British Astronomical Association

VARIABLE STAR SECTION CIRCULAR

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Contents

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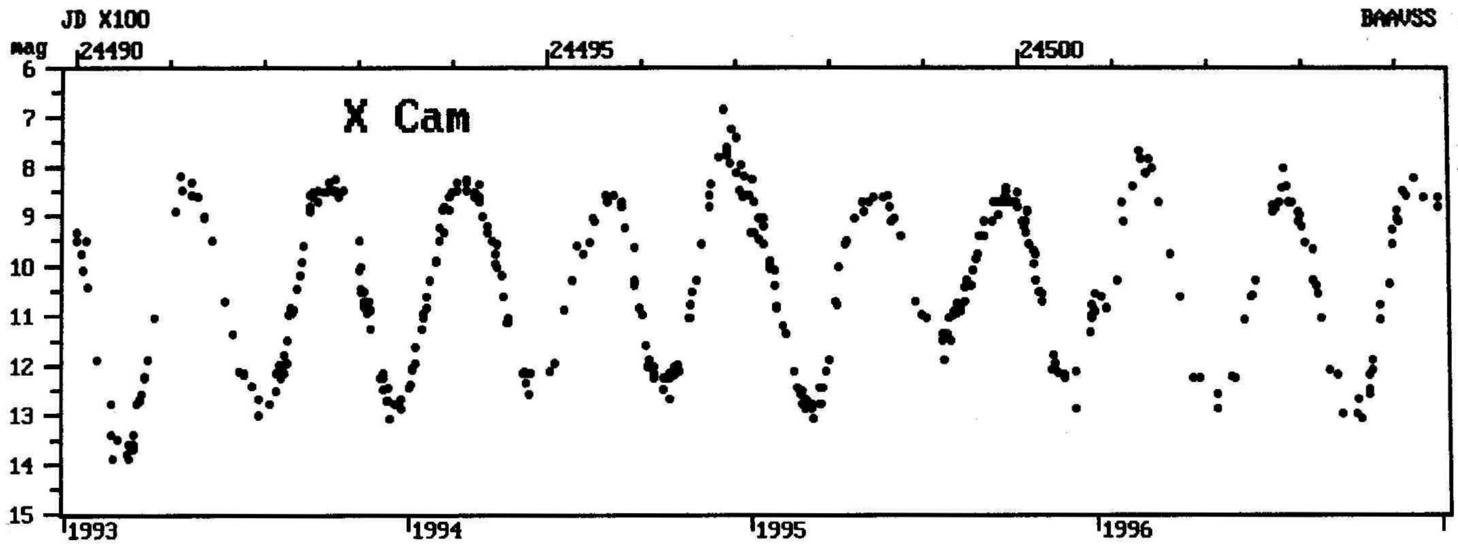
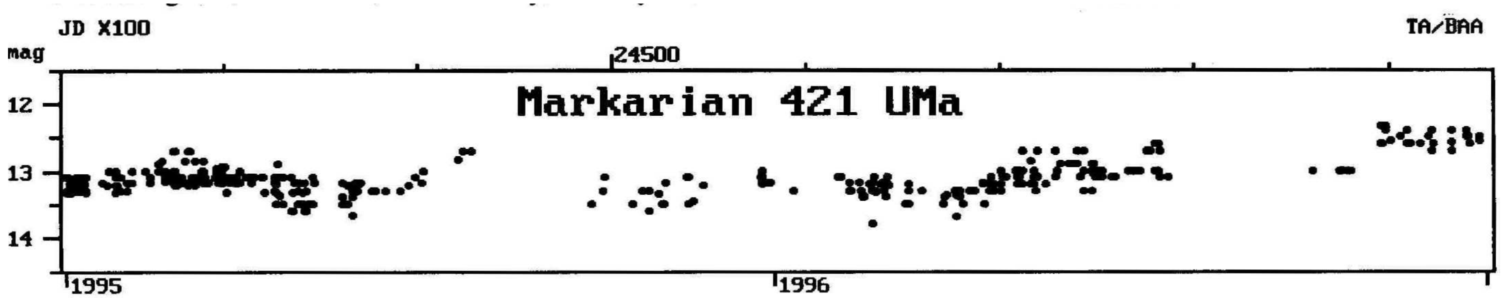


X Cam 1993 to 1996. 421 observations by;-
S W Albrighton, R J Bouma, G A V Coady, R C Dryden, M J Gainsford, D Gill, G W Salmon, J Toone.

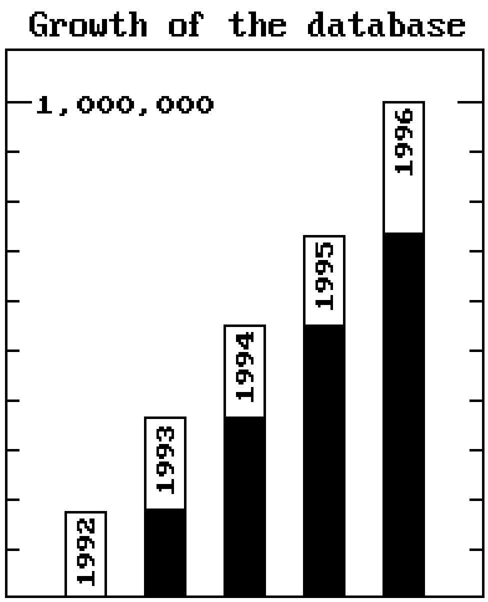


Markarian 421 UMa 1995 to 1996. 365 observations by;-
M J Gainsford, M Gill, D Gill, J Greaves, G M Hurst, R A H Paterson, G Poyner, J Toone, W J Worraker.

