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VARIABLE STAR SECTION CIRCULAR 73

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A message from the retiring Director, John Isles

Having completed a second five-year term as Director of the VSS, I shall be retiring. The main reason for this is that I would like to have more free time to devote to photoelectric photometry. I am pleased that an able successor has been found in Tristram Brelstaff. Tristram had already taken over running the Eclipsing Binary Programme and he took over leadership of the whole VSS at the end of 1992 October.

I shall be giving priority to completing reports on the Eclipsing Binary Programme in VSSC Circulars up to the year 1991, and in the BAA Journal up to the constellation Vulpecula; and to finishing the final report in the series on Mira stars which was left incomplete on the death of Doug Saw. I have also been invited by the Council to investigate the feasibility and desirability of the BAA acquiring some photoelectric photometers for loan to members. This has prompted the questionnaire that you will find enclosed with this Circular. At the same time as asking about your interest in photoelectric photometry, we thought we should ask for some other information that will help the Section officers in running the VSS and trying to meet your needs; so please would all Section members complete and return the questionnaire, even if they do not wish to get involved in photoelectric photometry.

It has been a privilege to direct the Section at a time when its work has been so important, and it is a pleasure to thank all those observers, helpers, BAA officers, professional contacts and correspondents throughout the world who have made my task so enjoyable. I wish Tristram every success.

Errata - VSSC 72

p. 25: VW Cep, Epoch 11193, Heliocentric JD should read '7572.5497'

p. 25: NSV 1280 Tau, First year of observation should read '1969'
NSV 1702 Tau, Programme should read 'B'

p. 35: S Sct, Last year of observation should read '1989'

Observational totals - 1990

The grand total of observations for 1990 was 29,478, excluding eclipsing binary observations. There were 52 observers (including those persons following the JAS programme). The leading observers were: over 3000, Poyner and Toone; over 2000, Albrighton, Gainsford and Paterson; over 1000 Brundle, Middlemist, Ramsay, Stott, Taylor and Worraker; over 500, Bone, Dryden, Rhona Fraser, Kiernan, Pointer, Srinivasan. As may be seen from the table, the most popular star was R CrB, then Z Cam, T CrB and CH Cyg. The list shows a very large number of stars (175) for which totals were less than 100 for the whole year. Every observer is encouraged to try to adopt at least one of these objects (if not already on their individual programmes). A relatively small number of additional estimates would greatly help to improve the coverage of these neglected stars.

R And	123
W And	151
Z And	14
RS And	35
RW And	89
RX And	380
SU And	26
TZ And	62
VX And	67
AQ And	58
BZ And	35
DX And	56
EG And	32
EU And	50
FN And	16
HP And	38
LS And	38
R Aqr	12
VY Aqr	56
R Aql	12
V Aql	98
UU Aql	102
UW Aql	52
V450 Aql	105
V603 Aql	30
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V1294 Aql	50
V1370 Aql	29
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SV Ari	21
TT Ari	41
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UV Aur	21
AB Aur	170
ψ[1] Aur	32
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V Boo	109
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RW Boo	71
RX Boo	79
UZ Boo	39
CR Boo	14
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X Cam	153
Z Cam	419
RY Cam	75
ST Cam	102
UV Cam	71
XX Cam	276
ZZ Cam	74
X Cnc	129
RS Cnc	187
RT Cnc	60
SU Cnc	13
YZ Cnc	7
U CVn	40
V CVn	239
Y CVn	134
RT CVn	2
TU CVn	133
TX CVn	17
W CMa	49
S Cas	72
T Cas	123
UV Cas	234
WZ Cas	80
HT Cas	82
V391 Cas	68
V393 Cas	74
V452 Cas	27
V465 Cas	294
V630 Cas	42
V635 Cas	36
γ Cas	393
ρ Cas	271
W Cep	149
RU Cep	97
RW Cep	150
RX Cep	127
SS Cep	131
AR Cep	162
DM Cep	90
FZ Cep	17
μ Cep	250
o Cet	239
R Com	24
AL Com	24
R CrB	938
S CrB	149
T CrB	412
V CrB	122
W CrB	145
RR CrB	111
SW CrB	95
R Cyg	107
S Cyg	74
V Cyg	128
W Cyg	309
RU Cyg	40
RV Cyg	68
SS Cyg	399
TT Cyg	66
AF Cyg	299
BC Cyg	90
BI Cyg	4
CH Cyg	467
CI Cyg	207
EY Cyg	98
HN Cyg	29
V460 Cyg	85
V482 Cyg	95
V503 Cyg	3
V542 Cyg	22
V630 Cgy	6
V632 Cyg	33
V778 Cyg	47
V795 Cyg	82
V973 Cyg	132
V1016 Cyg	25
V1028 Cyg	5
V1113 Cyg	7
V1329 Cyg	32
V1819 Cyg	47
χ Cyg	128
P Cyg	180
Sco.'s var	37
Q Cyg	46
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RY Dra	197
TX Dra	159
UW Dra	53
UX Dra	72
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AH Dra	135
AT Dra	60
DO Dra	102
U Gem	281
TU Gem	52
TV Gem	129
WY Gem	110
AW Gem	10
BM Gem	101
BN Gem	69
BQ Gem	39
BU Gem	132
DW Gem	26
IR Gem	219
IS Gem	33
X Her	161
RU Her	89
SS Her	45

ST Her	49
SX Her	68
UW Her	54
AC Her	269
AH Her	265
IQ Her	48
OP Her	139
V443 Her	4
V566 Her	52
V592 Her	41
g Her	119
R Hya	16
U Hya	53
SU Lac	81
SX Lac	50
T Leo	13
X Leo	182
RS Leo	15
RY Leo	72
RZ Leo	41
U LMi	30
W Lyn	2
X Lyn	14
Y Lyn	150
SV Lyn	78
R Lyr	173
XY Lyr	86
AY Lyr	314
DM Lyr	46
V344 Lyr	5
U Mon	348
RV Mon	63
V616 Mon	9
X Oph	136
RS Oph	170
V841 Oph	11
V2048 Oph	15
U Ori	124
W Ori	104
BL Ori	90
BQ Ori	118
CK Ori	94
CN Ori	164
CZ Ori	197
RU Peg	227
AG Peg	126
GO Peg	77
IP Peg	5
S Per	132
X Per	263
RS Per	150
SU Per	65
TZ Per	387
UV Per	387
UW Per	73
AD Per	64
AX Per	53
BU Per	148
GK Per	250
KK Per	53
PR Per	64
V400 Per	17
Z Psc	62
TV Psc	39
TX Psc	39
V1017 Sgr	1
V Sge	71
RZ Sge	76
SV Sge	118
WZ Sge	176
AW Sge	24
HM Sge	24
HS Sge	31
QW Sge	5
R Sct	364
S Sct	59
Nova 1981	25
Nova 1989	33
R Ser	81
LX Ser	39
Y Tau	124
RV Tau	108
SU Tau	213
TT Tau	57
BU Tau	134
CE Tau	47
W Tri	72
T UMa	149
Z UMa	277
RY UMa	190
ST UMa	119
SU UMa	266
SW UMa	230
TV UMa	56
VY UMa	86
VW UMa	109
BC UMa	20
BZ UMa	58
CH UMa	179
CY UMa	19
DV UMa	3
V UMi	140
SS UMi	55
RW Vir	35
RX Vir	31
SS Vir	67
SW Vir	55
BK Vir	37
V Vul	94
RZ Vul	6
TY Vul	2
PU Vul	237
PW Vul	11
QU Vul	10
3C 273	52
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Mark. 421	110

Computerization

Dave McAdam

Offers of help with keying in past observations have been very encouraging. Some people have helped on a 'one off' basis by entering a few years for one or two variables, others are providing on-going help by taking regular batches of report copies.

To date, valuable assistance with this work is gratefully acknowledged from the following people;

Bill Bingham, Tristram Brelstaff, Mike J. Carson-Rowland, Eoin Clancy, Greg Coady, Mike Collins, Peter Dean, Storm Dunlop, Vic Garvey, Dennis Gill, Ian Howard-Duff, Herbert Joy, David Lloyd, Norma McAdam, Tony Miller, John Moran, Roger Pickard, Gavin Ramsey, Brian Rye, Valerie Stoneham, Paul White, Rita Whiting.

A few observers sent reports in machine-readable form (for 1990 and 1991). Electronic-mail reports were received from Guy Hurst, Roger Pickard, John Howarth, and Tony Millar. (The last two relayed by Roger.) Guy programmed a special database routine for converting his own records to the VSS computer format. Personal reports from Gary Poyner and Guy have also been processed from disks. Although Gary uses a PCW computer with 3" disk drives, he had the files transferred to 3.5" disks so that they could be read by the section machine. (Transfer facilities from non-DOS disk formats may be advertised in magazines specific to a particular computer. [*See also* p.25- Ed.])

Direct computer reports are extremely helpful because they completely do away with re-entry and can be incorporated straight into the computer archives. If the format differs from those we are trying to standardise, then it will nearly always be worth writing a conversion program. This was done for Gary's observations (a prolific grand total for 1991 of nearly 5500 observations including a number of non-programme stars) thereby saving many hours of re-keying. Computer records do not immediately replace paper ones, so observers should also send reports to Melvyn Taylor as usual. However, as we progress, members sending computer reports may be spared the task of preparing paper copies.

Some reports and the almost completed records for a handful of variables were originally read into a test system on a BBC Master computer. Also, a number of existing BBC computer records for the years 1983-84 have been provided by Greg Coady (via Storm Dunlop). All these data remain viable and have been converted to IBM format on the section machine.

The advantages of having full observational detail on computer are apparent even though we have only a small percentage of the total stored at the moment. One benefit is that light-curves for these circulars can be plotted routinely by a computer program designed to work from a standard data format. Another benefit is that large numbers of observations can easily be sent for analysis to any part of the world on computer disks at minimal cost. A few such transactions with interested professionals have been made in the last year and these will increase proportional to our computerized data.

It is hoped that full estimates can be entered for at least the last 10 to 12 years on most programme stars, many of these reports remain to be dealt with. Observers who own a computer might consider keying in their own current observations. Please contact me if you think you can help with either.

The Jack Ells APT

Roger Pickard

Following the announcements in The Observatory (1) and the BAA *Journal* (2) the Jack Ells APT has been made available to the CMHAS as the successful applicant.

The telescope and all the associated equipment have been removed to a site in Kent affording darker skies than the original location at Bexleyheath, and is operational once again, albeit in a slightly less productive form until the small group of operators become more familiar with it.

Although the telescope was used mainly for the timing of minima of eclipsing binaries at Bexleyheath, it is proposed to extend the type of object observed. It is also anticipated that the telescope will be able to perform at a fainter magnitude than the 8-9 limit at Bexleyheath, given the darker skies at its new location.

If any researcher (amateur or professional) has a project that may be particularly suitable for the APT, (e.g., repeated observations all through the night), they are invited to contact the writer at the address below to discuss particulars of the project.

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c/o 28 Appletons, Hadlow, Kent TN11 0DT
Tel: 0732 850663
E-mail: JANET - UK.AC.KENT.STARLINK::RDP
INTERNET - RDP@STARLINK.KENT.AC.UK

1 *The Observatory*, **110**, 197, 1990
2 *J. Br. astron. Assoc.*, **100**, (6), 278, 1990

Major period change in VW Cep

Roger Pickard & John Watson

This star has been a favourite eclipsing binary for PEP observers, (at least in the South of England, for some reason), since RP first observed it towards the end of 1984. The late Jack Ells (1) also made a number of observations in the mid 1980's and JW has contributed several observations since. The reason for this popularity is probably because it is an easy star to observe photoelectrically, being fairly bright at magnitude 7.23 - 7.68, with a very short rotation period (<0.3d) (2), which means a time of minimum can be obtained in less than two hours at the telescope.

Following the launch of the Stargazers Trust competition (3), RP, having only just become operational after rebuilding his telescopemounting, decided to submit an observation of the time of minimum of this star as his entry. This observation came to the notice of a professional astronomer at RAL, Chris Lloyd (CL), who pointed out that if the observation were confirmed it would show a change in the period of VW which, apparently, had not been noted elsewhere. Both JW and RP then made further observations, which confirmed the change and submitted them to CL. He then analysed all the observations, together with those dating back many years, and found that VW appears to have undergone three discrete period changes at approximately 20 year intervals. A paper has appeared in the IBVS reporting this change (4). The more recent observations are tabulated below:

HJD	Min.	Observer
2448506.4398	2	RDP
2448506.5751	1	RDP
2448566.4134	1	JW
2448570.5864	1	JW
2448597.3037	1	JW
2448600.5034	2	RDP
2448604.2601	1	JW
2448619.2883	1	RDP

Figure 1 shows the O-C diagram from (photoelectric) observations that have been collected from a number of sources, including the current work, plotted against the new ephemeris. This appears to show evidence of period changes, but when further analysis is done to remove the effect of a faint third companion in the system, then the resultant diagram is much more meaningful - Figure 2. This clearly shows the abrupt period changes, the last occurring around JD 2444600 (1980).

The proposed ephemeris is:

JD 2446822.5233 + 0.2283099.E .

and should be substantially correct for the next five years or so.

Whilst one doesn't expect every (!) observation to gain immediate professional interest, it is very gratifying to know that amateur observations can be of very real interest to the professional community.

The assistance of Chris Lloyd in performing the analysis and in encouraging us to make further observations is gratefully acknowledged.

References

1 *J. Brit. Astron. Assoc.* 1990, **100** (4), p.165

2 *Eclipsing Binary Handbook 1988*, BAA Variable Star Section, 1987

3 *J. Brit. Astron. Assoc.*, 1990, **100** (4), p.160

4 IBVS No.3704, 1992 March 16

[Regretttably, a figure showing the actual observations could not be reproduced - Ed.]

