for RV and SX Mon

The chart opposite is the latest preliminary chart for the stars RV and SX Mon. These are on the Binocular programme, but one star in the sequence has given problems. The changes to the original chart are that comparisons A and L are dropped and C is amended to magnitude 6.9. We would be grateful if experienced observers would check the sequence, by attempting to judge the number of Pogson steps (0.1 m) between the comparisons. Estimates made whilst the area is still available in the evening sky would be greatly appreciated and should be reported to Melvyn Taylor as soon as possible. Estimates of the variables should be made at the same time. Details of the variables shown on the chart are:

RV Mon: 06h 55.7m +06°14.1', 6.8-8.3, SRb, 131.5 d, C4-C6
SX Mon: 06h 43.3m +04°49.5', 7.3-8.5, SR, 100 d, M6
The mean magnitude of both stars varies.
V505 Mon: 7.15-7.65 V, ED/GS/D, 53.7805 d - on Ecl. Programme.
V613 Mon: 7.64-8.5 V, SRb± - Not on programme, but if the quoted range is correct, it might be considered for inclusion.
BG Mon: 9.2-10.4 V, SRB, 30 d±, C5 - Not on programme.

064604 SX Mon 7·3 - 8·5 SR
065306 RV Mon 6·8 - 8·3 SRB



Source:
Visual estimates
DAP, WJW, TM,
CSRS, MDT, IAM.

DAP 1972 Mar 14.
Latest preliminary; 1987 Dec 30,
MDT

MINIMA OF ECLIPSING BINARIES, 1986 - (1) And to Cet

John Isles

In the accompanying list of observed minima, photoelectric determinations are underlined. For further explanations, see VSSC 58.

The total numbers of observations received for known and suspected eclipsing variables in constellations And-Cet, including estimates reserved for separate discussion, are summarised below.

	Observations	Timings
Photoelectric:		
J Ells (EJ)	322	13
A Hollis (HO)	76	3
R Pickard (PI)	34	3
Total	432	19
Visual:		
N Bone	20	-
T Brelstaff (BS)	418	29
A Chapman	10	-
L Cluyse (UY)	51	2
H Duncan (DH)	133	7
R Geddes	75	-
A Horton	1	-
J Isles (IS)	69	5
G Kirby (KG)	8	1
P Langridge	14	-
G Maris (VM)	50	1
A Markham (QM)	227	4
I Middlemist (MM)	155	14
G Pointer	45	-
J S Smith	27	-
G Spalding (SP)	10	1
M Taylor (TY)	45	2
N Taylor	75	-
R Watts	3	-
P Wheeler	22	-
W Williams	2	-
A Woodruff	34	-
Composite timing	-	1
Total	1494	67
Grand total	1926	86

In addition to the above timings, we repeat earlier results by

observer EJ, which as previously published were affected by an error in the light-time corrections. An asterisk draws attention to further information in the following notes.

LY Aur. Observations 6678-6795 folded onto a single cycle in order to derive the timings.

U Cep. Composite timing from observations by QM on 6437, MM on 6446 and Watts on 6593.

GK Cep. Observations 6434-6795 by QM and 6505-6784 by DH folded onto single cycles in order to derive the timings.

The numbers of estimates given against certain minima include estimates made on other nights which were also used in deriving the time of minimum. These were as follows.

Star	Date	No	Other dates
RT And	6495	3	6488
ST Aqr	6677	8	6659-6667
	6688	4	6689
SS Ari	6688	3	6689
XZ Cam	6677	2	6457
RZ Cas	6641	6	6671
TV Cas	6556	4	6442-6596
	6654	12	6645-6672
	6712	7	6741-6790
	6741	10	6442-6781
TX Cas	6667	9	6442-6688
CR Cas	6442	6	6675-6689
SS Cet	6442	3	6457

Observed minima

Star	Epoch	Helio JD 244...	O - C	No	Observer	
RT And	8512.5	6495.340	+0.003	10	MM	*
WZ And	8319	6659.470	+0.005	6	BS	
AB And	31178	6457.310	-0.003	7	BS	
	31733	6641.513	+0.006	8	BS	
	31739	6643.500	-0.004	5	IS	
	31766	6652.471	+0.005	10	IS	
BX And	16134	6372.3680	-0.0106	25	EJ	
	16139	6375.4267	-0.0025	33	EJ	
	16298	6472.4415	+0.0040	12	HO	