THE DATABASE REACHES *One Million!*

DAVE MCADAM

After attaining a grand total at 31st Dec 1996 of 999,634, the millionth observation was logged on 3rd January from the first report to be dealt with in 1997. This was an observation by Mike Gainsford of SS Cygni at 9.4m declining from outburst on 1996 December 23, 1847UT; using 254mm reflector. Congratulations to Mike on the millionth! - and thanks and appreciation to everyone who has helped with BAAVSS records.



In the last five years, the massive paper records have been tackled and around 10,000 hours of voluntary work has steadily built a database that enables much easier reference and analysis. Some variables, such as mira and semi-regulars, are only worth analysing when the whole dataset is available. Several papers and articles have been made possible, published here in the VSSC, in the BAA Journal and elsewhere.

The rapid progress from 3/4 million in February 1996 was due to increased totals by most contributors. Phil Barnard's amazing feat of entering nearly 100,000 from published memoirs made the grand total 50% greater than in previous years. Herbert Joy led in each of the earlier years and his quota was again over 65,000, despite delays in providing paperwork.

Here are the entry totals for 1996;

Phil Barnard	97371	Mike Gainsford	2379 [1]
Herbert Joy	65463	John Day	1812 [1]
Dave McAdam	26791	Alan Chew	1456
John Moran	16564	Michael Gill	1375 [1]
Dennis Gill	13531 [2]	Kevin West	952 [5]
Gary Poyner	12341 [1]	Ian Nartowicz	630 [1]
Mike Carson-Rowland	7708	Graham Salmon	624 [2]
David Lloyd	5394 [2]	Guy Hurst	520 [1]
Roger Pickard + Crayford	4798 [2]	Jonathan Shanklin	61 [1]
TA transfer	4268 [3]	Karen Holland	41 [1]
Tony Markham	4050 [2]		
+ SPA	3842 [4]	Total 271971	

[1] Personal observations alone.
[2] Personal observations plus existing record entries.
[3] International observations primarily reported for The Astronomer summary.
[4] Current observations by SPA members collated by Tony Markham.
[5] Visual data entry. Personal PEP data supplied/stored separately.

The grand total at 31st Dec 1996 was 999,634. Note that the end-of-year cut off for entries means that personal totals shown here are NOT the total observations actually made in the year;- reports (mainly for December) received in January 1997 start a new entry log. Annual observing totals for 1996 will appear after paper reports are collated.

The total observations made during 1996 and logged directly by computer methods approaches 30,000. (about 70% of the expected full total) The software system (as intended) is now dealing with a majority of the reporting workload. The time is probably right for reviewing how current paper reports are computerised in future years. However, another change that may be forced upon us is in regard to work on old existing records. In the latter months of 1996, the photocopier (which has seen better days) became maladjusted and practically unusable. If maintenance cannot revive it then it will no longer be possible to copy old reports for keying. There are a few more written chronological lists and published memoirs that can be done without copying. However the irreplaceable original reports pose a big problem because the cost of safe two-way postage is much greater than the cost of one-way bundles of photoreduced papers.

Important records still require doing, but at the time of writing it is unclear how we may continue to deal with them.

BAAVSS WORLD WIDE WEB PAGES

http://www.telf-ast.demon.co.uk/

Dave McAdam

These pages were first uploaded to my personal demon web space on 12th Nov. 1996 and announced to a number of BAA members by e-mail on Nov. 14th. Initially there were light-curves, details from the database, and a couple of introductory items about the VSS. Since then, articles from recent VSSC's have been added with Karen Holland's help, and Gary Poyner has provided notes on the Recurrent Objects Programme variable DX Andromedae. Short-term current light-curves from joint TA/BAA monthly reports are maintained together with selected longer-term light-curves.

Demon's WWW personal home-page service is relatively new and there are still occasional problems. Despite this the access counter reached 215 by the end of the year. There are mutual links with the BAA, TA, and SPA-VS web pages, also links to other BAA section and international web sites.

One of the first requests via the web pages was from Pamela Rathbun who acknowledged VSS data with the following e-mail;-

"Dear Mr. McAdam,

Thank you for the files on RCrB. They will be used to compare the change in line velocities for narrow and broad emission lines during RCrB's minumum in the winter of 1995-1996. This work is being done at the University of Texas, under the supervision of Dr. David L. Lambert. The spectra I am analyzing were obtained by 9 different observors on the McDonald Observatory 82" and 107" telescopes using medium and high resolution spectographs. As our research evolves, I will periodically be putting information on my
webpage at: http://anchor.as.utexas.edu/~pamela/projects.html. As I mentioned before, we will site your work in any publication that uses the comparison to photometry.

Thank you very much for your assistence.

Sincerely,

Pamela L. Rathbun"

The WWW pages provide a different kind of section publicity than the VSSC's. Hence, authors may consider writing for a more general readership;- short articles on variable stars and related topics, and/or light-curve & CCD images, would be welcomed from section members. Send material (preferably in electronic format) to me for publication on the section web pages.

NOVA CAS 1995

Guy Hurst

The light curve (Figure 1) presented now encompasses 2,913 estimates submitted by both members of the British Astronomical Association and The Astronomer Group.

Although discovered as long ago as 1995 Aug 24 by M.Yamamoto, the nova continues to be an easy object at around mag 10.6 at the time of writing (1997 Jan 23). The light curve is very unusual. Most novae display a rapid rise to maximum (around a few days) and then decline from maximum with variations in the transition phase.