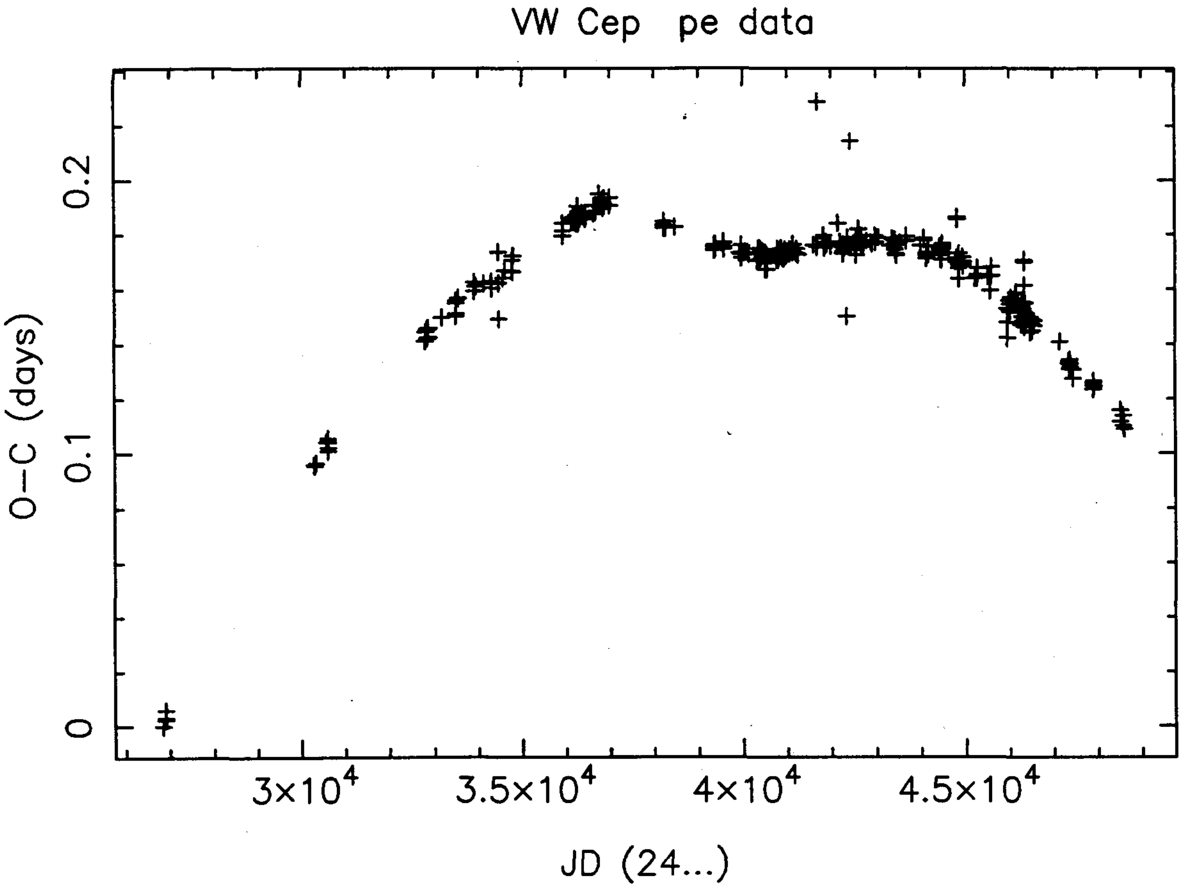

Figure 1

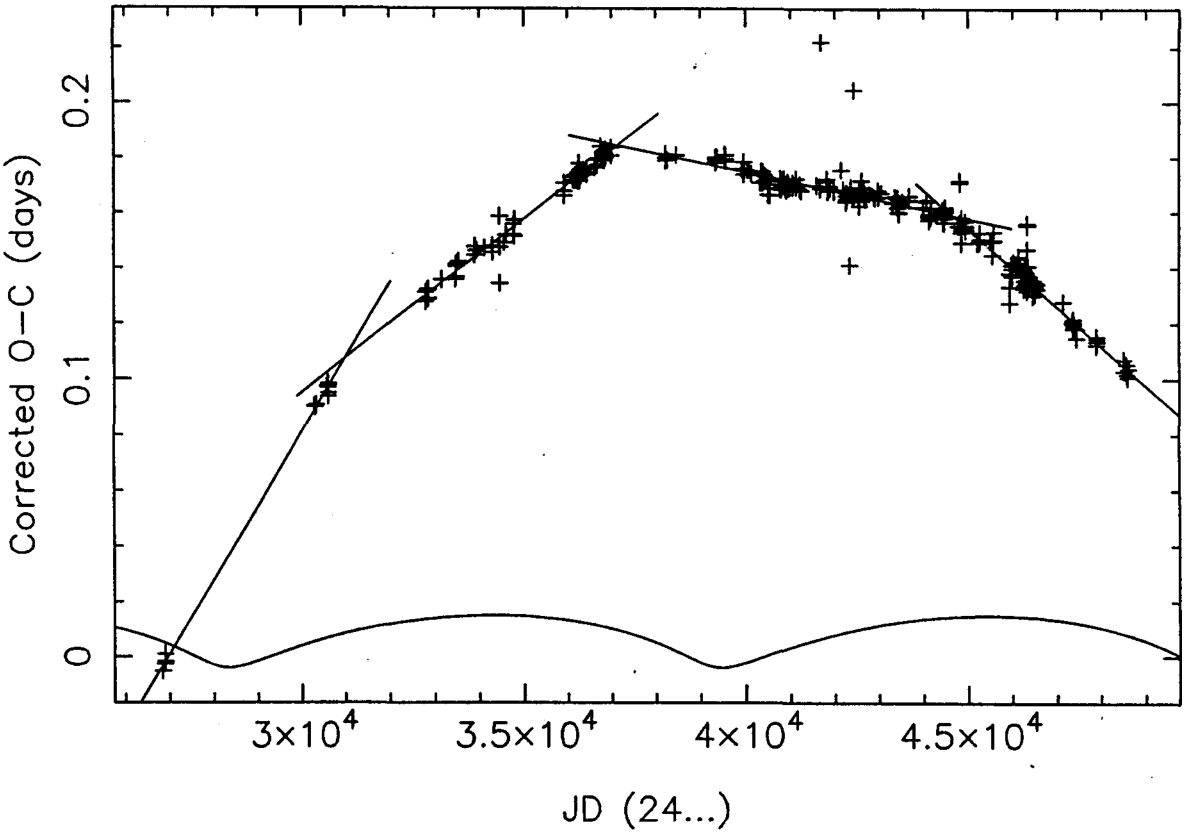

Figure 2

Light-curves from computer records

Dave McAdam

A program has been written for generating light curves from the computer record of each variable. Although raw data plots may be made when they may show a specific feature, more often periodic mean plots are made where the dot sizes are related to the number of observations made in successive intervals of time. The larger the dot, the more certain is its position. The relative dot size is determined by a method similar to the one which cartographers use to depict stars of different magnitudes on star charts. Facilities for observer bias and for weights of individual observations are included and both are occasionally useful. The program has been revised on experience with increasing numbers of data, helpful advice from others, and constraints on printing quality.

Plots in this circular from an earlier version of the program are characterized by extra horizontal lines at the top and bottom, one above the Julian dates and the other below the months. Apart from this, the more important difference is that the earlier plots have high and low limit bars on means of two or more estimates, whereas the later plots have error bars based on the standard deviation. On either type of plot, small height of the bars show that observations in the period agree well, whereas longer bars indicate that the star may have been varying rapidly, or that for some reason observational scatter is large. The SD error bars give a smaller and better indication of the scatter when calculating means from greater numbers of estimates.

GMAT versus UT and computer records

Dave McAdam

The VSS seems to be the only organization that still uses Greenwich Mean Astronomical Time as a standard. Some observers question if this is sensible when everyone else uses UT. The main argument for GMAT is apparently that UK observers, who continue to observe from evening into the morning do not need to remember to increment the date at midnight. Contributing observers in the opposite hemisphere, of course, have the GMAT date change during some part of their night.

As far as computer records are concerned, the conversion either way between GMAT and UT is trivial and, once programmed, will always do the right thing. Conversions to/from JD are slightly more involved, but are also easily programmed. Therefore, the three time systems are quite acceptable for routine computer input providing reports state clearly which system has been used.

In dealing with past records for computerization, over 80 years on some variables, we are faced with a mixture of the three time systems. Anyone keying reports into computer files is advised to enter the times in whatever system the observer has used and let the computer take care of the conversions.

The IAU Colloquium 136 on Stellar Photometry, in Dublin
Chris Lloyd

Some meetings are about science and others are about instruments, but this one was rather different. It was concerned with the practice of stellar photometry rather than the science or the instruments, although of course the impact on the science and instrumental developments were discussed. The general flavour of the meeting was best described by one of the speakers, a university user of the US observatories, who likened herself to a regular diner at a restaurant who had been given a detailed tour of the kitchen.

Despite the many problems which were discussed the meeting was uplifting and forward looking. Topics covered included photoelectric photometry, CCD photometry, IR photometry, photometric systems, APT's, global networks, even photometry from space, and was followed by a cricket match. What follows is a very selective summary.

A detailed and wide-ranging review of photometric systems revealed a number of problems in obtaining standard magnitudes which have been largely ignored for some time. There are three related parts to the problem. The first is the filters them themselves, the second is the transformation to the standard system and the third is the detector. Relatively small differences between the filter used and the standard may cause significant and systematic differences between the instrumental and standard magnitudes. In particular differences in the blue edge of the B filter can generate errors of 0.08m. Transformation from the instrumental to standard system are assumed to be linear in B-V but any significant differences between the instrumental response and the standard leads to strongly non-linear transformation coefficients with significant 3rd and 4th order terms. So unless your system is well matched to the standard and you take a lot of trouble over the transformations there is little chance of obtaining UBV magnitudes accurate to a few per cent.

Obtaining standard magnitudes with a CCD is even more difficult because the detector is even less well matched to the original 1P21 than modern PMT's. Using standard UBVRI filters with CCD's and hoping to transform them to the standard system is doomed to failure. To obtain reliable transformations to the UBV system some professionals now calculate the required filter profile and have the filters specially made. Which for an observatory is not particularly expensive but is probably beyond most amateurs. Some observatories have programmes to establish fields of accurate CCD standards but in some cases serious transformation problems have appeared.

A problem has also shown up with some sets of high transmission Strömgren uvby filters. These have very steep sides and give instrumental magnitudes which are almost impossible to transform back to a constant or standard system. It is possible to generate systematic errors of up to 0.1m in the Strömgren indices from photometry which is internally accurate to a few mmags [millimagnitudes, 0.001 mag - Ed.]. As the indices are used for large-scale stellar population and other studies this is potentially a serious problem.

The two problems mentioned above stem from differences in the shape or central wavelength of the instrumental band with respect to the standard. The UBV transformation problem is made worse by the small but sensitive overlap between the B and V filters. Similarly the steep sides of the offending Strömgren filters make the transformations very sensitive to the central wavelength. It is now clear that the 'best' photometric system has smooth bell shaped filters with a substantial degree of overlap between adjacent wavebands. This allows linear combinations of several wavebands to convert to a standard system or if the resolution is sufficient to any other system. It seems likely that over the next few years a new photometric system based on these principals will appear.

Most of this may not seem relevant to most amateurs as generally they do differential photometry which avoids transformation and calibration problems. For eclipse timings and where absolute accuracy is not important a magnitude that is sort-of V or B or R is fine but it is very difficult to combine, even differential, light curves made by other people or even with the same instrument at some other time. Filters in particular are known to age and change with temperature, so an instrumental magnitude this year will probably not be the same as next year.

The precision of 'all sky' UBV photometry as performed by the best practitioners is still limited to 0.01-0.02m. There are probably many sources of error but the main ones are probably instrumental, transformation problems, extinction and errors in the standards. Differential photometry in the instrumental system is, at its best, probably an order of magnitude more accurate. This has been the position for two decades now and, for a variety of reasons, probably represents the limit of present instrumentation. Relative photometry with CCD's reaches about the same level but this requires accurately re-positioning the stars on the same pixels and, of course, using quality chips. In star clusters it is possible to obtain magnitudes reliable to <5mmag on stars that are typically 5-10 magnitudes fainter than those on which PEP is used.

One of the main problems of CCD photometry near the limit is the removal of the differential sensitivity across the chip, so-called flat fielding. It was shown that although twilight and 'dome' flats (created using an illuminated screen inside the dome) could be reproduced at the 1% level they could also have systematic errors of up to 4%, or 0.04m. This is most probably due to scattered light in the telescope and is a likely source of error for all small telescope users. One way around this for amateurs is to follow the practice of re-positioning the stars on the same pixels to reduce the effect of flat fielding. As with other types of differential photometry the magnitudes will be in the instrumental system and not directly comparable with any other measurements.

On a rather more instrumental note the session on APT's centred around the US experience of using the Tuscon based APT's, which now range in size from 10-30 inches. APT's have proved reliable and accurate, and very efficient in terms manpower required to support them and science per dollar. For this reason they were attracting support from various funding agencies in the US and as money became tighter were being more widely regarded as a serious research tool. ESO have automated the Danish 1-metre and the SAAO are constructing a new APT based on the Tuscon design. Several other national APT's are under development.

APT's are under development.

While on the subject of instruments several new and not so new bits of equipment were presented. The French development of Norman Walker's 4* photometer was described along with some results. A similar German four channel fibre optic spectrophotometer was also described. A telecommunications detector called the avalanche photodiode (APD) has been tested by several groups and is being hailed by its supporters as the replacement for the PMT. This is some way off. The APD's currently available have a gain of 100 - 1000 compared to the 10^6 of the PMT. Also the larger ones cannot be used for photon counting, yet. However the APD is very efficient, has a large dynamic range and is robust, and with development may be a suitable replacement.

The ability to co-ordinate telescopes at different longitudes enables a whole range of problems to be tackled and two such programmes were described. The idea of a global network based on APT's, has been around for some time but has recently been formalised by Dave Crawford (KPNO) and others. The aim of GNAT is to provide the framework and forum for collaboration through (e-mail) communication and to act as a focus for funding. This GNAT concept is sufficiently broad to encompass automatic, automated and (ordinary) astronomical telescopes. The meaning of the 'A' is deliberately ambiguous. How GNAT will work in practice is not clear but the aim is that any member of the network should be able to organise co-ordinated observing programmes rather than be told what to do by GNAT. Requests to join the network were being invited. A number of scientific and technical working groups have been established.

The other network is a much tighter group of observers on about 8 sites called the Whole Earth Telescope (WET). The time is allocated on normal professional telescopes in the usual way and they use very similar 2 or 3 star photometers to provide comparable differential photometry of a variable continuously for some days. The network has had seven runs so far and the most spectacular result is the discovery of 121 frequencies in a pulsating white dwarf.

Finally, Dave Crawford, wearing his International Dark Sky Association hat, made a plea to support efforts to curb light pollution by joining one of the many groups, and I pass this on to you.

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Minima of eclipsing binaries, 1989

John Isles

The numbers of observations received for known and suspected eclipsing variables in 1989, including estimates reserved for separate discussion, are given below.

		Observations	Timings
Photoelectric:			
	J Ells (EJ)	5078	71
Visual:			
	N Bone	8	-
	T Brelstaff (BS)	2264	92
	A Chapman	28	-
	H Duncan (DH)	318	9
	R B I Fraser	7	-
	B A L Green	16	-
	J E Isles (IS)	78	1
	S Koushiappas	10	-
	D McKain	5	-
	I Middlemist (MM)	249	25
	P A Moore	9	-
	J Napper	23	-
	J Peck	1	-
	G Pointer (POG)	147	5
	A Smeaton	46	-
	J S Smith	10	-
	S Srinivasan (VN)	165	3
	M D Taylor (TY)	95	6
	R Waddling	57	-
	P J Wheeler (WH)	73	9
	Composite timings	-	5
	Total	3609	155
	Grand total	8687	226

The code EJ indicates timings made with the Jack Ells Automatic Photoelectric Telescope, including runs set up by D.J., J.W. and P.E. Ells. In the accompanying list of observed minima, photoelectric determinations are distinguished by 'pe' after the observer abbreviation. The times of minima were derived using a computer program analogous to the tracing-paper method, except the second minimum of VW Cep by EJ on 7539 and the minimum of CQ Cep on 7856, which were found by fitting a parabola by least squares. The quoted numbers of observations are those used in the analysis, which may be fewer than the total number actually made. A colon indicates uncertainty and has exactly the same meaning as a question mark in some earlier lists. For further explanations, see *VSSC* **58**.

An asterisk draws attention to further information in the following notes. Epoch and O-C are against the linear elements in the main table of the *GCVS* except for the secondary minimum of RR Lyn, for which separate elements are given in the Remarks in the *GCVS*, and HP Lyr, for which revised elements are taken from *JBAA*, **99** (1) 14, 1989.

For certain stars, all estimates made in the year were folded onto a single cycle in order to derive the timings. The dates covered by the observations were as follows: V367 Cyg 7531-883, Beta Lyr 7531-883, V505 Mon 7529-616, V566 Oph 7654-834.