Star	Epoch	Helio JD 244...	O - C	No	Observer	
ST Aqr	6967	6677.512	+0.002	12	BS	*
	6981	6688.468	+0.024	10	BS	*
DX Aqr	4186	6643.546	+0.024	6	IS	
OO Aql	15841.5	6641.522	+0.011	7	BS	
	15845.5	6643.532	-0.007	6	IS	
	15863	6652.404	-0.004	9	IS	
	15877	6659.503	0.000	4	BS	
	15894.5	6668.392	+0.020	9	BS	
QY Aql	2273	6656.413?	-0.060?	6	UY	
SS Ari	18867.5	6688.466	-0.013	8	BS	*
TT Aur	19148	6761.4492	-0.0117	27	EJ	
WW Aur	5361.5	6483.4270	-0.0028	8	EJ	
	5371	6507.4182	+0.0007	28	EJ	
BF Aur	3673.5	6444.333	+0.007	7	BS	
	3680.5	6455.399	-0.009	17	MM	
	3704.5	6493.4104	+0.0045	17	EJ	
EO Aur	6211	6442.4301	+0.0158	27	EJ	
IM Aur	5026	6784.4123	-0.0439	22	EJ	
IU Aur	4429	6471.4213	-0.0094	31	EJ	
	4440	6491.350	-0.007	10	MM	
LY Aur	1916	6730.47?	+0.22?	19	QM	*
	1916.5	6732.47?	+0.22?	15	QM	*
SV Cam	6486	6441.280	+0.013	8	BS	
	6513	6457.297	+0.017	6	BS	
XZ Cam	1290	6677.457	+0.120	6	BS	*
AL Cam	15079	6441.442	-0.020	8	BS	
AO Cam	5706	6442.3949	-0.0719	10	PI	
AW Cam	9530	6089.3839	-0.0031	49	EJ	
	9849	6335.4460?	-0.0006?	20	EJ	
	10024	6470.4275	-0.0048	32	EJ	
YY CMi	16840	6446.4620	+0.0233	18	HO	

Star	Epoch	Helio JD 244...	O - C	No	Observer	
YY CMi	16866.5	6475.4429?	+0.0126?	18	HO	
RZ Cas	2402	6071.2895	-0.0001	39	EJ	
	2725	6457.3580	+0.0054	12	PI	
	2751	6488.431	0.000	9	MM	
	2782	6525.471	-0.013	6	DH	
	2879	6641.426	+0.003	12	DH	*
	2884	6647.410	+0.011	8	DH	
	2889	6653.389	+0.014	5	DH	
	2940	6714.339	+0.006	6	MM	
	2945	6720.314	+0.005	11	TY	
	2971	6751.370	-0.015	10	MM	
	2981	6763.345	+0.007	10	SP	
TV Cas	822	6092.4082	+0.0012	54	EJ	
	1078	6556.446	+0.014	7	QM	*
	1132	6654.321	+0.009	14	DH	*
	1164	6712.285	-0.030	10	QM	*
	1180	6741.347	+0.031	11	VM	*
	1201	6779.3764	-0.0043	14	EJ	
TW Cas	2914	6170.5140	-0.0197	29	EJ	
	3035	6343.3504	-0.0158	23	EJ	
	3236	6630.437?	-0.007?	14	UY	
TX Cas	5805	6667.544	-0.164	14	BS	*
AB Cas	2873	6641.505	+0.014	9	BS	
	2892	6667.466	+0.005	9	BS	
	2941	6734.442	+0.004	8	KG	
CR Cas	2083	6442.308?	-0.054?	11	BS	*
DO Cas	18273	6437.3586	-0.0024	28	EJ	
IR Cas	5990	6441.366	+0.007	16	BS	
	6284	6641.492	+0.011	9	BS	
OR Cas	1791	6441.459	+0.001	9	BS	
	1966	6659.462	+0.004	7	BS	
PV Cas	3578.5	6491.426	-0.035	10	MM	
	3579	6492.329	-0.007	5	MM	
V368 Cas	4672	6352.3278?	-0.0636?	30	EJ	
V523 Cas	22341.5	6441.312	+0.009	10	BS	
	22342	6441.430	+0.009	10	BS	

Star	Epoch	Helio JD 244...	O - C	No	Observer	
V523 Cas	23198	6641.468	+0.008	9	BS	
	23223.5	6647.424	+0.005	8	BS	
U Cep	764	6446.340	+0.048	10	3	*
VW Cep	6636	6004.2931	-0.0157	33	EJ	
	6726	6029.3424	-0.0147	33	EJ	
	6730	6030.4553	-0.0151	75	EJ	
	6960	6094.4661	-0.0166	35	EJ	
	6985	6101.4231	-0.0175	26	EJ	
	7136	6143.4502	-0.0159	33	EJ	
	7269	6180.4627	-0.0192	34	EJ	
ZZ Cep	8667	6491.431	0.000	10	MM	
CW Cep	4017	6336.3852?	-0.0198?	36	EJ	
	4070.5	6482.4197	+0.0057	27	EJ	
EG Cep	7150	6488.434	+0.006	9	MM	
	7431	6641.476	+0.009	9	BS	
	7464	6659.446	+0.006	8	BS	
EK Cep	1687	6472.400	-0.010	12	MM	
GK Cep	7977	6162.4923	+0.0616	53	EJ	
	8267.5	6434.4488	+0.0645	29	EJ	
	8267.5	6434.4504?	+0.0661?	12	PI	
	8453	6608.085	+0.043	39	QM	*
	8453.5	6608.544?	+0.035?	51	QM	*
	8486	6638.991	+0.056	45	DH	*
	8486.5	6639.460	+0.057	62	DH	*
	8805	6750.4031	+0.0658	27	EJ	
V338 Cep	1128	6488.384	+0.022	9	MM	
SS Cet	1342	6442.409	+0.004	8	BS	

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