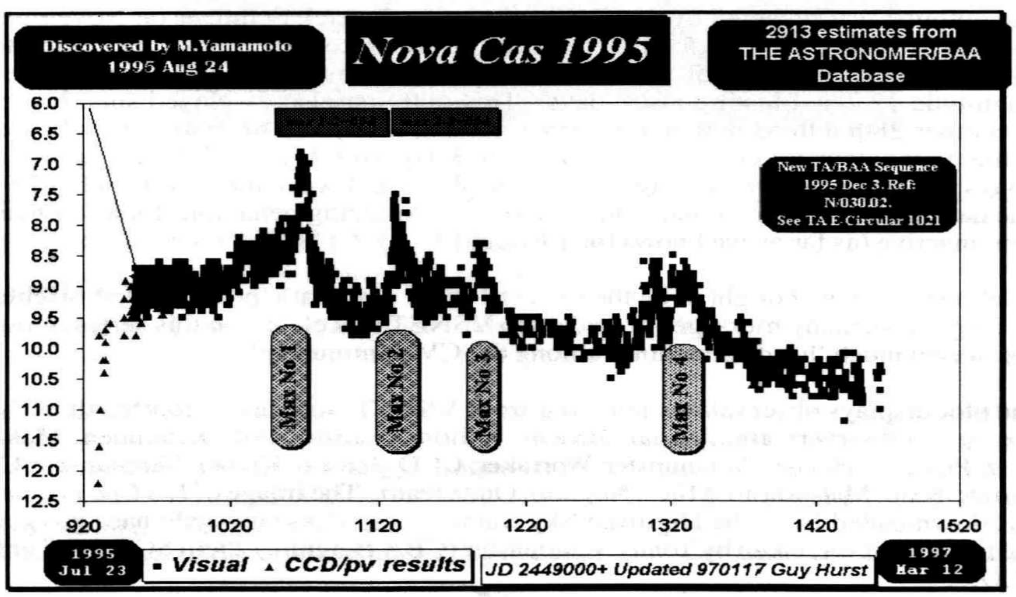
In the case of Nova Cas 1995 however, the light curve shows four distinct maxima. Details follow:

	JD 2449000+	mag	Gap(days)
Maximum 1	1070	7.1	-
Maximum 2	1135	8.0	65
Maximum 3	1190	8.6	55
Maximum 4(A)	1310	8.6	120
Maximum 4(B)	1330	8.6	20

It is interesting that the gaps between maxima 1,2 and 3 were similar but in the case of maximum 4 it was roughly twice the period of the previous intervals. This may be coincidence but it will be interesting to see what professionals make of this when a fuller analysis with spectral information is available.

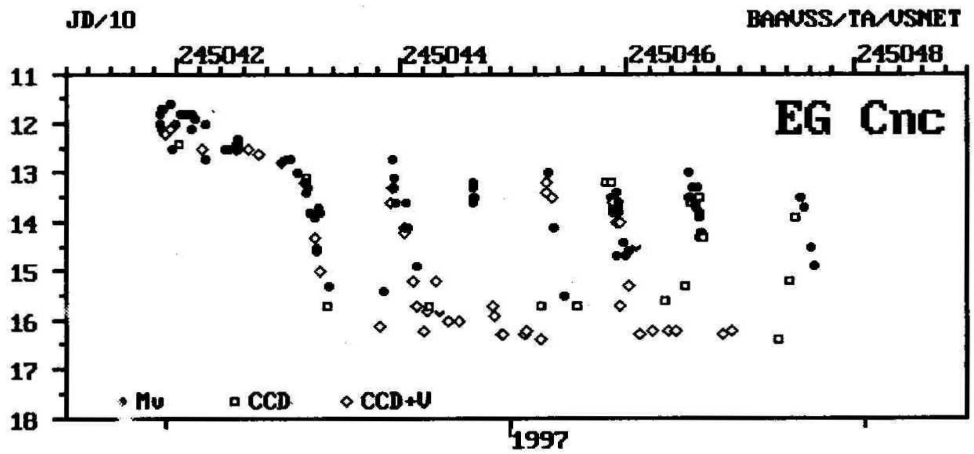
The other point is that maximum 4 appears to show a double peak, both at approximately mag 8.6, and separated by about 20 days. After maximum 4 no other really pronounced maxima have occurred but this raw light curve does show that there has been significant scatter during recent weeks. One possibility is that observers may have switched from binoculars to telescopes as the nova faded below magnitude 10 and this can sometimes cause inconsistency in estimates especially if telescopes enable the observer to detect colour in the nova whereas binoculars do not. In any event it is essential for observers to always quote the instrument used in case this is a factor to be taken into account in later analysis.

Please keep observing and send your reports to me weekly either using the BAAVSS report forms or via e-mail (preferred). Details of these are shown on the back cover.



RECURRENT OBJECTS PROGRAMME NEWS:
GARY POYNER

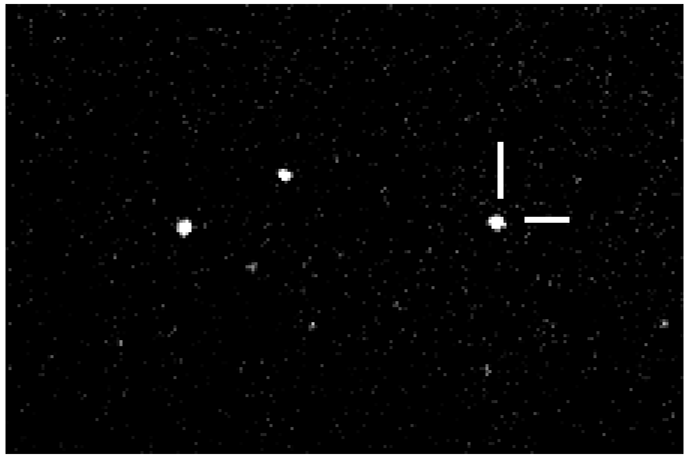
A major outburst of the long period dwarf novae EG Cancrii occurred at the end of November, and has revealed many surprises! Only one other outburst had been recorded and confirmed - November 1977 - although there was one unconfirmed sighting in October 1996. Although originally described as a Nova Like variable, it had been suggested that EG Cnc might resemble a long period dwarf nova. The detection of superhumps by observers at Ouda in Japan and by CBA observers in the USA on December 3/4 confirmed that the outburst was a supermaximum, and that EG Cnc was probably a member of the WZ Sge type stars, owing to its large amplitude and long recurrence period. The superhump period was measured at 0.0604d, with a maximum amplitude of 0.2 mag.