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

Star	Date	No	Other dates
CD And	7803	6	7767-836
LO And	7767	5	7776
ST Aqr	7776	8	7790-808
V377 Aql	7847	40	7702-858
	7758	31	7701-857
V346 Aql	7734	6	7743
V822 Aql	7745	11	7760-835
	7761	2	7761-808
	7774	10	7741-822
	7851	35	7591-857
WW Aur	7560	6	7545-608
AM Aur	7767	6	7834-6
XZ Cam	7855	8	7767-834
AZ Cam	7835	7	7847
RZ Cas	7565	7	7651-767
	7571	3	7559
TX Cas	7800	28	7701-814
CR Cas	7791	21	7794-857
GK Cep	7556	30	7531-883
	7564	35	7537-862
SW Cyg	7817	12	7776-808
VW Cyg	7802	7	7760-76
KU Cyg	7761	22	7760-2
AV Del	7762	10	7770-847
Z Dra	7759	5	7774
AI Dra	7776	4	7770

Star	Date	No	Other dates
AR Lac	7537 (EJ)	39	7531
	7537 (BS)	15	7529-65
AW Lac	7762	1	7763
δ Lib	7673	7	7531-701
RR Lyn	7544	7	7554-802
	7847	21	7558-857
TT Lyr	7776	12	7787-813
TZ Lyr	7800	9	7776-99
V839 Oph	7758	5	7751
	7761	4	7762
	7814	6	7791
VV Ori	7546	6	7539-613
V1031 Ori	7567	12	7574-860
	7783	11	7541-858
Z Per	7835	10	7847
AB Per	7854	12	7761-847
AY Per	7761	2	7808
ST Per	7762	3	7767
β Per	7591	9	7608-823
	7852	3	7849
Y Psc	7853	7	7834
U Sge	7738	4	7772
SY Sge	7813	9	7767-834
V Ser	7791	17	7760-808
CF Tau	7856	6	7853
GR Tau	7853	4	7856
λ Tau	7853	23	7529-849
RS UMi	7847	7	7804-53
BP Vul	7757	5	7751

Minima of Eclipsing Binaries, 1989

Star	Epoch	Helio JD 244...	O-C	No	Observer	
RT And	10614	7817.3456	-0.0013	15	EJ (pe)	
AB And	35110.5	7762.483	+0.004	10	BS	
	35125.5	7767.456	-0.001	9	BS	
	35330	7835.326	-0.003	9	BS	
BX And	18429	7772.5789	-0.0144	27	EJ (pe)	
	18563	7854.360	+0.011	10	MM	
CD And	621	7803.45	+0.74	10	BS	*
DS And	11513	7776.504	-0.002	7	BS	
LO And	9679	7767.895	+0.070	11	BS	*
RY Aqr	3565	7835.299	-0.022	7	BS	
ST Aqr	8374	7776.354	-0.016	17	BS	*
OO Aql	17935	7702.472	-0.001	8	BS	
	18043.5	7757.466	+0.006	8	BS	
	18079	7775.459	+0.007	7	BS	
	18081	7776.472	+0.007	10	BS	
V337 Aql	3083.5	7758.361:	+0.034:	36	BS	*
	3116	7847.284	+0.106	42	BS	*
V346 Aql	5257	7734.528	-0.006	10	WH	*
V822 Aql	976	7745.325	+0.121	12	DH	*
	979	7761.232:	+0.143:	3	POG	*
	981.5	7774.569	+0.243	11	DH	*
	996	7851.185	+0.082	36	VN	*
SS Ari	21547.5	7776.474	-0.068	10	BS	
	21692.5	7835.336	-0.075	10	BS	

Star	Epoch	Helio JD 244...	O-C	No	Observer	
SX Aur	6114.5	7561.3747	+0.0038	32	EJ (pe)	
	6291.5	7775.5516	-0.0035	38	EJ (pe)	
	6356	7853.6070	+0.0017	32	EJ (pe)	
TT Aur	19762.5	7580.418	-0.014	8	MM	
	19770	7590.418:	-0.009:	9	TY	
WW Aur	5788	7560.364	+0.014	8	BS	*
ZZ Aur	36747	7597.376	+0.023	6	MM	
	36757	7603.372	+0.007	5	MM	
AM Aur	590	7767.540	+0.821	8	BS	*
AR Aur	2214	7556.3353	-0.0626	22	EJ (pe)	
	2288	7862.301	-0.064	8	MM	
	2288.5	7864.374	-0.058	12	MM	
BF Aur	4371.5	7549.4153	+0.0012	44	EJ (pe)	
IM Aur	5681	7601.400	-0.035	8	MM	
	5880	7849.5928	-0.0542	31	EJ (pe)	
	5891	7863.330	-0.037	5	MM	
IU Aur	5050.5	7597.374	+0.111	6	MM	
ZZ Boo	1810.5	7603.5054	+0.0337	32	EJ (pe)	
44i Boo	28762	7555.4350	+0.0238	20	EJ (pe)	
	28766	7556.5060	+0.0235	9	EJ (pe)	
	28766.5	7556.6404	+0.0240	13	EJ (pe)	
	29161.5	7662.4301	+0.0264	19	EJ (pe)	
	29206.5	7674.4825	+0.0271	16	EJ (pe)	
SV Cam	8707	7758.495	+0.020	11	BS	
	8712	7761.460	+0.020	11	BS	
	8348	7545.5823	+0.0192	14	EJ (pe)	
XZ Cam	1397	7855.97	+0.07	14	BS	*

Star	Epoch	Helio JD 244...	O-C	No	Observer	
AL Cam	16084	7776.424	-0.013	12	BS	
AW Cam	11463	7580.454	+0.054	4	MM	
	11499.5	7608.5503	-0.0042	36	EJ (pe)	
AZ Cam	5391	7767.444	+0.017	9	BS	
	5442.5	7835.378	+0.012	16	BS	*
WW Cnc	18333.5	7593.372	+0.015	8	MM	
XZ Cnc	19723.5	7614.380	-0.117	6	MM	
R CMa	2891	7573.370	+0.005	8	POG	
YY CMi	17871	7574.391	+0.018	13	TY	
RZ Cas	3642	7553.4064	+0.0105	14	EJ (pe)	
	3652	7565.361	+0.012	12	DH	*
	3657	7571.334	+0.010	9	WH	*
	3688	7608.382	+0.005	9	POG	
	3781	7719.5437	+0.0085	16	EJ (pe)	
	3801	7743.443	+0.003	7	WH	
	3816	7761.399	+0.031	8	POG	
TV Cas	1707.5	7697.4693	+0.0066	42	EJ (pe)	
TX Cas	6192	7800.32	-0.08	30	BS	*
AB Cas	3685	7751.406	+0.014	7	BS	
CR Cas	2558	7791.39	-0.06	24	BS	*
IR Cas	7951.5	7776.550	+0.026	10	BS	
PV Cas	4208	7593.354	-0.027	8	MM	
V368 Cas	4953	7603.356	+0.053	6	MM	
V523 Cas	27973.5	7757.466	+0.017	10	BS	
	27977.5	7758.396	+0.011	9	BS	

Star	Epoch	Helio JD 244...	O-C	No	Observer	
[V523 Cas]	27995	7762.490	+0.016	10	BS	
	28016	7767.394	+0.012	10	BS	
VW Cep	12152.5	7539.5901	-0.0412	8	EJ (pe)	
	12153	7539.7266	-0.0438	12	EJ (pe)	
	12723.5	7698.5043	-0.0446	33	EJ (pe)	
	12748.5	7705.4626	-0.0442	19	EJ (pe)	
	13258	7847.2639	-0.0442	10	EJ (pe)	
	13258.5	7847.4022	-0.0450	14	EJ (pe)	
	13259	7847.5418	-0.0446	13	EJ (pe)	
	13259.5	7847.6809	-0.0446	14	EJ (pe)	
WX Cep	6693	7700.5349	+0.0086	37	EJ (pe)	
XX Cep	1250	7761.464	+0.003	12	BS	
ZZ Cep	9274	7791.4997	-0.0045	44	EJ (pe)	
AH Cep	7205	7776.4975	+0.0175	48	EJ (pe)	
CQ Cep	9277	7682.4746	-0.0604	41	EJ (pe)	
	9321.5	7755.4891	-0.0814	50	EJ (pe)	
	9324.5	7760.4350	-0.0593	45	EJ (pe)	
	9352	7805.5552	-0.0734	42	EJ (pe)	
	9363.5	7824.4476	-0.0554	42	EJ (pe)	
	9383	7856.4461	-0.0613	66	EJ (pe)	
CW Cep	4460	7545.3854	-0.0286	40	EJ (pe)	
	4541	7766.472	-0.003	7	WH	
EG Cep	9144	7574.412	+0.008	13	TY	
	9469	7751.412	+0.006	6	BS	
	9480	7757.406	+0.009	9	BS	
GK Cep	9466	7556.442	+0.074	31	DH	*
	9474.5	7564.384	+0.058	36	DH	*
	9514	7601.368	+0.064	8	MM	
	9653	7731.4952	+0.0654	35	EJ (pe)	
	9740.5	7813.4075	+0.0657	22	EJ (pe)	

Star	Epoch	Helio JD 244...	O-C	No	Observer	
NN Cep	1529	7654.5494	-0.0022	47	EJ (pe)	
	1579.5	7758.4975	+0.0015	47	EJ (pe)	
SW Cyg	1289	7762.514	-0.073	13	BS	
	1301	7817.387	-0.078	21	BS	*
VW Cyg	793	7802.191:	+0.087:	10	BS	*
WZ Cyg	11862	7758.444	+0.035	15	BS	
	11869	7762.527	+0.026	13	BS	
GO Cyg	19271	7762.4709	+0.0389	34	EJ (pe)	
KU Cyg	361	7761.543	+0.116	25	BS	*
MY Cyg	3453	7677.5197	+0.0009	28	EJ (pe)	
V367 Cyg	561.5	7834.23	+0.75	25	DH	*
	563	7861.31	-0.07	22	DH	*
V466 Cyg	13641.5	7757.439	-0.002	11	BS	
	13697.5	7835.387	+0.019	11	BS	
V477 Cyg	1508	7728.5219	-0.0038	15	EJ (pe)	
V836 Cyg	4585	7849.3906	+0.0054	26	EJ (pe)	
V1143 Cyg	730	7790.5160	-0.0048	23	EJ (pe)	
V1425 Cyg	5844.5	7720.5241	+0.0043	50	EJ (pe)	
	5874	7757.4632	-0.0020	49	EJ (pe)	
AV Del	1057	7762.590	-0.001	15	BS	*
Z Dra	3138	7759.385	-0.048	9	BS	*
WW Dra	4236	7631.6089	+0.1539	28	EJ (pe)	
AI Dra	3595	7601.368	+0.002	8	MM	
	3626	7638.5332	+0.0045	25	EJ (pe)	

Star	Epoch	Helio JD 244...	O-C	No	Observer	
[AI Dra]	3741	7776.411	+0.018	6	WH	*
	3756	7794.402	+0.028	8	WH	
	3761	7800.381	+0.013	8	WH	
	3811	7860.341	+0.031	11	MM	
	3806	7854.311	-0.004	10	MM	
BH Dra	4204	7659.4633	-0.0059	18	EJ (pe)	
RX Her	8192	7740.4632	+0.0001	31	EJ (pe)	
TX Her	3747	7726.4812	-0.0091	24	EJ (pe)	
AK Her	13057.5	7690.4851	+0.0015	25	EJ (pe)	
	13086	7702.4944	-0.0026	19	EJ (pe)	
DH Her	4433	7761.497	+0.020	14	BS	
HS Her	1597	7775.4120	-0.0057	31	EJ (pe)	
68u Her	20390.5	7651.4916	-0.0070	41	EJ (pe)	
	20410	7691.4871	-0.0066	43	EJ (pe)	
SW Lac	7059	7539.3058	-0.0107	13	EJ (pe)	
	7748.5	7760.442	-0.012	10	BS	
	7751.5	7761.401	-0.015	9	BS	
	7913.5	7813.362	-0.011	8	BS	
	7969.5	7831.3216	-0.0113	16	EJ (pe)	
	8022.5	7848.364	+0.032	6	MM	
	8047.5	7856.341	-0.008	8	MM	
	8060	7860.366	+0.008	9	MM	
	8063	7861.332	+0.012	4	MM	
VX Lac	2335	7767.415	+0.005	12	BS	
	2415	7853.373	+0.004	11	BS	
AR Lac	2997	7537.2871	-0.0517	91	EJ (pe)	*
	2997	7537.299:	-0.040:	22	BS	*
	3103	7747.5004	-0.0568	50	EJ (pe)	

PRO-AM LIASON COMMITTEE (PALC-VS)
Newsletter No.4

PRO-AM EXCHANGES REPORT 4

Covering period 1990 January 1 to June 30

	Date	Subject	Professional

001 900101 Asteroids — Brian Marsden, CBAT
Astrometry of asteroids 10-13 by Brian Manning sent to CBAT by GMH and published on MPCs.

002 900105 1989 YE — Brian Marsden, CBAT
CBAT relay that Manning 12 = 1989 YE and award discovery in favour of those obtaining results in 1982!

003 900105 1989 TD11 — Brian Marsden, CBAT
Manning 3 designated 1989 TD11 as a 'one-night-stand' in MPCs.

004 900106 Pos SN in NGC4450 — Brian Marsden, CBAT; M. Kidger
McNaught (Australia) relayed that Evans had found a possible supernova in NGC 4450. Dr Mark Kidger (Tenerife) checked this at our request and found no new object on 1991 Jan 7.28 UT to mag 17 using 1.5-m IR Telescope (Q1990/1).

005 900106 Fadars — David Pike, RLVAD
Observations of VX Cas, SV Cep, UX Ori, V346 Ori, V351 Ori, V586 Ori by John Howarth and Roger Pickard relayed to David Pike.

006 900116 Nova in LMC — Rob McNaught, Australia
Rob relays news to GMH of this discovery by Gordon Garradd (both members of our team). Jan 16.47 UT, mag 11.5. Announced on IAUC 4946.

007 900117 Symbiotic stars — Ladislav Hric, Czechoslovakia
BAAVSS received invitation to participate in long-term photometry. Charts drawn by JEI and issued to observers. Subsequently announced in BAA Circular 697 issued 1990 May 19.

008 900118 P Cygni — Brian Marsden, CBAT
CBAT receive a pro' report that spectrum very intense, which could suggest a brightening to magnitude 3. We advise that patrol photos and visual estimates made during last 24 hours show it normal at magnitude 5.0.

009 900129 P/Comet Wild — Brian Marsden, CBAT
CBAT thank us for early astrometry by Manning (published in IAUC 4956) and hope the hurricane has not caused damage to us or UK observatories!

010 900129 Kappa Dra — Petr Hermanec, Vancouver
JEI sent summary of observations of this Be star for possible incorporation in proposed paper.

011 900201 AL Com Brian Marsden, CBAT
Tentative report by W. Worraker of a rare outburst: Feb 1.23 UT, 14.1; 2.20, 14.2 (Q1990/10). M. Verdenet did not record it on Feb 3 [14.5. GMH relayed to CBAT but independent confirmation not obtained.

012 900201 TT Crt R. McNaught, Australia
A. Pearce relays via McNaught that this variable is in outburst (1991 Jan 24, 12.7). This UG star was discovered by one of our group, Richard Fleet.

013 900206 Carbon Stars Ian Griffin, UCL
Interim results of visual monitoring of VX And, EU And, V778 Cyg and BM Gem for correlation with observations at other wavelengths sent by JEI. Also Fourier analysis of ST her, AD Per.

014 900207 19891a1 and 1989e1 Brian Marsden, CBAT
Astrometry by D. Buczynski 1989 Nov 22 and Dec 12 relayed to CBAT by GMH.

015 900208 Alan Young Brian Marsden, CBAT
News relayed to several professional astronomers of the sad death of Alan Young who carried out extensive astrometry and photography of extra-galactic supernovae. E-mails of sympathy from all over the world relayed to Peggy, his widow.

016 900213 1989r Brian Marsden, CBAT
Astrometry by D. Buczynski 1989 Sept 2 - Oct 5 relayed to CBAT by GMH.

017 900216 Be stars Martin Gorrod, Southampton
JEI sent details of available BAA data on five stars for possible use in collaborative project.

018 900219 T Leonis Brian Marsden, CBAT
Outburst detected by P. Schmeer Feb 15 and 16. Relayed to CBAT by GMH. Published on IAUC 4965, 4973.

019 900228 1990g Brian Marsden, CBAT
Astrometry by D. Buczynski Feb 17-25 relayed to CBAT by GMH.

020 900301 Brian Manning -Asteroids Ralph Martin, Cambridge
At Pro's request, paper relating to first British Asteroid Discoveries in 80 years prepared by Brian Manning and sent by GMH for possible publication in STARLINK bulletin.

021 900308 Manning Asteroids Brian Marsden, CBAT
Details of further discoveries (up to Manning 15) relayed to CBAT by GMH.

022 903008 Doug Saw Various
News of Doug Saw's death (as a former director of the BAAVSS) circulated to various parties by SD.

023 900313 SW UMa Brian Marsden, CBAT
Outburst detected by P. Schmeer Mar 13.78, 10.8 and confirmed by G. Hurst Mar 13.85 UT, 10.7 relayed to CBAT by GMH. Published IAUC4979.

024 900314 Comet (1990a) Brian Marsden, CBAT
Astrometry by D. Buczynski of 1990 Mar 2 relayed to CBAT by GMH.

025 900315 Mira Cet, Chi Cyg Heather Reeder, Hatfield Poly.
JEI sent visual observations for correlation with infrared data.

026 900316 Asteroid Reporting Brian Marsden, CBAT
CBAT provide GMH with exact format for asteroidal reporting so that data can be directly imported by them into the MPC database. N. James has written a computer program to check residuals and automatically prepare a report in the agreed format.

027 900318 Comet (1990b) Brian Marsden, CBAT
Approximate position for this new comet derived from a photograph by M. Mobberley of Mar 17 relayed to CBAT by GMH.

028 900318 Comet (1989c1) Mark Kidger, Tenerife
Analysis of light curve of this comet received by GMH from Mark Kidger using observations we previously supplied.

029 900319 Comet (1990b) Brian Marsden, CBAT
First astrometry results ever by Martin Mobberley relayed by GMH to CBAT.

030 900319 MWC 560 Graeme Waddington, Oxford
Data from Mount Wilson H-alpha survey supplied to GMH at our request.

031 900320 Comet (1990b) Brian Marsden, CBAT
Astrometry on Mar 19 by D. Buczynski relayed to CBAT by GMH.

032 900323 Supernovae Gill Pearce, Oxford
Meeting arranged by GMH to discuss possible collaboration on SNe results.

033 900324 V635 Cas Diane Roussel-Dupre, Los Alamos
Provisional exchange (Dupre,GMH) as to possible collaboration on the monitoring of this optical component of an X-ray source. (Initial outburst announced in IAUC 4942).

034 900326 Manning 16 Brian Marsden, CBAT
Discovery details of latest asteroid relayed to CBAT.

035 900328 V635 Cas Diane Roussel-Dupre, Los Alamos
Joint project agreed. Diane preparing finder/sequence for our use. Subsequently detailed history of the star received.

036 900326 Comet (1990b) Brian Marsden, CBAT
Astrometry by M. Mobberley of Mar 25 relayed to CBAT by GMH.

037 900327 Manning 16 Gareth Williams, CBAT
CBAT advise GMH this object = (3596) Meriones, a Trojan.

038 900327 Dwarf Novae Janet Drew, Oxford.
GMH agrees a project for our team to monitor dwarf novae outbursts during the first week in April in collaboration with IUE monitoring. E-Circular issued. Immediate e-mail from our Swedish observers who wish to participate as well as those in UK!

039 900401 IR Gem Janet Drew, Oxford
Report sent by GMH indicating recent estimate by S. Korth, Germany on Mar 31.9 UT = 14.8. Is this above minimum?

040 904001 Manning Asteroids Brian Marsden, CBAT
Astrometry on asteroids up to Manning 19 relayed to CBAT.

041 900403 Jack Ells Various
RP circulates the sad news that Jack Ells died recently.

042 900403 Dwarf Novae Janet Drew, Oxford
Detailed report of observations by Worraker, Korth, Moeller, Pearce, Poyner, Toone collated and sent by GMH as per note of 900327. Of particular importance was a supermax of IR Gem on Apr 3 which was then monitored by IUE in response to our alert.

043 900404 Comet Austin Mark Kidger, Tenerife
Revised analysis of light curve supplied to GMH for circulation to amateur astronomers.

044 900406 CY UMa Brian Marsden, Dan Green
Outburst detected by P. Schmeer Apr 5.04, 13.0 relayed to CBAT by GMH.

045 900411 Algol Thorsteinn Saemundsson, Reykjavik
JEI sent details of new elements used in BAA predictions of minima.

046 900412 AAVSO Meeting in Brussels Various
SD circulates latest details on this VS event.

047 900415 V635 Cas Diane Roussel-Dupre, Los Alamos
Photography by M. Mobberley of Apr 13.867 UT yields mag 14.5pv and result relayed by GMH. Suggestion of chart sequence errors?

048 900416 Possible Comet? Mark Kidger, Tenerife
Mark reports a group in Spain saw a possible comet near M65 & M66. Observational check by GMH Apr 15 shows no new object in 15x80B. Result relayed back to Tenerife by GMH (Q1990/37).

049 900418 V635 Cas Diane Roussel-Dupre, Los Alamos
Investigation underway regarding reliability of star magnitudes taken initially from the Guide Star Catalogue.

050 900420 RY Sgr Brian Marsden, CBAT
Details of a fade of RY Sgr (Apr 19, 7.9) received by telegram from Colin Henshaw relayed to CBAT by GMH. Various results appeared on IAUC4999.

051 904030 V3890 Sgr Alan Gilmore, P. Kilmartin, N.Z.
Outburst detected by Albert Jones Apr 27.72, 8.5. Relayed via Gilmore and Kilmartin, then via Andrew Pearce who obtained confirmation for us. Published on IAUC 5002.

052 900503 GK Cep H.Rovithis-Livaniou, Athens

JEI sent photoelectric and visual timings of minima of this eclipsing binary for use in the study of period changes.

053 900505 Comet (1989c1) Brian Marsden, Dan Green

Astrometry by M. Mobberley of Apr 29 relayed to CBAT by GMH.

054 900505 Dwarf Novae Janet Drew, Oxford

Final summary of our observations for this IUE project relayed by GMH (45 different variables covered during the first week of April). Janet confirms IR Gem observed, the first time in UV.

055 900505 DX And Janet Drew, Oxford

Request to GMH for our group to permanently monitor RX And and to alert professionaol group when it starts to rise to maximum.

056 900513 RY Sgr Don Pollacco, G. Ramsay, St Andrews

Don requested latest results re an observing run in Chile. Obtained estimates from Andrew Pearce in Australia for Apr 28 & 29 (mag 8.5) and relayed via G. Ramsay (Scotland) who re-routed to Chile!

057 900513 Comet Austin Mark Kidger, Tenerife

Mark requests any data for Apr 20 in connection with possible tail disconnection event. Results from Grima, Gambin, Pereira relayed.

058 900516 SR Variables John Percy, Toronto

JEI received recommendations for stars to be given priority by binocular observers, and suggestions for methods of analysis.

059 900519 DX And Brian Marsden, Janet Drew

Outburst detected by P. Schmeer, Germany on May 19.056, 13.3. Relayed to CBAT and Janet Drew (see 900505) by GMH. Janet responds 900521 to say spectra to be taken at La Palma in response to our alert.

060 900522 Jupiter Mark Kidger, Tenerife

Mark asks GMH to alert amateurs to the need to check the planet for a small very dark red spot on STR seen by him on May 21 at 21.00 UT.

061 900523 ROSAT Robert Smith, Sussex

Robert has e-mailed Simon Duck suggesting UK amateurs help with the monitoring of ROSAT program stars.

062 900524 Gamma Cas stars Paul Roche, Southampton

JEI received proposal for collaboration on observation of Be stars BD+37 1160 and +26 883.

063 900525 RLSAC Dave Stickland, Barbara Bromage

Dave arranges for new STARLINK box for GMH under node manager Barbara Bromage. This has ‘direct’ connections with various SPAN nodes and will permit log-on to CBAT for computer checks on ‘suspects’.

064 900526 V635 Cas Diane Roussel-Dupre, Los Alamos

More historical data supplied to GMH. Diane advises that our result to date suggest the behaviour is different to previously observed outbursts. We supply data for Apr 29, May 16, May 19 showing steady around 14.7 according to results from G. Johnstone (photography) and S. Korth (visual).

065 90052 3C 273 Mark Kidger, Tenerife

Mark asks GMH to alert amateurs for close monitoring of this quasar which may be in outburst. Recent result by J. Toone (May 21, 13.0) relayed. Subsequently we relay new result by Toone May 27 (22.55 UT) mag 12.9 which MAY indicate a slight rise. Result with Nordic 2.5-m telescope on May 28 was V=12.85 confirming accuracy of Toone's results.

066 900608 Asteroid (4506) Brian Marsden and others

Brian advises us that asteroid 1990 FJ, found by Manning 1990 Mar 24 has been numbered. This is the first asteroid to be discovered from Britain in over 80 years which has subsequently been numbered.

067 900608 ICQ Dan Green, CBAT

Proposal received from Dan that GMH act as UK coordinator for ICQ and investigate possibility of relaying comet observations in an agreed format via e-mail to USA.

068 900613 DX And Janet Drew, Oxford

Faint outburst of DX And reaching about 13.2 on May 20 and covered by Poyner, Verdenet and Schmeer relayed to Janet by GMH.

069 900618 Links with Finland Graeme Waddington

Given the outstanding results on VS by Finnish observers, GMH asks Graeme to find e-mail routes to Finland, notably the new MIZAR bulletin board system. This he successfully achieved and we are now in regular contact.

PRO-AM EXCHANGES REPORT 5

Covering period 1990 July 1 to Dec 31

	Date	Subject	Professional

001 900711 BZ UMa Antonio Bianchini, Italy
Outburst observed by P. Schmeer 1990 July 9 mag 12.2 and details relayed to Italy.

002 900723 DX And Janet Drew, Oxford
S. Korth observed the star at 14.4 July 18 and wonders if this is above usual minimum. Details relayed to Janet who has special interest in this variable.

003 900801 Carbon stars Ian Griffin, UCL
JEI sent interim results of visual monitoring of VX And, EU And, V778 Cyg and BM Gem for correlation with observations at other wavelengths.

004 900809 AM Her, MV Lyr, CM Del, VW Vul I.L. Andronov, USSR
Asks for more specific data on the 'summaries' found in The Astronomer. Duly supplied.

005 900817 Symbiotic stars Ladislav Hric, Czechoslovakia
JEI sent observations in last two years for inclusion in paper giving results of programme of long-term photometry.

006 900917 R CrB stars David Kilkenny, SAAO
JEI received data and finding charts for known and possible R CrB stars needing observation by amateurs.

007 900914 BC UMa Barbara Hassell, ROSAT
Outburst observed by P. Schmeer, Sept 9, 11.5; ROSAT team alerted.

008 900914 BC UMa Derek Jones, Tim Nayor
Previous alert being relayed to La Palma observers.

009 900920 FN And Brian Marsden, CBAT
RARE outburst by Schmeer Sept 19, 13.5 relayed to CBAT. Confirmation by M. Mobberley also relayed Sept 23.

010 900922 3C 273 Mark Kidger, Tenerife
Data requested by Mark on this quasar. Comprehensive visual observations by John Toone relayed back.

011 900925 PRO-AM Article P.Hingley, RAS
Requested article on PRO-AM duly supplied in connection with a book commemorating T.W. Webb.

012 901025 Carbon stars Ian Griffin, UCL
JEI sent final results of visual monitoring of VX And, EU And, V778 Cyg and BM Gem for correlation with observations at other wavelengths.

013 901106 DX And Janet Drew, Oxford
Data requested by Janet prior to La Palma observing run. Results for Oct (min around 14.8) relayed.

014 901118 U Gem Tim Naylor, La Palma

Recent results on U Gem requested and relayed. Nov 19 they confirm IUE used for UV Spectra during outburst detected by our observers.

015 901120 Hydrogen-deficient carbon stars David Kilkenny, SAAO

JEI received finding charts for several stars possibly worth observing by our observers.

016 901113 RS Oph A. Evans, Keele

Dr Evans requested BAA observations since 1967 for analysis. Results for 1988 and 1989 sent 901127 by JEI. Remainder being sent by MDT.

017 901127 DX And Janet Drew, Oxford

Further results by S. Korth, Germany relayed to Janet. Janet confirms observing run yielded orbital period 10.6 hrs.

018 901129 Comet (1990p) Brian Marsden, CBAT

Astrometry by B. Manning and H. Ridley (Nov 20) relayed.

019 901223 UV Per Taichi Kato, Japan

Following IBVS 3522 advising a large proper motion, we undertook astrometry and compared this with historical measures. This did NOT confirm the proper motion suggested.

020 901226 TAV 0033+59 Don Pollacco, St Andrews

Discovery of unusual variable in Cas by Mike Collins relayed to Don. Results 1954-1990 Sept show little change from 10.6 but followed by rapid fade to 11.9 (1990 Dec 25).

021 901227 CY UMa Brian Marsden, CBAT

Outburst detected by P. Schmeer Dec 27 13.3v relayed.

022 901230 TAV 0033+59 Don Pollacco, St Andrews

Updated list of observations showing 11.8v by Dec 29.95 UT.

023 901230 Finder Charts N.N. Samus, Sternberg

Samus suggests we publish finder charts in TA as several variables newly catalogued have no chart published in the literature.

PRO-AM Exchanges Summary Updated

Half year ending	Number of exchanges	Report Nos
1988 Dec 31	42	1
1989 Jun 30	51	2, 3
1989 Dec 31	45	3
1990 Jun 30	69	4
1990 Dec 31	23	5
To Date	230	

Star	Epoch	Helio JD 244...	O-C	No	Observer	
AW Lac	18492.5	7758.459	+0.087	11	BS	
	18496	7762.441	+0.069	12	BS	
UV Leo	15259	7597.430	+0.010	8	TY	
δ Lib	2025	7673.481:	-0.111:	11	BS	*
UV Lyn	17550	7554.4261	+0.0085	29	EJ (pe)	
RR Lyn	1447	7544.251	-0.140	10	BS	*
	985	7847.208	-0.001	28	BS	*
TT Lyr	1749	7776.559	+0.016	21	BS	*
TZ Lyr	5703	7800.317	+0.008	11	BS	*
HP Lyr	21.5	7807	-12	29	BS	*
λ Lyr	3055.5	7742.03	+35.86	120	10	*
	3056	7748.51	+35.88	124	10	*
V505 Mon	54	7544.6:	+5.1:	39	4	*
	54.5	7565.1:	-1.3:	24	4	*
V451 Oph	1303	7696.5275	-0.0023	21	EJ (pe)	
V566 Oph	14542.5	7793.151	+0.017	16	VN	*
	14601	7817.102	+0.004	21	VN	*
V839 Oph	17873	7758.441	+0.055	15	BS	*
	17880.5	7761.525	+0.071	10	BS	*
	17895	7767.439	+0.055	7	BS	
	17914.5	7775.404	+0.045	10	BS	
	18009.5	7814.270:	+0.056:	10	BS	*
VV Ori	4481	7546.478:	-0.019:	7	DH	*
ER Ori	14057.5	7578.345	+0.003	8	TY	
	14093	7593.371	-0.002	7	TY	

Star	Epoch	Helio JD 244...	O-C	No	Observer	
V1031 Ori	1432.5	7567.328	-0.210	17	BS	*
	1496	7783.553	-0.247	12	BS	*
U Peg	30057	7776.447	-0.027	10	BS	
AW Peg	376	7735.5104	+0.0166	48	EJ (pe)	
BX Peg	12702.5	7757.408	-0.014	7	BS	
	12720.5	7762.456	-0.014	8	BS	
	12902	7813.354	-0.013	9	BS	
	13023	7847.285	-0.013	8	BS	
Z Per	712	7835.271	-0.064	28	BS	*
ST Per	2011	7762.367	+0.017	9	BS	*
AB Per	3473	7854.267	-0.622	14	BS	*
AY Per	1750	7761.323:	-0.047:	8	BS	*
IZ Per	871	7789.5527	+0.0021	47	EJ (pe)	
β Per	671	7565.480	+0.005	10	DH	
	680	7591.324	+0.044	7	POG	
	771	7852.211	+0.005	12	IS	
Y Psc	589	7853.250	-0.028	22	BS	*
RV Psc	42374	7856.296	-0.018	10	BS	
SX Psc	2257	7856.298	-0.004	12	BS	
UV Psc	5168	7856.4240	+0.009	13	BS	
U Sge	9054	7738.537	-0.002	7	WH	*
V Sge	19196	7760.410	+0.007	12	BS	
	19198	7761.433	+0.002	11	BS	
SY Sge	4174	7813.263	+0.057	13	BS	*

Star	Epoch	Helio JD 244...	O-C	No	Observer	
V Ser	5170	7791.305	-0.012	19	BS	*
CF Tau	6243	7856.211	-0.040	13	BS	*
GR Tau	7631	7853.302	-0.010	13	BS	*
λ Tau	6665	7853.331	+0.083	26	5	*
W UMa	5439	7580.390	-0.002	8	MM	
TX UMa	829	7537.6298	+0.0578	37	EJ (pe)	
AW UMa	6675.5	7593.5378	-0.0029	28	EJ (pe)	
	6727.5	7616.3516	-0.0031	25	EJ (pe)	
	6746	7624.4691	-0.0021	14	EJ (pe)	
RS UMi	501	7847.276	+0.062	11	BS	*
RT UMi	3505	7762.467	+0.100	13	BS	
	3556	7856.401	+0.094	13	BS	
RU UMi	11817	7799.390	+0.001	8	MM	
Z Vul	1941	7712.4997	-0.0049	14	EJ (pe)	
	1976	7798.409	-0.018	8	WH	
BP Vul	904	7757.331	+0.007	10	BS	*
	955	7856.291	+0.009	11	BS	
DR Vul	3331.5	7799.428	+0.005	10	MM	
GP Vul	12796	7813.362:	-0.013:	8	BS	

Addenda and Corrigenda

The following corrections to previous lists of minima should be noted.