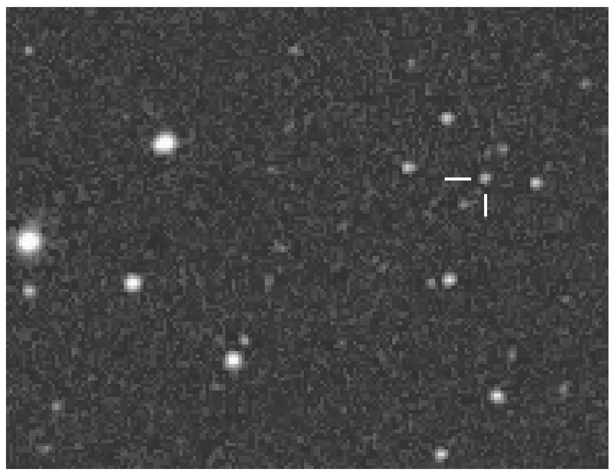


The outburst was detected by the German amateur Patrick Schmeer on November 30th; this reached magnitude 11.5 on December 1st; by December 15th it had faded to 15.7. Some five days later a not too unexpected second outburst was observed, reaching magnitude 12.7 and lasting just 3 days. This outburst also displayed superhumps. On December 28th a third outburst occurred, lasting 2days. This was then followed by a further four outbursts at intervals ranging from 3days to 8days, each lasting approximately 2 days and reaching similar magnitudes (see plot). As I write these words (Jan 28th), EG Cnc has just faded from outburst number seven. Amazing behaviour for a star which had been inactive (as far as we know) for 19 years!

Tidal instability is thought to be the cause of these enigmatic post outburst brightenings, although from many messages posted on to VSNET it is clear that this series of outbursts has caused much ‘head scratching’ among the CV community!

The plot displays observations retrieved from VSNET, and those reported directly to the Director. Observers are...Visual -Broens, Dillon, Hanson, Itoh, Kinnunen, Makiguchi, Pietz, Poyner, Schmeer, Vanmunster, Worraker: CCD -Jensen, Kiyota, Vanmunster: CCD+V -James, Kato, Matsumoto, Miles, Nogami, Ouda team. The image of EG Cnc in quiescence was downloaded from the Digitised Sky Survey (http://skyview.gsfc.nasa.gov), and the one in outburst was taken by Tonny Vanmunster (CBA Belgium) 25cm SCT, ST-7 unfiltered CCD.





86th AAVSO SPRING MEETING
"VARIABLE STARS : NEW FRONTIERS"
Sion and St. Luc, Switzerland - May 26-31, 1997

Janet Mattei has communicated details of the forthcoming AAVSO meeting in Switzerland, and has invited the BAAVSS to be co-sponsors of the event. Further details are expected to be released soon. Interested VSS observers should send a SAE to the Director for any future announcements (see back page of this circular), or make contact with the AAVSO directly at 25 Birch Street, Cambridge, MA 02138, USA, E-mail meetings@aavso.org

VSS MEETING - PART 2

Tristram Brelstaff

The next talk was on GV-band CCD photometryH in which GJohn MackeyH described his experiences using a Starlight Xpress CCD for photometry. His first attempt was on Nova Cas 1993 in February 1994 when he derived a magnitude from an unfiltered image. He was unsure of the reliability of this magnitude and so waited to see other people's results before submitting it. As it turned out, his magnitude was 0.8 mag brighter than visual observations made on the same night. He was later told that this was due to the sensitivity of his CCD to the strong infrared emission from that particular nova. This impressed upon him that he really needed to use filters if he was to get useful results.

He now uses a Schott BG39 blue filter to block the red end of the spectrum and a OG515 yellow fiter to block the blue end. This narrows down the response of the CCD to aproximately the V-band. One draw-back of using filters is that they reduce the amount of light reaching the CCD and so increase the required exposure times - typically by a factor of two or three. With these longer exposures you need an accurate drive for the telescope. The above filters only cost a few tens of pounds each and were of reasonable quality for amateur use. For carrying out B and R band photometry as well you would need some mechanism such as a filter wheel for changing filters.

John said that the Guide Star Cataloge magnitudes were not accurate enough for photometry but he had got reasonably consistent results by using four comparison stars for each measure - two brighter and two fainter than the variable.

In CCD photometry it is important to avoid saturating the image. In spite of what is sometimes said, CCDs are not linear over all their range. The best way to check for saturation was to use the CCD software to display a histogram of the image and to check the peak height.

John then outlined various possible observing programs. These included novae, supernovae, active galaxies, variable stars, comets, asteroids and mutual phenomena of satellites.

In the discussion, Mark Kidger pointed out that the Starlight Xpress CCD was well suited for V-band photometry as its sensitivity peaked in the visual, but that most other CCDs peaked in the red and so were better for R-band photometry. In response to a question from Karen Holland, John said that he used the bright twilight sky for flat-fielding. This was at 1/2 to 2/3 saturation.

This summary of the talks given at the variable star meeting will be continued in the next circular.

The deadline for the June circular will be 1st May; please send any articles to the editor - preferably in electronic form (image formats preferred are TIFF, PCX, BMP).

HOW LOW CAN YOU GO?

John Toone

Recently whilst checking a sketch I made of M6 with a 6cm refractor from Manchester 20 years ago, I noticed that BM Sco (Mv 6.0-8.1, SRd, 850 days) was recorded and depicted as one of the brightest cluster members. Since BM Sco has a declination of -32° 13' I asked myself how many other variable stars with declinations lower than 30° south could be observed from the UK. Moreover, I also wondered what is the lowest declination variable star that can and has been observed from the UK.