SX Aur - JD of minimum in VSSC 61 should read 6066.3151; O-C should read +0.0299.

AS Cam - JD of minimum in VSSC 63 should read 6397.4088; O-C should read -0.0083.

VW Cep - The minimum in VSSC 63 on 6145.4005 should be deleted. JD of second minimum in VSSC 72 should read 7272.5497.

CQ Cep - JD of minimum in VSSC 60 should read 5440.559; O-C should read +0.065.

IU Per - epoch of second minimum in VSSC 61 should read 14192; JD should read 6061.379; O-C is correct.

The following minima were inadvertently omitted from earlier lists:

AR Aur	2013.5	6727.332:	-0.060:	5	TY
TW Cnc	187	5086.76	-0.12	16	BS
XX Cep	417	5814.477	+0.010	10	BS
AW Lac	16284	5234.403	+0.015	6	BS
Delta Lib	1554	6577.383	-0.025	9	DH
TX UMa	605	6851.4384	+0.0318	34	EJ (pe)

Computing Section - Program & Data Library

The BAA's Computing Section now has a Program & Data Library (P&DL), which exists both to offer help to members on computing problems, and also as a source of various public domain machine-readable catalogues and programs.

Some of the data sources available include the Zodiacal Catalog, the (revised) USNO Zodiacal Catalog, Spectroscopic Binary Orbits Catalogue, and NASA Selected Astronomical Catalogs. Progams include constellation display and star mapping programs, artificial satellite track program, artificial satellite prediction program, and lunar occultation programs.

The P&DL also offers a data-transfer service between Amstrad 3" disks (for the PCW 8256, PCW 8512 and PCW 9512 computers), and the standard 3.5" MS-DOS format (which can also, of course, be read by all modern Macintosh machines).

The charges made depend upon the size of the catalogues and of the size and number of disks required. The level of charges is set to make a very small operating surplus to help the Section's work.

A full booklet may be requested by sending an A5 SAE to the Coordinator:

Robert Harrold
10A Barker Avenue, RoseHeyworth Estate, Abertillery, Gwent NP3 1SE

Overseas members may obtain the booklet (sent by airmail) by including an extra £1.00 when sending subscription renewals to the Editor, who will forward the money and address to the P&DL. Please ensure that you specify that you require the booklet in any accompanying note or letter.

SZ Piscium

Tristram Brelstaff

SZ Psc is a 7th-magnitude eclipsing binary with a period of just under 4 days. Visual timings made by VSS observers in the years 1975-79 showed large deviations from the predictions available at that time. This sort of behaviour is to be expected in this star, because it is know to be an RS Canum Venaticorum-type binary. In other words, it shows star-spots that distort the shape of the light-curve. Scattered observations by Melvyn Taylor in 1991 suggest that SZ Psc is again deviating from the latest predictions. The eclipses appear to be occurring several hours earlier than the following elements from the *Krakow Yearbook* (*Rocznik Astronomiczny*) for 1992:

Min I = JD 2443498.5020 + 3.9658663 E .

Further observations are needed in order to confirm this change. Visual observations, if they are made with care, should be adequate, but photoelectric observations would be better because the range is not very large and the variations are rather slow. [A chart, originally drawn by John Isles for the Binocular Sky Society in 1972, is reproduced here.]

Important Notice - Submission of observations

With computerization of the VSS's reported observations now becoming an essential part in the communication of results, it is important for all observers to submit their report forms promptly. For observations made January to June, these should be received by the Secretary at the end of August (at latest); and for July to December, at the end of the following February. Failure to do this would probably mean an inefficient working order for our voluntary data-handling team and may well result in the loss of valuable variable star estimates from yearly light-curves.

Observers submitting their results in machine-readable form directly to the Computer Secretary (Dave McAdam) are requested to present a summary of star name and number of estimates made to the Secretary (Melvyn Taylor) in order that VSS totals may be assessed.

New charts for SS Vir and SW Vir: preliminary chart for UV Aur

John Toone

Revised charts have been prepared for SS Vir and SW Vir, and also a second preliminary chart for UV Aur. These are reproduced on the following pages. Full-size copies may be obtained in the usual manner. Notes on the stars themselves are as follows:

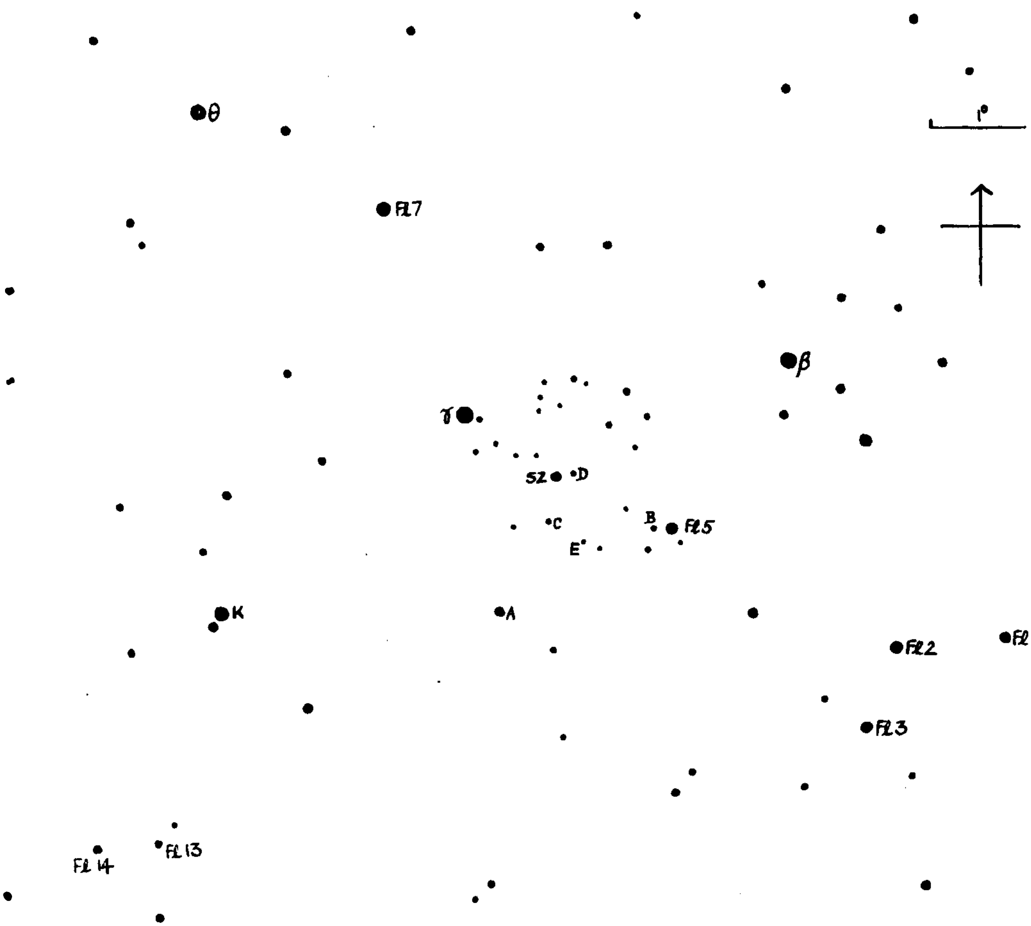
SS Vir A lettered sequence is now introduced, eliminating 60 and 76 which are both of spectral class M, 60 being FW Vir. Comparison K is added for use when SS is near minimum light.

SW Vir The only change from the previous chart is that the magnitude of F is revised to the value quoted in *Sky Catalogue 2000.0*. Visually F seems closer to E than G.

UV Aur This second preliminary chart has been introduced to provide an extended sequence, because in recent times this star has been fainter than magnitude 10. Comparison F has been dropped and replaced with G to L inclusive. It must be stressed that this sequence is preliminary only, and observers are urged to check and send any comments to the Chart Secretary.

230802 SZ · Piscium 7.0–7.6 EA 3.97^d

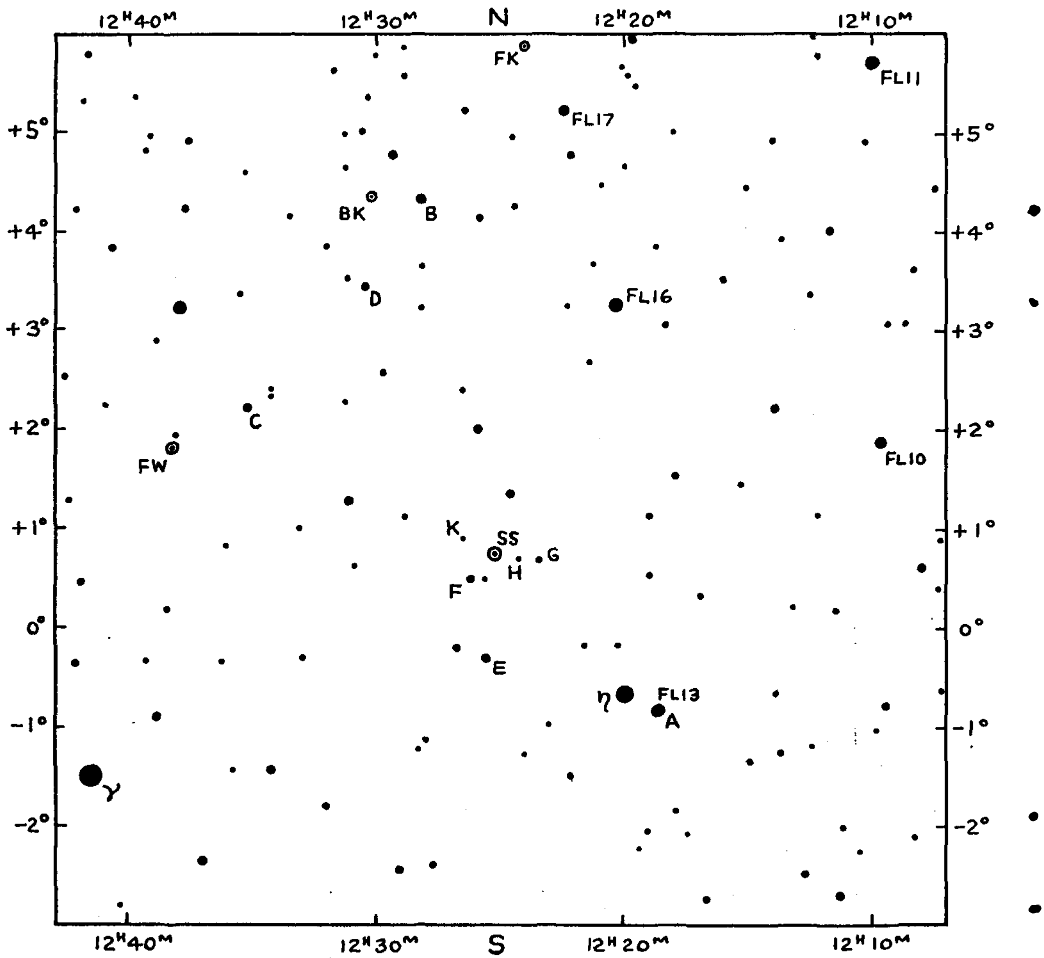
(1950) $23^h\ 10^m\!.8$ $+02°24'$ D = 10^h



Sequence derived from H.A. 54, Publ. U.S.N.O. XXI, pv. plate by W.E.P.; corrected to V scale	A = 6.6 B = 6.9 C = 7.1 D = 7.72 E = 8.3	© Binocular Sky Society 1972	J.E.I. 72.06.11

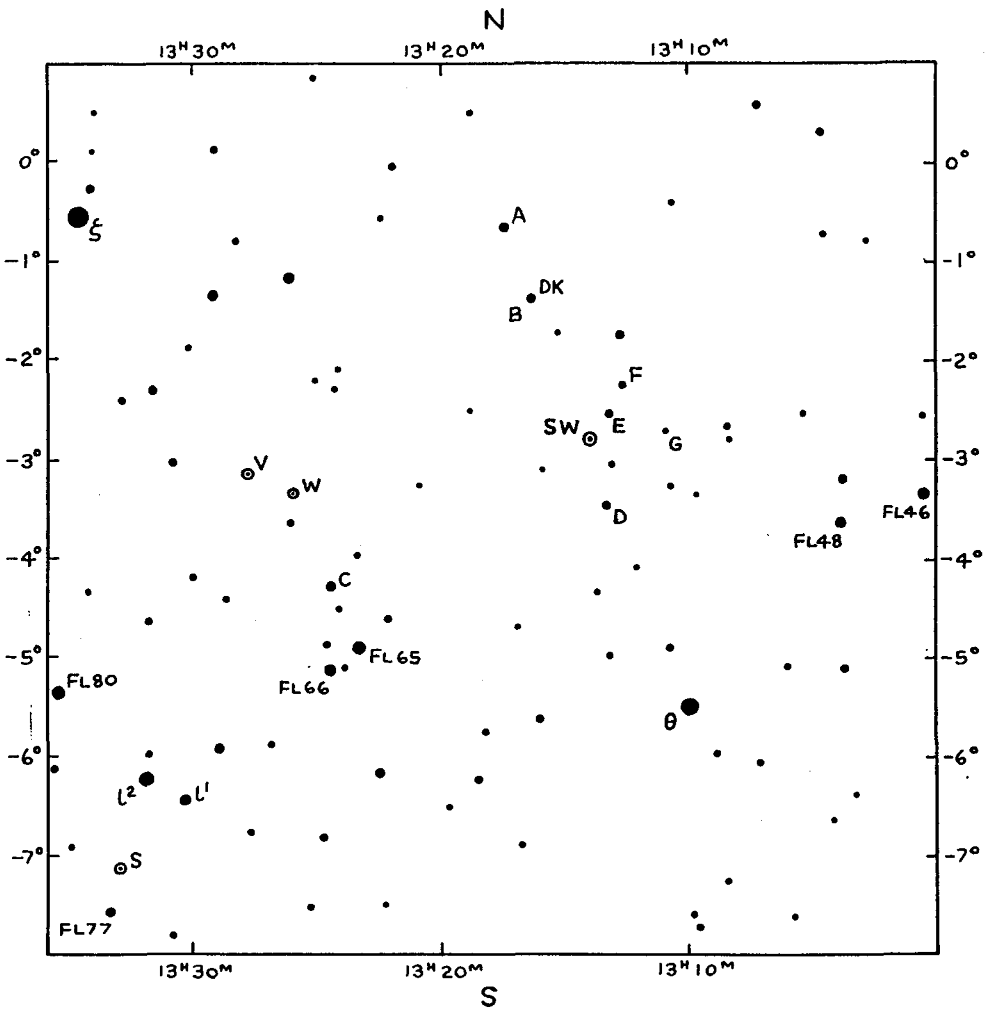
097·01 9° FIELD DIRECT

SS VIRGINIS 12H 25·3M + 00°48′ (2000)



SEQUENCE: B VISUAL ESTIMATE. OTHERS FROM AAVSO CHARTS (a), (b) & (d).	A 5·9	F 8·3	BAA VSS	
	B 6·6	G 8·6	EPOCH: 2000	
	C 7·0	H 9·4	DRAWN: JT 23-6-91	
	D 7·4	K 10·4	APPROVED: JEI 23-7-91	
CHART: FROM ECLIPTICALIS	E 7·7			

SW VIRGINIS $13^H 14{\cdot}1^M$ $-02°48'$ (2000)

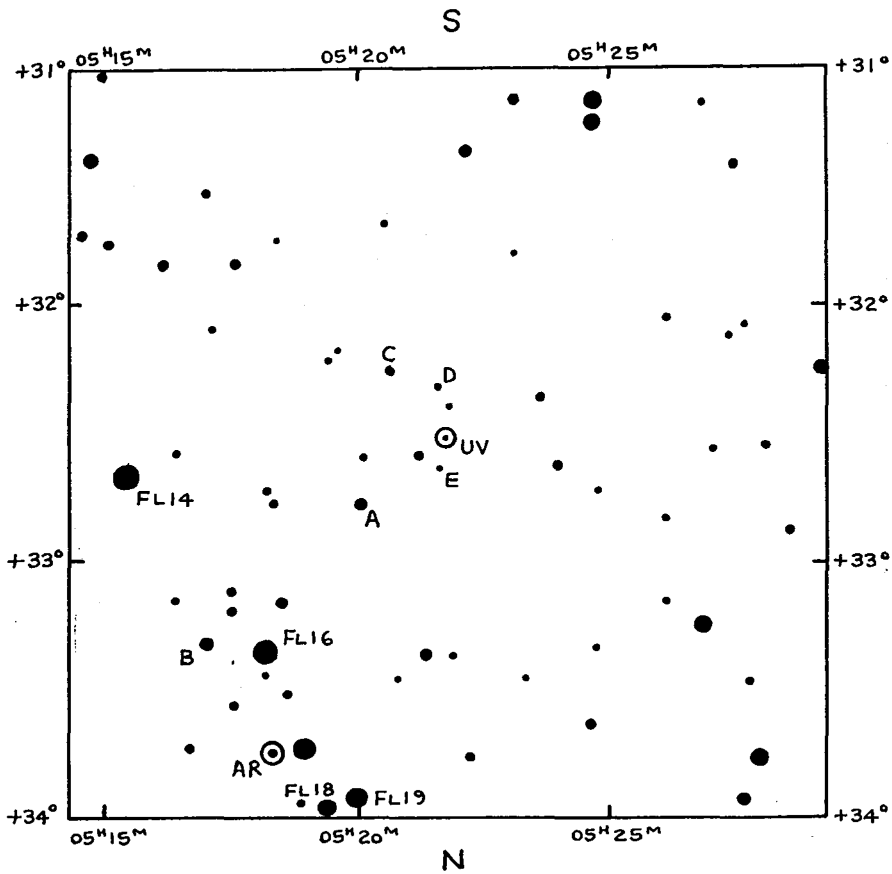


SEQUENCE: C FROM AAVSO CHART FOR V VIRGINIS. OTHERS VISUAL ESTIMATES. F REVISED 1991.
CHART: FROM ECLIPTICALIS

A	6·3	E	7·7
B	6·5	F	7·9
C	7·1	G	8·5
D	7·4		

BAA VSS
EPOCH: 2000
DRAWN: JT 30-6-91
APPROVED: JEI 23-7-91

UV AURIGAE	$05^H 18^M 33^S$	$+32° 27.8'$	(1950)
	$05^H 21^M 49^S$	$+32° 21.8'$	(2000)



SEQUENCE: FROM BULL AFOEV 12 (3), 1978.
CHART: FROM SAOC & PAPADOPOULOS.

A	7.0	D	8.7
B	7.6	E	9.1
C	8.2		

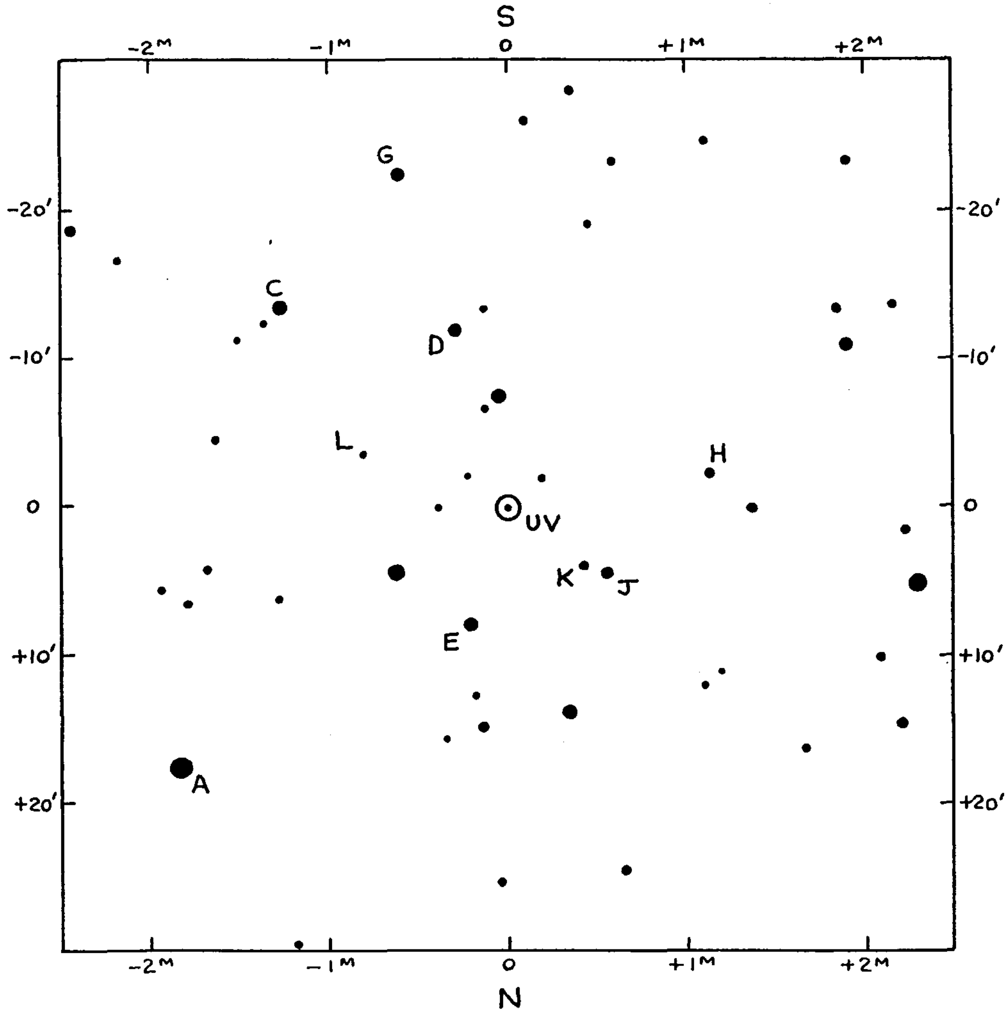
BAA VSS
EPOCH 2000
DRAWN: JT 10-5-92
APPROVED:

074·02

1° FIELD INVERTED

UV AURIGAE $05^H 18^M 33^S$ $+32° 27.8'$ (1950)

$05^H 21^M 49^S$ $+32° 21.8'$ (2000)



SEQUENCE: A-E BULL AFOEV 12 (3), 1978.
G-L VISUAL ESTIMATES WJW 1991.
CHART: FROM STELLARUM.

A	7.0	H	10.0
C	8.2	J	10.4
D	8.7	K	10.8
E	9.1	L	11.4
G	9.3		

BAA VSS
EPOCH: 2000
DRAWN: JT 10-5-92
APPROVED:

R Scuti in 1991

Melvyn Taylor

(R Sct, 4.2 - 8.6V, 146^d, G0 - K2, RVA: RA $18^h 44^m 49^s$, Dec. -05° 45.6')

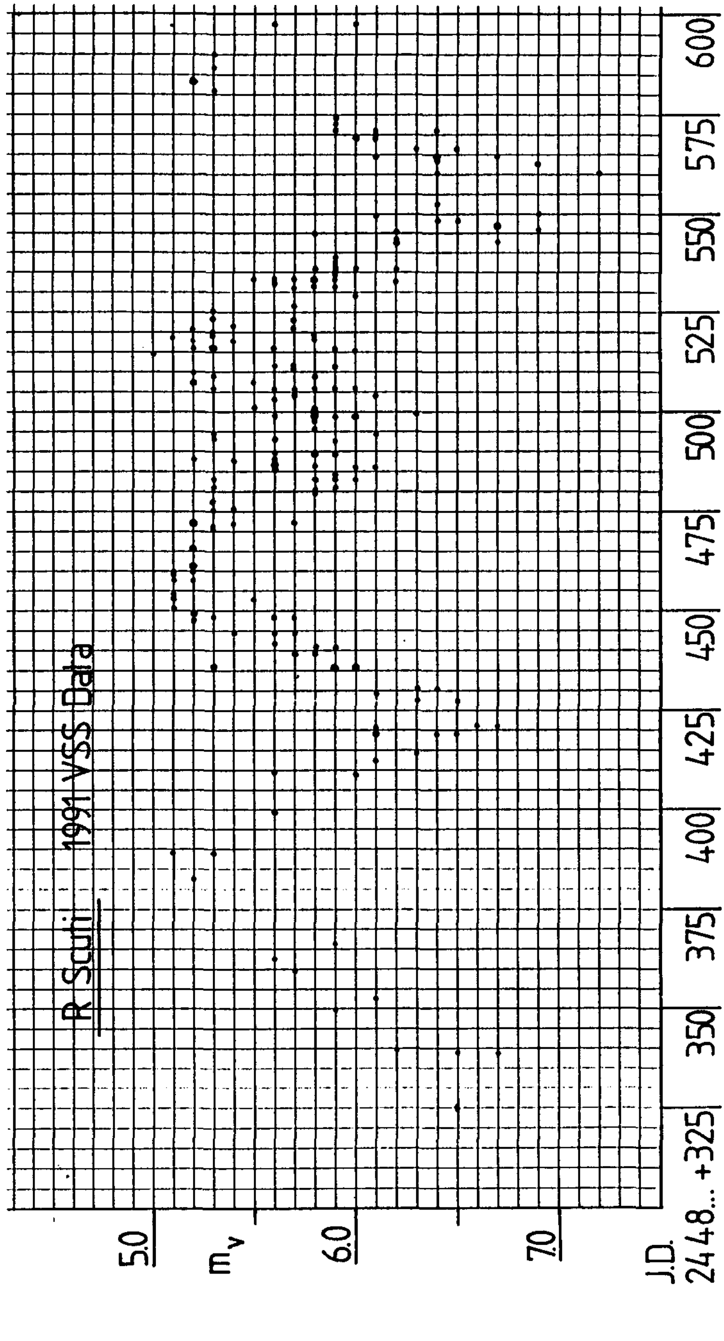
The plot of uncorrected VSS observations for R Sct made during 1991 is given *opposite* with the small dot being one estimate, and the larger dot two or more. Two hundred and twenty-eight observations have been made available from the following observers: Albrighton, Bone, Brelstaff, Dryden, Fraser (J), Fraser (RBI), Gavine, Kousahiappas (in Cyprus), Livingstone, Markham, Middlemist, Munden, Nicholls, Pointer, Poyner, Ramsay, Ridley, Smeaton (in Germany), Taylor, Thorpe (in Australia), Worraker, and Xylaris (in Cyprus).

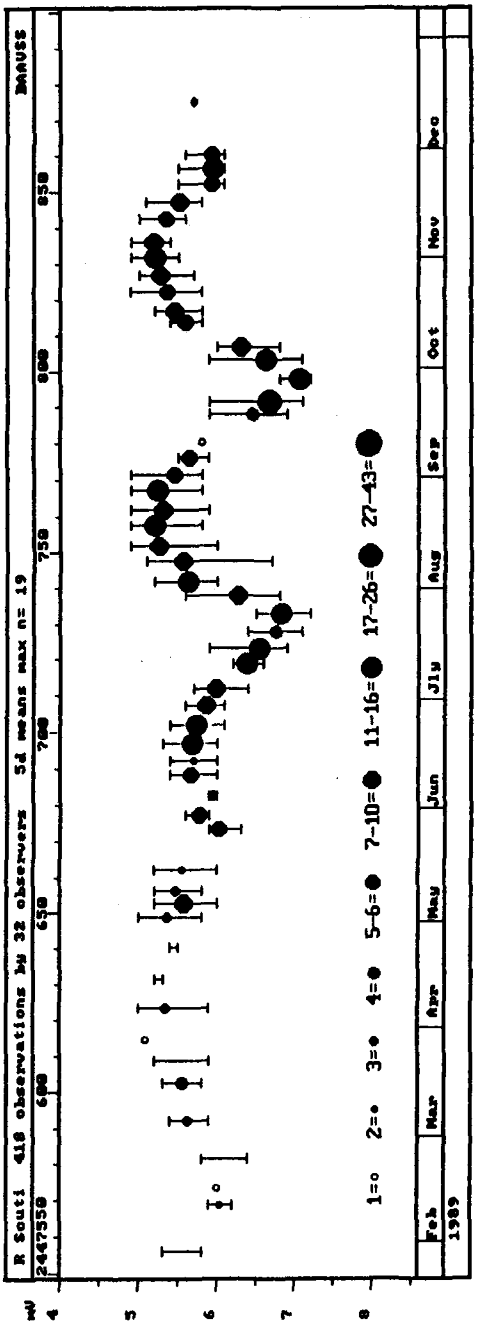
The mean variation as seen by a smooth line through the data shows some unusual features; the initial rise apparently coming from a secondary minimum, which in reality is a 'deep' (about 6.5 magnitude) one. The following dates of maxima and minima are preliminary:

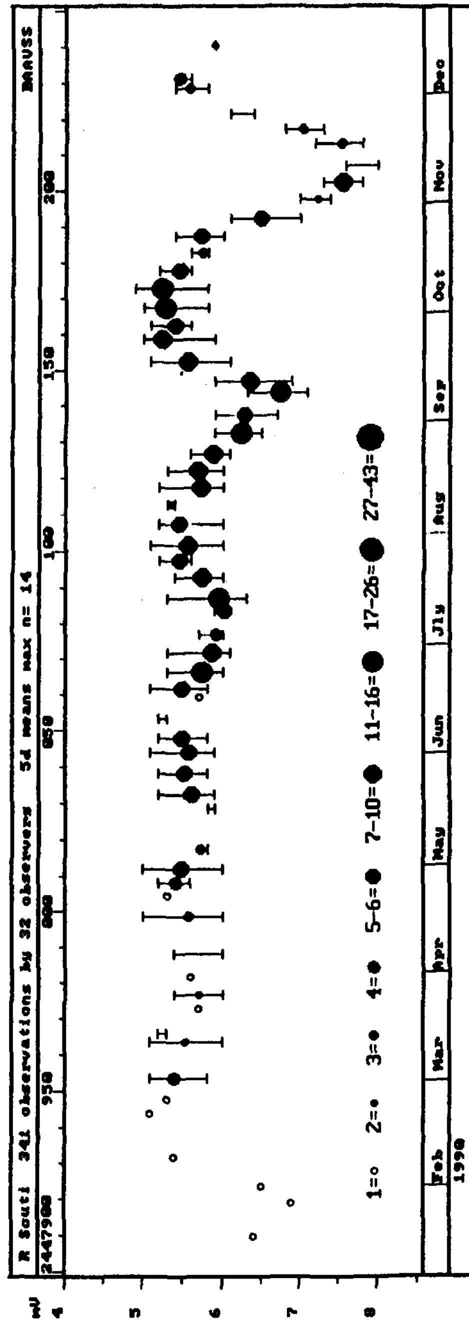
	magnitude	Julian Date	Calendar Date
Maxima:			
	5.2	2448387	(1991 May 10)
	5.2	2448459	(1991 Jly 21)
	5.3	2448517	(1991 Sep.17)
	5.2	2448583	(1991 Nov.22)
Minima:			
	6.5 (I)	2448422	(1991 Jun.14)
	5.8 (II)	2448497	(1991 Aug.28)
	6.8± (I)	2448556	(1991 Oct.26)

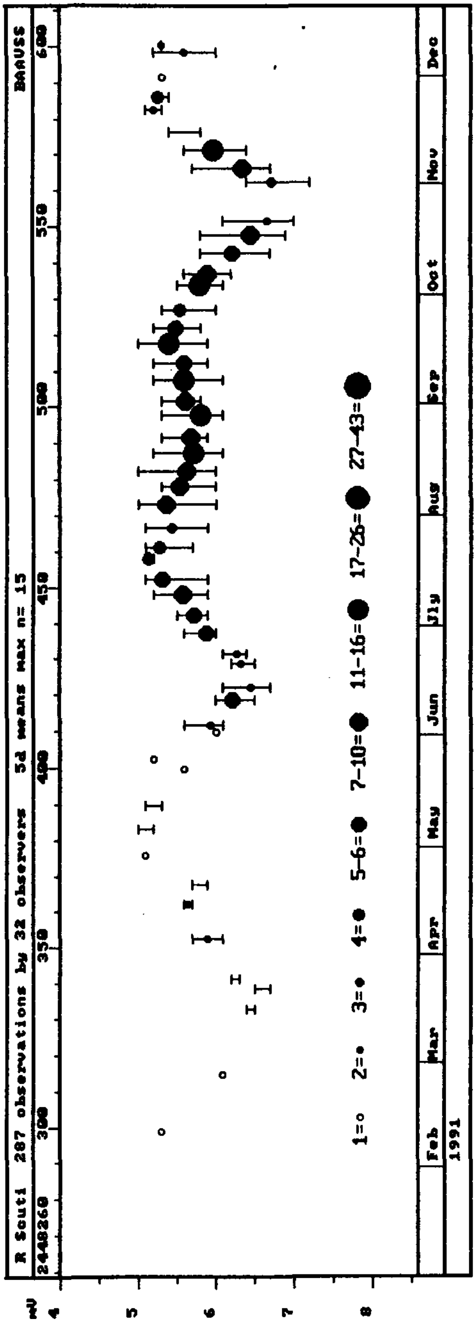
Given the right observational circumstances, the star may be observed much earlier in the year than the first estimate on 1991 March 13, and any observer who may be able to to this is to be encouraged, so that the light-curve may be extended. A similar statement also applies to the observability near the year's end, when it is also near the horizon. Any observer willing to add this star to their programme of observtion may obtain the chart, which also shows S Sct and V Aql, from John Toone, the Chart Secretary.