In the absence of finding any information within existing literature on this subject I searched my own variable star logbooks and the following estimates of far south variable stars from the UK were unearthed:

Star		Location Observed From		Estimated	Date
Designation	Declination	Site	Latitude	Mag	
Y Scl	-30°08'	Manchester	53°30'	8.2	20-10-81
RY Sgr	-33°31'	Sychtyn	52°39'	<11.3	16-8-93
RR Sco	-30°35'	Ongar	51°43'	11.2	8-6-94
RY Sgr	-33°31'	Newquay	50°24'	8.2	14-6-94
T Cen	-33°36'	Cressage	52°38'	7.0	7-5-95

All of the above observations were made with a 20cm Schmidt Cassegrain which is very convenient to handle when set almost horizontally. With 12x50 binoculars the lowest declination variable star that I have an estimate logged for was that of T Mic (declination -28°16') recorded at magnitude 7.9 on the 22-6-88 from Newquay. On the same night that T Cen was observed (7-5-95) I glimpsed V806 Cen (declination -34°27') with 12x50 binoculars skimming the horizon. No magnitude estimate could be made due to the lack of comparison stars. Visual estimates of this star are probably worthless anyway as the extreme range is catalogued as just 0.1 magnitudes. V806 Cen by the way can never rise more than 3° above the horizon at the latitude of where the star was seen.

The observations of RY Sgr were confirmed to be accurate by Colin Henshaw observing from Botswana who reported that this star had faded from its normal maximum of magnitude 6 in June 1993 and wrote me a note stating that it was returning from minimum in June 1994 (his observation on 15-6-94) was 8.1).

Incidentally the 1993 negative observation of RY Sgr from Sychtyn (mid Wales) proved that the star was at a fainter level than could be determined by a southern hemisphere observer armed with a normal pair of binoculars.

If any observer intends to hunt down far south variable stars such as these then the following points are worthwhile noting:-

- Observe from a site which has a clear unobstructed southern horizon. The south coasts of England and Wales are favoured which should also reduce, if not eliminate light pollution problems (lighthouses permitting).

- Ensure the star is at maximum elevation. Remember this will be when the observers local siderial time matches the Right Ascension of the star. If you do not have an accurate siderial time clock the next best thing to use is a simple Phillips Planisphere or equivalent.

• Having located the star make your estimate by using directly visible comparison stars at the same altitude (ie immediately preceding or following) as the variable because extinction is a major problem with stars at such low elevations as these.

• Only observe when the seeing conditions are exceptional with no moonlight or haze present.

Setting circles can assist the observer but I have always relied upon star hopping or triangulation methods. To locate RY Sgr, for instance, I always draw an imaginary line between σ and ϕ Sgr passing south eastwards through ζ Sgr. When I reach a position roughly equal to the separation between ζ Sgr and the other two stars I check the telescopic view. RY should then be inside the field of view forming a right-angled triangle with two 7.5 magnitude stars (this is dependent, however, upon RY being at or near maximum).

What is the lowest declination variable star that has been observed from Scotland? Perhaps VSS members in Scotland could write and advise us on this. Although Scottish observers have a minimum 5 ° latitude disadvantage over their southern English counterparts they have in some areas light pollution and altitude advantages over the rest of the UK.

In order to observe a lower declination variable star than either T Cen or RY Sgr from the UK I would recomment AI Sco (declination -33°49') as a suitable target star. AI Sco lies just 1° NE M7 which is quite easy to see under good conditions with a small pair of binoculars from southern England (I have photographed it from Cornwall). This brings me back to where I began - a bright open cluster in Scorpio.

I would like to hear from anyone who has observed low declination variable stars before or anyone who is successful in observing AI Sco or any other -30° declination variable star from the UK. It would be particularly interesting to see how close variable star observers can get to within their own theoretical horizon limit. Any UK based observer can of course get involved in this.

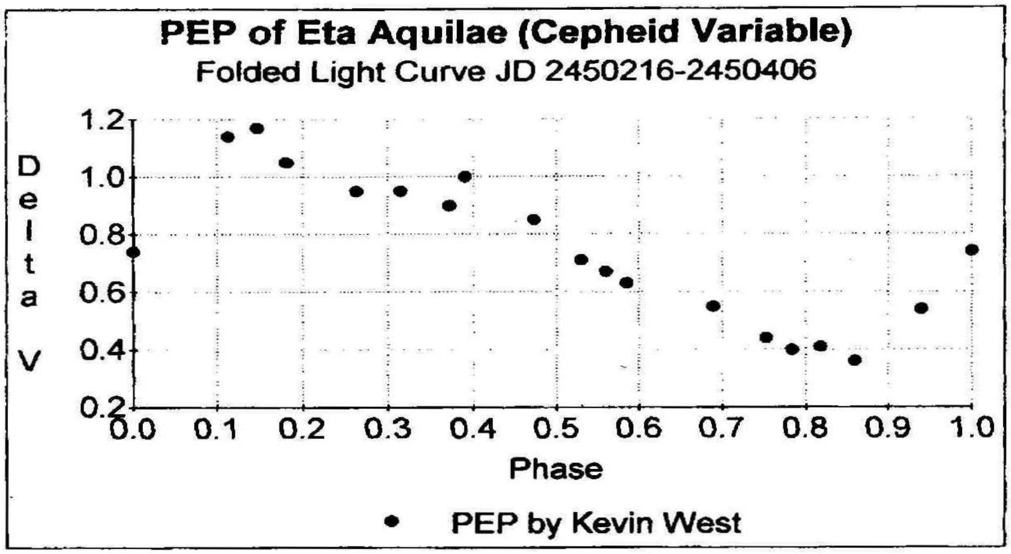
Happy hunting and good luck.