[Pages 34-5 show light-curves of R Scuti for 1989-91 as individual years, and as a combined plot for the three years, compiled from the Section archives. A scale shows the number of observations included in each mean. The observers were as follows: S.W. Albrighton, N.M. Bone, T. Brelstaff, R.C. Dryden, H.L. Duncan, R.W. Fleet, J. Fraser, R.B.I. Fraser, D. Gavine, J. Howarth, J.E. Isles, N.S. Kiernan, S. Koushiappas, R. Livingstone, T. Markham, I.A. Middlemist, B.R.M. Munden, M.J. Nicholls, R.D. Pickard, G. Pointer, G. Poyner, G. Ramsay, S.G. Ridley, J.D. Shanklin, A. Smeaton, S.R. Srinivasan, T. Tanti, M.D. Taylor, J. Thorpe, J. Toone, W.J. Worraker, K. Xylaris.]


R Scuti 1991 VSS Data
5.0
m_v
6.0
7.0
J.D.
2448... +325
350
375
400
425
450
475
500
525
550
575
600


R Scuti 418 observations by 32 observers 5d means max n= 19
BAAVSS
2447550
1989
Feb Mar Apr May Jun Jly Aug Sep Oct Nov Dec
1=o 2=• 3=• 4=● 5-6=● 7-10=● 11-16=● 17-26=● 27-43=●
mV


R Scuti 341 observations by 32 observers 5d means max n= 14
BAAVSS
2447900
1990
Feb Mar Apr May Jun Jly Aug Sep Oct Nov Dec
1=o 2=• 3=• 4=● 5-6=● 7-10=● 11-16=● 17-26=● 27-43=●
mV


R Scuti 287 observations by 32 observers 5d means max n= 15 BAAVSS
2448260
1=○ 2=• 3=• 4=● 5-6=● 7-10=● 11-16=● 17-26=● 27-43=●
Feb Mar Apr May Jun Jly Aug Sep Oct Nov Dec
1991

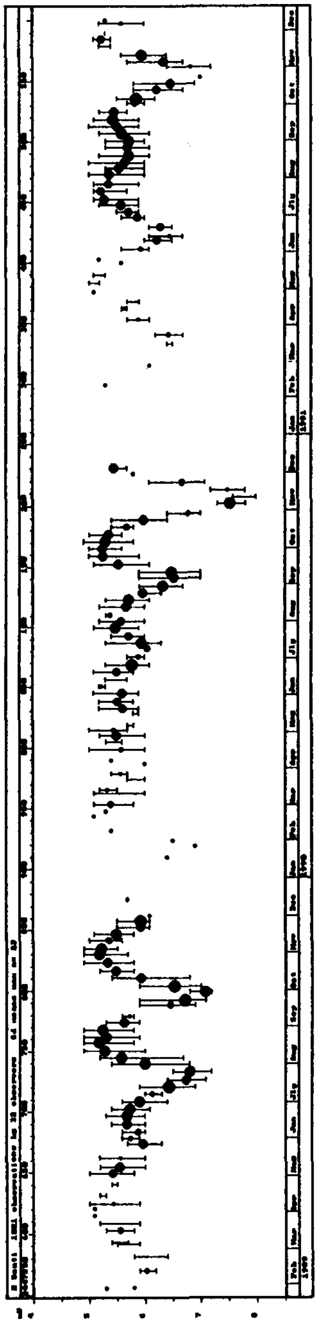


Chart improvements - Suggestions for the U Cephei sequence

Tristram Brelstaff

Tony Markham has pointed out that comparison stars A and B in the U Cephei sequence are really too close together to allow accurate visual estimates to be made with them. He says that he prefers to use stars H and K from the VSS sequence for RX Cephei, instead. Looking back at my own observational records, I find that I too have found it necessary to use alternatives to stars A and B. In my case, I chose three stars which I labelled X, Y and Z. It so happens that my Y is identical with Tony's K. On the accompanying copy of the existing chart these alternative comparison stars are shown labelled in square brackets.

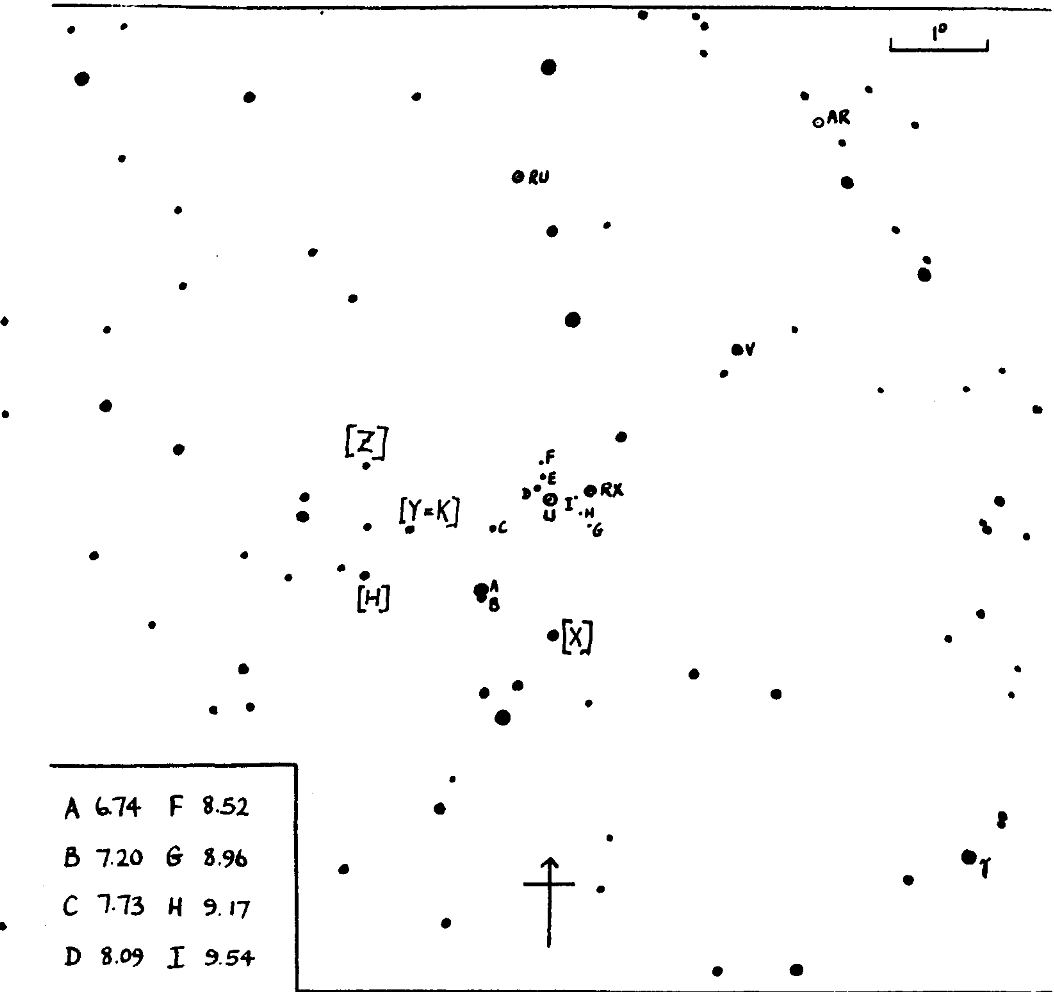
Before I update the chart, it would be useful if I could have a few unbiassed estimates of the magnitudes of these stars relative to the existing sequence and to each other. This would help me to decide which ones to include in the new sequence and to assign magnitudes to them. If you want to help, then wait for a good moonless night and then estimate each of the new stars against at least two others. It would be helpful if you also included A, B, C and U (if it is a maximum) in this. You can use either a step method or the fractional method. Binocular observers might find it difficult to make estimates of A and B unless they hold their instruments very steady.

U Cephei is quite an interesting eclipsing binary in itself. It is apparently quite an active system with irregular episodes of mass transfer from the cool component to a disk around the hot component. These are accompanied by irregularities in the light-curve and changes in the period. The eclipses last for just under 10 hours and are quite easy to time through binoculars or a small telescope. If you would like to have a go then the following table lists the approximate times of minima that are observable from Britain in the next few months. All times are GMAT.

1992			1993			1993			1993		
Dec.	02d	08h	Jan.	11	05	Feb.	27	14	May	13	09
	04	20		13	17					18	09
	07	08		16	05	Mar.	04	14		23	08
	09	19		18	17		09	13		28	08
	12	07		21	05		14	13			
	14	19		23	16		19	13	Jun.	02	08
	17	07		26	04		24	12		07	07
	19	19		28	16		29	12		12	07
	22	07		31	04					17	07
	24	18				Apr.	03	12			
	27	06	Feb.	02	16		08	11	Jly	09	17
	29	18		05	04		13	11		14	17
				07	15		18	11		19	17
1993				10	03		23	10		24	16
Jan.	01	06		12	15		28	10		29	16
	03	18		17	15						
	06	06		20	03	May	03	10	Aug.	03	16
	08	17		22	14		08	09		08	15

005381 U Cephei 6.7 – 9.0 $2^d.49$ EA

(1950) 00^h $57^m.7$ +81° 36′



A	6.74	F	8.52
B	7.20	G	8.96
C	7.73	H	9.17
D	8.09	I	9.54
E	8.44		

Sequence from Sky-Tel 1968 Mar

V Cep	6.6	cst.	
RU Cep	8.2 – 9.4	109^d	SRd
RX Cep	7.5 – 7.8	–	L
AR Cep	7.1 – 7.8	–	SRb

J.E.1
71.07.18

Suspected variables and all that

Chris Lloyd

In *VSSC* **72**, 13, Tony Markham relates his experiences of using the Spearman Rank Correlation Test, as described by John Isles *VSSC* **67**, 12, on a number of well known and suspected variables. However, I realised that the test as given did not correspond to my understanding of it, and on checking, to the description given in the standard texts. The formula for the Spearman Rank Correlation coefficient

$$r_s = 1 - 6.SSRD/(n^3 - n)$$

is correct but SSRD should be the sum of the squares of the rank differences between the rank in x (in this case time) and the rank in y (magnitude) of the *i* th observation, so

$$SSRD = \Sigma (X_i - Y_i)^2$$

and *not* the difference in the y ranks of consecutive x values.

When applying this test to suspected variables there is the treatment of tied ranks to consider. Suspected variables by their nature do not vary much and so many observations will have the same magnitude, and nominally the same rank. Various schemes for randomising tied ranks have been suggested but it has also been pointed out that randomising could lead to widely divergent results. The correct solution is to give each tied rank the average of the ranks with the same magnitude, which usually means that there are fractional ranks. Also because the formula for r_s given above is a simplification based on the assumption of no ties a small correction should strictly be applied, but in most cases this effect is small. The correlation coefficient should have the same absolute value whether the magnitudes are ranked in increasing or decreasing order, but of course the opposite sign. If there are no ties then the simple form will handle this correctly but if there are ties it will not. Using for example the data on NSV 13150 given by John Isles we have SSRD = 1209 and $r_s = 0.535$ by the simple formulation and $r_s = 0.525$ by the rigorous method when ranked by (numerically) increasing magnitude and 3885, -0.494 and of course -0.525 respectively, when ranked by decreasing magnitude. Note the difference between the values derived from the simple formulation. The associated probability of the points being random is $p = 0.006$, so at face value this is a good candidate for variability.

The Spearman Rank Correlation Test is primarily a test of trend, that is a general drift to brighter or fainter magnitudes, and the trend in the NSV 13150 data is obvious. If the data show some other non-randomness then this test will not perform well and some other test may be more appropriate.

How the observations present themselves will depend critically on the type of variable and how frequently it is observed. If the variable has a period which is long compared with the run of observations then it may show a trend but as the cycle becomes progressively less well sampled the measurements will just go up and down with no particular structure. Eclipsing binaries are a special problem because the variation occupies such a small part of the cycle and only a few faint measurements may indicate what is happening. Also by their very nature, irregular and eruptive variables are also difficult to detect convincingly. And of course as the observational errors become more dominant life becomes harder, but it is not always clear what the errors are.

Visual observation is not an exact business and the observations are subject to variety of biases and other errors. Tristram Brelstaff (*VSSC* **68**, 10) provides a excellent description of the problems faced by the observer and John Isles adds another. Probably the most corrupting of these is misidentification as this introduces entirely spurious measurements into the data. Generally though the distribution of errors is not *normal* and even constant stars may show runs of points or preferred values.

Against this background, any statistical test is going to have a hard time and it is unreasonable to expect one test to say yea or nay correctly each time. Many tests exist to detect different types of non-randomness in runs of data. The general problem of identifying variables from a number of visual observations is also similar to the detection of period changes in miras. This particular drum has been beaten before and a number of tests have been developed for the mira problem which with little or no modification may be applied equally to the problem of suspected variables. I have put together a suite of tests which observers may find useful. Some of the tests are described in *JBAA* **101**, 46 but I will go through them all briefly here.

The Spearman Rank Correlation test will show up general trends in the data but not much else. Two other tests which look at the correlation between consecutive points may also be used. One is a circular serial correlation and the other is the standard correlation on which the Lag-2 test of John Isles is based. These test the continuity of the data on a short scale. The span test measures the accumulated difference between the each observation and the mean magnitude and works well on one or two runs up and down in brightness. The other two tests are rather weaker but may be useful under some circumstances. The first measures whether the number of turning points in the data is likely to be due to chance, and on this problem it is probably not very useful. The other compares the time distribution of the high and low points and may on occasions be very powerful. The tests are contained in a simple program for IBM PC's.

I have used the tests on two sets of data. That of John Isles on NSV 13150 and Ian Middlemist on BS 551 (*VSSC* **67**, 26). On the NSV 13150 data all the tests except the turning points test suggest variability at a high level of confidence. As for BS 551, the position is not so clear cut. Looking at the individual seasons the turning points test fails every time. All the others suggest variability in the 1976 season, 3 in 1977 and 2 in both 1975 and 1978. All the tests fail in 1979. When all the data are combined all the the tests except the turning points and Spearman suggest variability at a very high level. On the basis of this I believe there is a good case for variability. These experiments are limited and clearly it would be very useful to extend them to real data of known constant stars.

After all the observing and application of endless tests the star remains a *suspected* variable until the nature of the variation is established. There are two possible options at this stage. If a period can be found then the problem is on the face of it solved. The difficulty here is that some periods are more reliably established than others, although if the star follows the predictions then there is a good case. Period finding is a useful tool but for the irregular and eruptive variables it will not help, which leads to the second option. Final confirmation can only come from more reliable observations and here there has to be a role for photoelectric photometry. Some visual observers may look upon this as an admission of failure but it is nothing of the kind. If visual observations have done all that can be expected of them and identified a good candidate for variability then any remaining doubt can only be laid to rest by accurate photometry.

Clarifying the nature of suspected variables is an important task. It is not a job for the lone visual observer but requires collaboration and co-ordination, otherwise the problem becomes endless and is never solved. It requires the best possible knowledge about the star in question and ultimately a photoelectric observer prepared to collaborate.