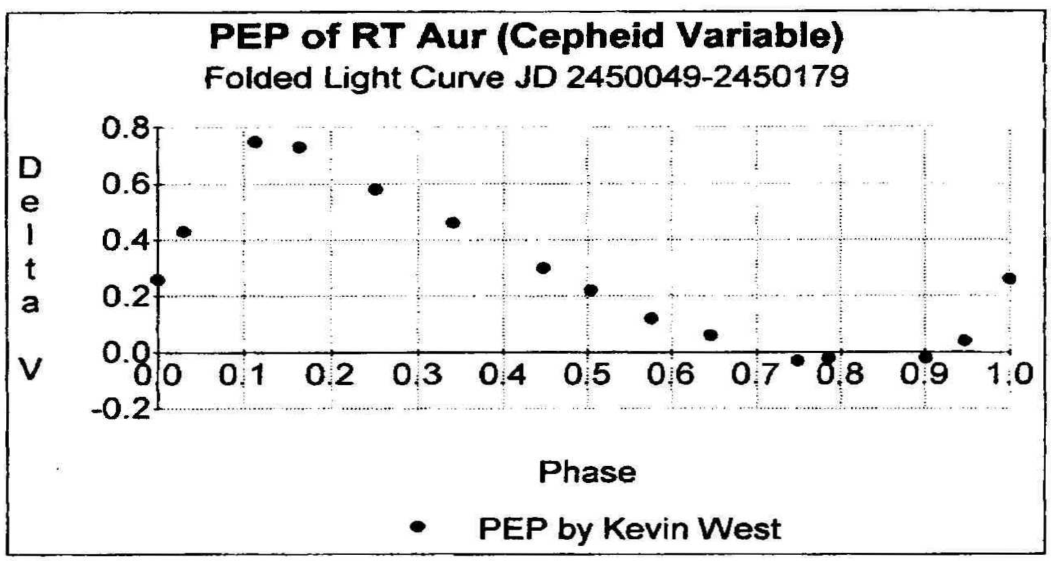
MORE FOLDED OBSERVATIONS OF CEPHEID VARIABLES

Kevin West

As a bit of light relief from my main programme, which is the long term photometric monitoring of fairly long period variables, it is nice to have a fresh new star each season. For this refreshment I turn to the Cepheids. These cosmic metronomes lend themselves to "light curving" thanks to their (usually reliable) periodicity. By folding of perhaps one season's observations onto one phase, a reasonable light curve can be plotted.

Regular readers may have seen previous efforts of mine on the cepheid SU Cass (VSSC 89 Sept 96). The more discerning may have noticed an unavoidable "mistake" in the light curve. Thanks to the limitations of my plotter which cannot cope with the reversed nature of stellar magnitudes, SU Cass appeared to have a slow rise to maximum, and a steep decline to minimum. This is most unlike a cepheid light curve which usually displays the opposite assymetry of a fast rise with a slow decline. Provided the reader checked the direction of the V magnitude axis, all should have been clear. This presentation problem has now been solved and below are the folded light curves of Eta Aquila and RT





Auriga.

On the curve of Eta Aquila, the suspicious point at Delta V=1.0 and Phase=0.39 had me rechecking my observations and reductions and I was sorely tempted to exclude it especially as the check star measure had been inconsistent. But the small error bars suggested that this was not an artefact of perhaps a poor sky. Also I have since read that some Cepheids do indeed show a small hump on the descent.

Of course the only way to be sure is to verify with further observations. A worthy project for the forthcoming Summer skies.

As always like most observers I am keen to learn anything about ones adopted variables so if any others observe or know of papers on them, perhaps you could contact me.

Kevin West may be contacted by telephone on 01983 614591 or by
e-mail: kwest@interalpha.co.uk.

RECENT OBSERVATIONS OF 44 BOOTIS

J. M. SAXTON

Introduction

In May/June 1996 I managed to obtain a complete light curve of this short period W UMa type eclipsing binary, and derived two new times of minima. This led me to investigate the history of eclipse timings of the star; analysis of my own and other recent eclipse timings in the literature has indicated a significant change in orbital period which has (to the best of my knowledge) not been reported correctly before. It is intended to submit a detailed description of the observations and analysis to the Journal; however, section members may be interested in a brief summary of the story so far.

44 Bootis is a triple system, of which the fainter component (B+C) is the nearest example of a W UMa type eclipsing binary. 44 Bootis is also known as i Bootis (not to be confused, as has sometimes been done, with iota Bootis !). Confusion as to the star's identity also seems to extend to the 4th edition of the GCVS, in which the eclipsing component BC carries the label ZZ Boo. However, the GCVS lists two (!) objects with the label ZZ Boo, the other being an EA type binary with a period of 4.99 days. Since it is the latter which occupies its correct position (between YZ and AA) in the catalogue, I assume that 44 Bootis BC acquired the label ZZ in error. The GCVS gives the range of BC as 5.8-6.4; however, observation is hindered by the proximity of the brighter A component, which during this century has never been more than 2.5 arcseconds distant. If the light from A+B+C is measured together -as is usually the case - the total range is only 0.17 magnitudes. (All subsequent references to the light variation in this article will refer to the combined light of the system (A+B+C)).