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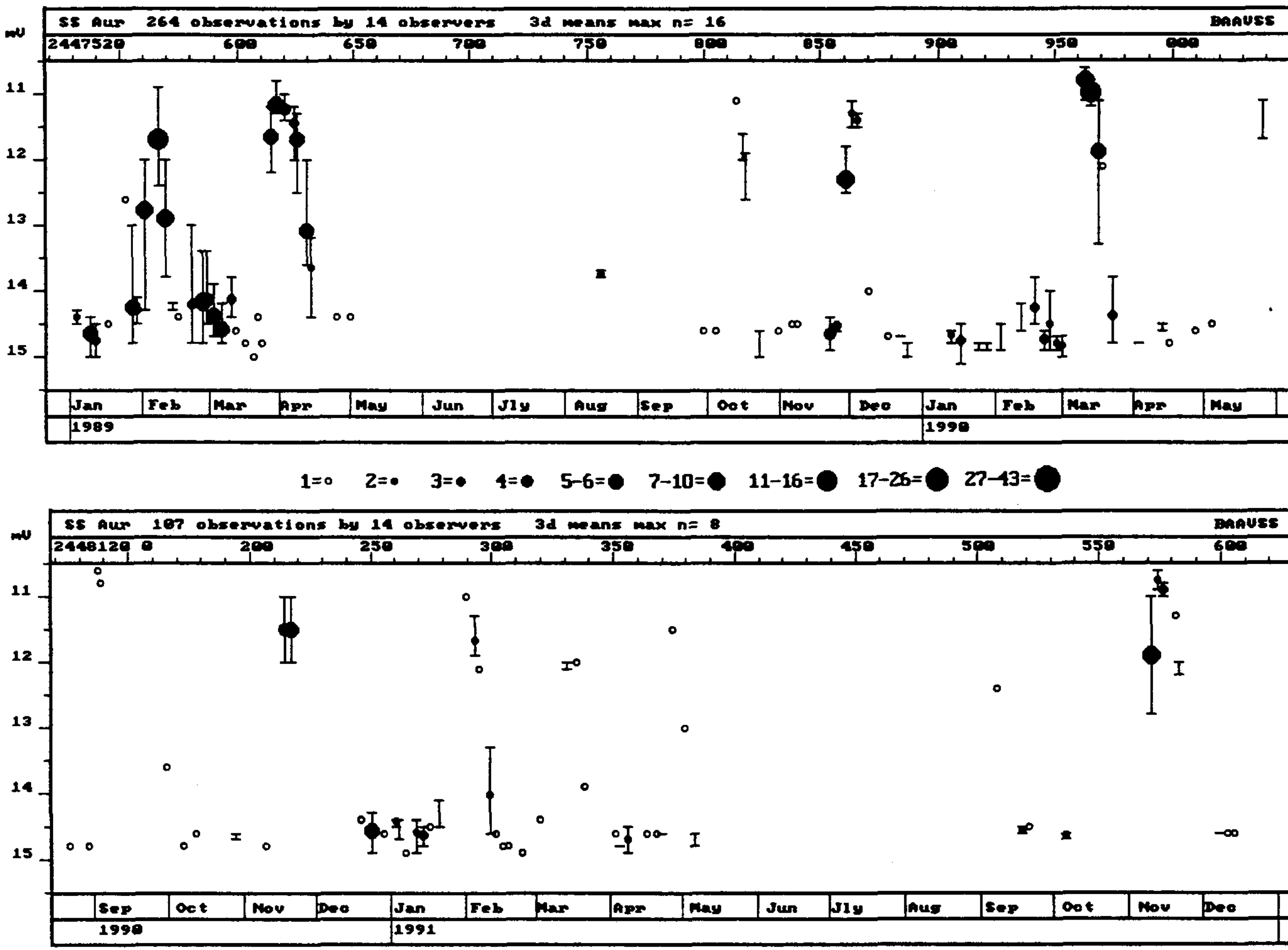
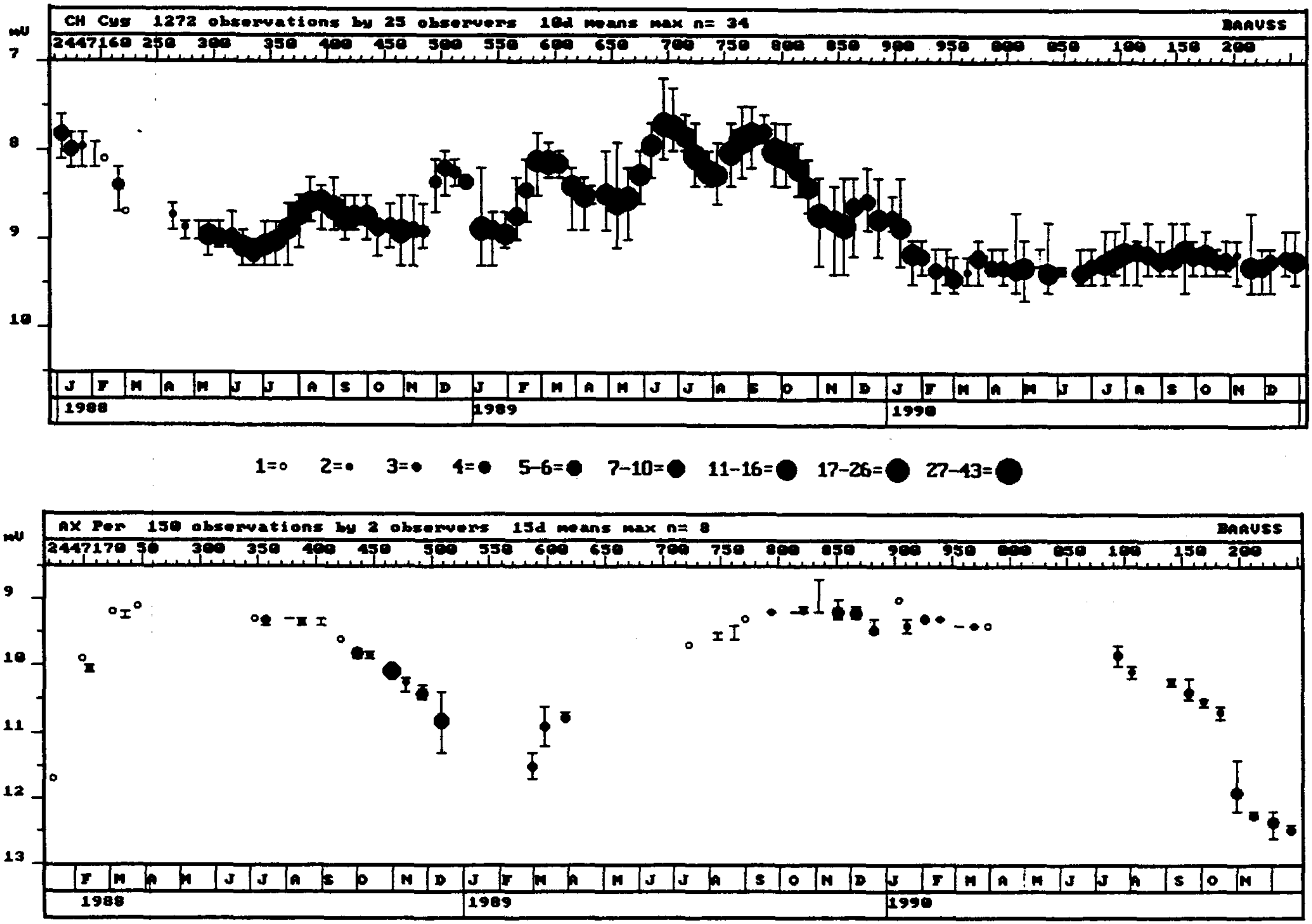
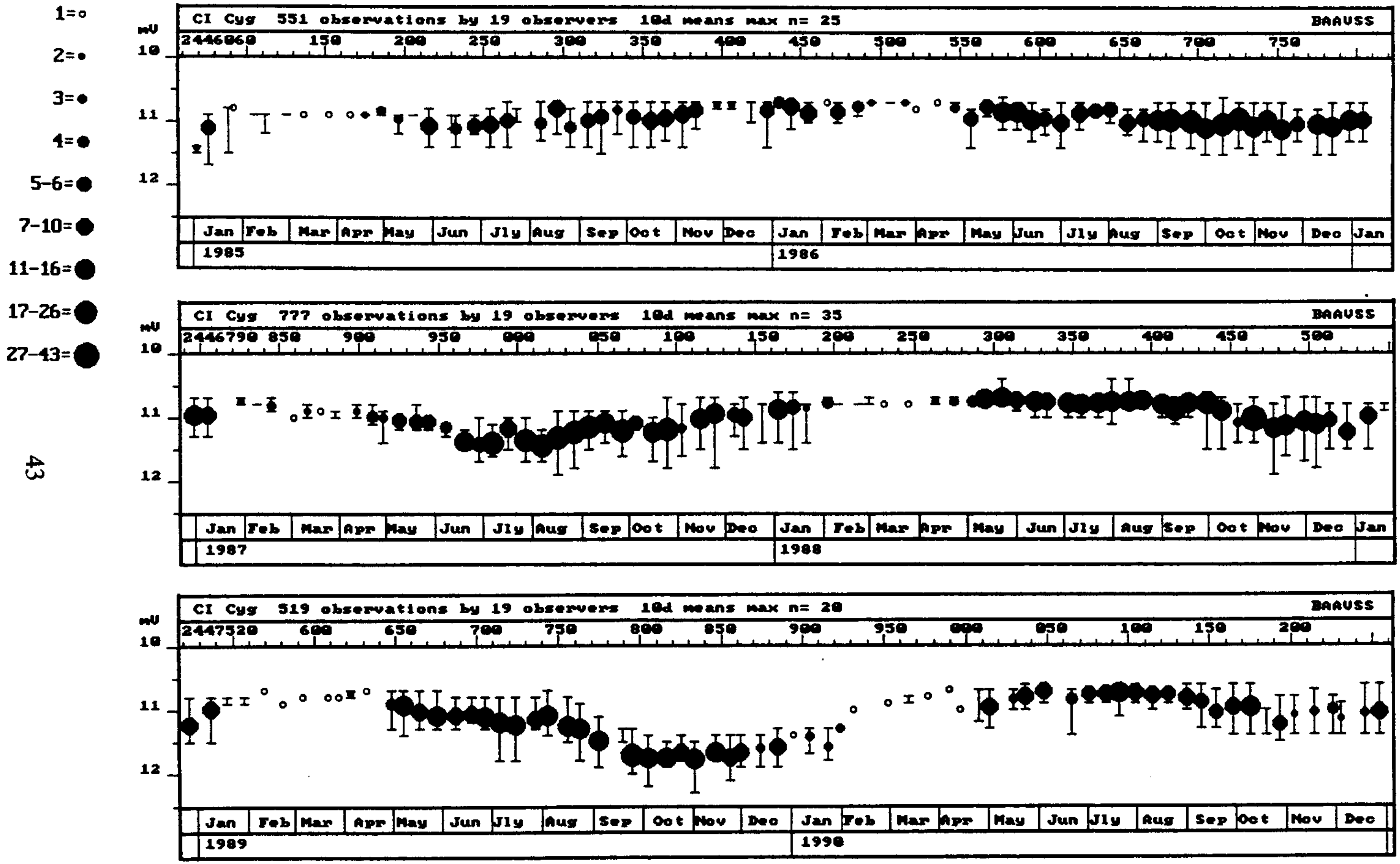


SS Aur, 1989-91 Observers: S.W. Albrighton, R.W. Fleet, M.J. Gainsford, J.E. Isles, C.P. Jones, P.C. Leyland, S.J. Lubbock, I.A. Middlemist, R.A.H. Paterson, G. Poyner, D. Stott, J. Toone, W.J. Worraker

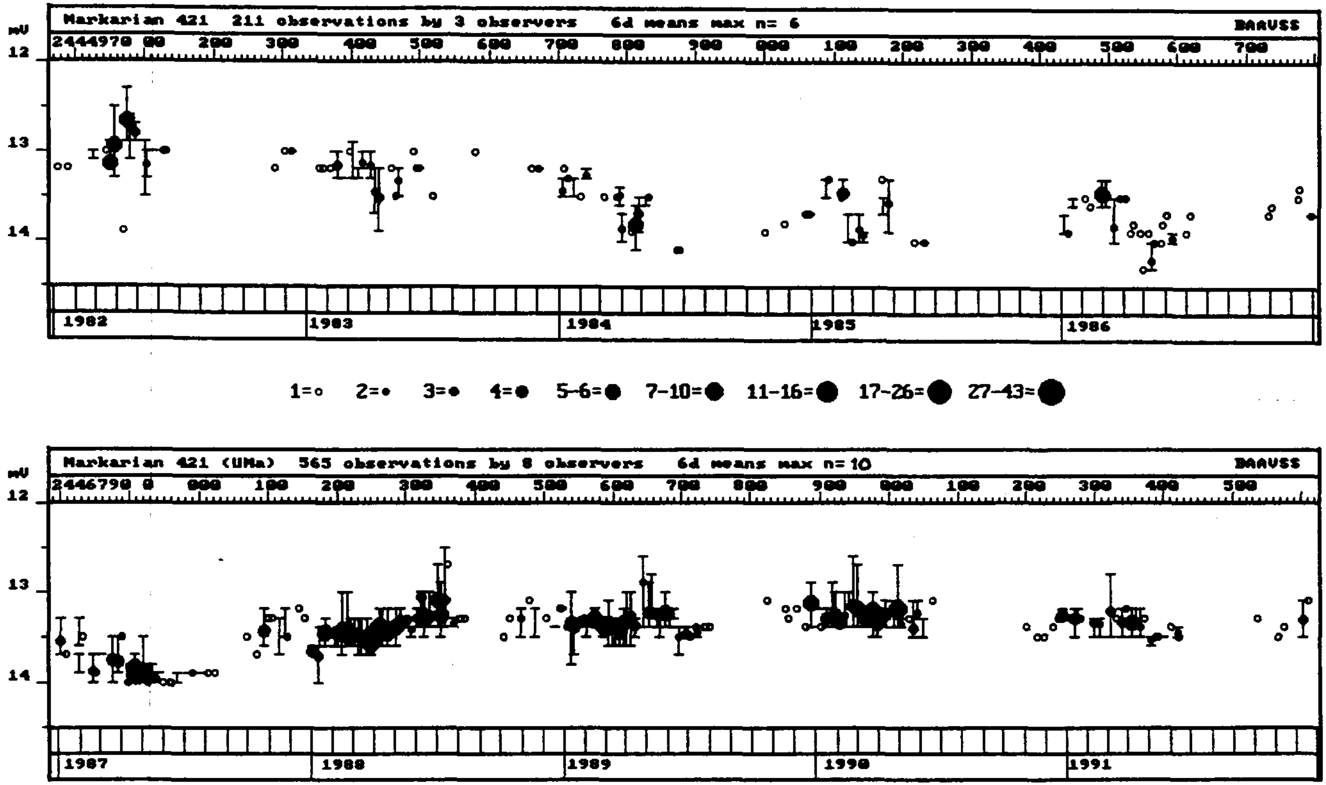


CH Cyg, 1988-90 Observers: S.W. Albrighton, N.M. Bone, H.J. Davis, R.W. Fleet, J. Fraser, R.B.I. Fraser, D. Gavine, J.E. Isles, C. P. Jones, N.S. Kiernan, R.J. McKim, J.W. Macvey, T. Markham, I.A. Middlemist, M.J. Nicholls, R.D. Pickard, G. Pointer, G. Ramsay, J. D. Shanklin, A. Smeaton, J.S. Smith, M.D. Taylor, J. Toone, K. West, W.J. Worraker **AX Per, 1988-90** Observers: L.K. Brundle, J.E. Isles



CI Cyg, 1985-90

Observers: S.W. Albrighton, R.H. Chambers, J.W. Cole, D. Conner, M.J. Gainsford, G.M. Hurst, J.E. Isles, C.P. Jones, I.H. Kennedy, I.A. Middlemist, R.D. Pickard, G. Poyner, G. Ramsay, J.D. Shanklin, D. Stott, T. Tanti, M.D. Taylor, J. Toone, P.J. Wheeler



Markarian 421, 1982-91

Observers: G.M. Hurst, J.E. Isles, S. Koushiappas, R.W. Middleton, R.A.H. Paterson, G. Poyner, D. Stott, J. Toone, W.J. Worraker

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