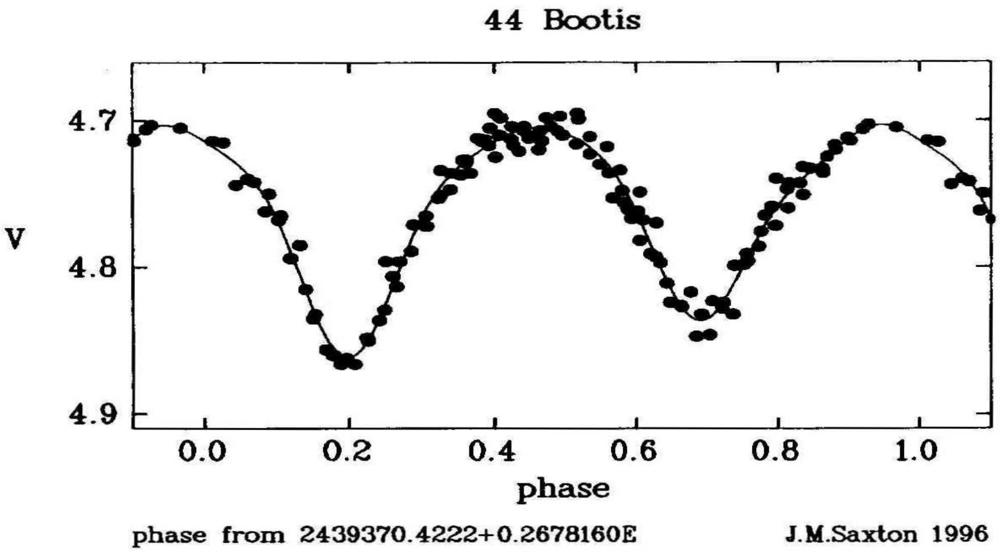
Observations

44 Bootis was observed on six nights in May/June 1996 using the author's 216 mm reflector and a single channel photoelectric photometer. The photometer is a homebuilt one, and employs a Hamamatsu 1P28 photomultiplier tube operated at -970 Volts. The anode current is fed to a DC amplifier and thence to a voltage-to-frequency converter, and the results logged manually. The electronics are very similar to those described by Hollis (1995).
47 Bootis (= k Bootis = HR 5627 = HD 133962 = SAO 45370) was used as the comparison star. In addition, some measurements of 39 Boo (= HR 5538 = HD 131041 = SAO 45231) were also made. All measurements were made with a V filter. Data were transformed to the standard system using catalogue values of (B-V) for the stars. A total of 20 measures of the check star, spread over 4 nights, was accumulated, yielding mean V=5.661, 1s=0.011.

Results

The combined light curve is shown in figure 1, which contains 127 data points. Phase was calculated from a linear ephemeris, which actually turned out to be significantly in error - the minima do not fall at phases 0.0 and 0.5. The smooth curve fitted to these data is a Fourier series up to and including the 5th harmonic; the r.m.s. scatter of points from the curve is just 0.009 magnitudes, which is very pleasing. Although all nights are plotted with the same symbol in figure 1, examination of the original data shows that night-to-night reproducibility is good. This is a necessary condition for obtaining eclipse timings from the combined light curve.

Figure 1



It is noteworthy that the light curve is essentially symmetrical, and that the maxima are of equal brightness (to +/- 0.01 in V). This has not always been the case, since 44 Bootis, like many W UMa stars, has a lightcurve which can vary in shape; the variations have been attributed to large starspots whose extent varies with time. For example, Hopp and Witzigmann (1982) observed the system on 10—11 April 1979, and found the two maxima to differ by approx 0.05 in V. Eggen (1948) reported observations made in 1930 which showed the two maxima to differ by approx 0.03 mag.

The positions (in phase) of the minima were derived from figure 1, by fitting quartic polymomials to the data from phase 0.1-0.3 and from 0.6-0.8. 1s errors were estimated by a Monte-Carlo method: the r.m.s. scatter from the best fit curve was noted, and then 1000 'synthetic' light curves generated in which the points were normally distributed about the best fit curve by an appropriate amount. For each synthetic curve the phase of minimum was noted by re-fitting a quartic polynomial, and the standard deviation of the 1000 synthetic minima phases was taken as the error. Parabolic and cubic fits produced the same minima phases within error. The derived minima phases have been converted into equivalent times (HJD) for two (arbitrary) minima in mid-May, and listed in the table below.

Equivalent Times of Minima

Min	HJD
I	2450216.219 +/- 0.002
II	2450216.353 +/- 0.003

Eclipse timings, ephemeris and period changes

Many W UMa systems also show variations in orbital period, which are revealed by eclipse timings made over a number of years. The precise reasons for the period changes remain unknown, although various mechanisms have been proposed. Mass transfer between the two stars is a possibility (and does not seem implausible given that in W UMa systems, the two stars are actually touching each other). In the case of 44 Bootis itself, apparent period changes also result from the orbital motion of A-BC about their centre of mass.

A detailed study of eclipse timings of 44 Bootis was made by Hill et al (1989). They considered astrometric, radial velocity, and eclipse timing observations. Their paper contains a list of over 300 eclipse timings assembled from various sources and dating back to 1916. If the eclipsing component 44 Boo BCwere a perfect 'clock' (i.e. had a stable period) then eclipse timings would allow us to study the system in the third dimension (at right angles to the plane of the sky), owing to the varying light travel time as A-BC orbit each other. The visual orbit does yield the inclination, but in order to relate the visual orbit to light travel time, it is necessary to know a scale factor which depends on both the distance to the system (which relates angular measure on the sky to absolute length) and also the position of the barycentre between A and BC (mass ratio $(m_A+m_{BC})/m_{BC}$). (The masses can actually be derived from the radial velocities and Kepler's laws, which leaves the system parallax (distance) as the unknown). Hill et al were able to estimate this scale factor by finding that a good fit exists between a scaled orbit and the observed eclipse timings from 1916-1965 (this also implies that intrinsic period changes in component BC were small -compared to orbital light-time changes - during this interval). A large intrinsic period change ocurred about 1967. Radial velocity of the barycentre of the system, which is constant, has been ingored: this is justified since our aim is to discover and understand changes in orbital period, both apparent and intrinsic, of component BC.

I have reanalysed all eclipse timings available to me, using the orbit and scale factor from Hill et al A total of 377 timings from 1916-1996 is presently avalailable: 312 from the compilation by Hill et al, 3 by A. J. Hollis and reported in VSSC 61, two from the J Ells APT and reported in VSSC No. 81, the two reported in this note, with the remainder being obtained from Oprescu et al (1991, 1996).

Figure 2

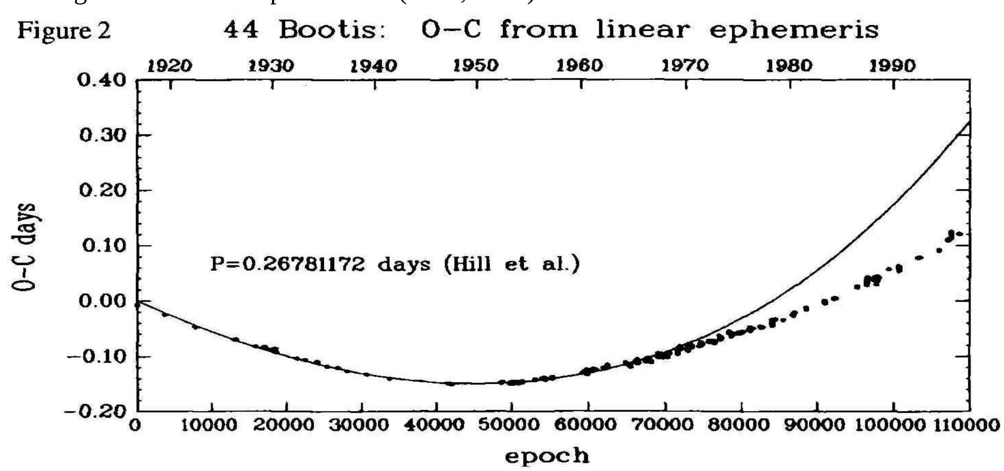
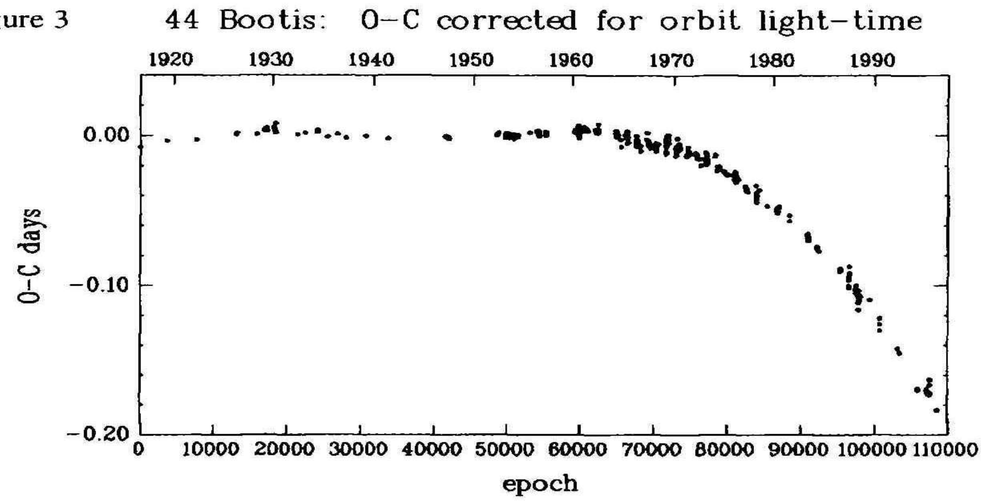


Figure 2 shows the O-C values versus orbit number (or time) with the computed times derived from a simple linear ephemeris. The solid line shows the O-C (relative to this linear ephemeris) which would be expected given the orbit and scale factor refered to above. It is quite clear that a significant portion of the variation in O-C is due to the orbital motion of A-BC. You can see the good fit from cycles 0-67000 (which enabled Hill et al to derive the scale factor) and that the fit becomes worse after this date.

Figure 3



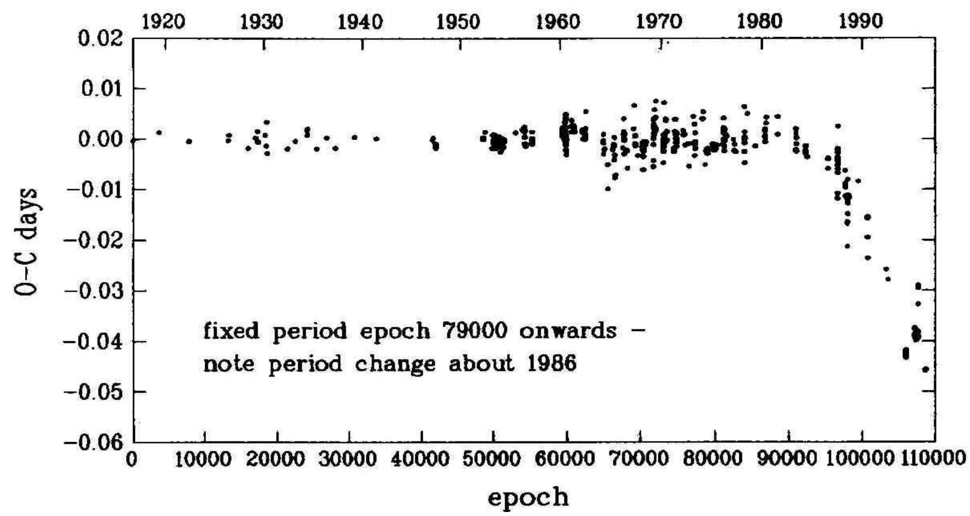
In figure 3, I show O-C where the computed times are now from a model which includes the linear ephemeris used for figure 2 and also a correction for orbit light-time. Remember that in a plot of O-C versus cycle number, a straight line of non-zero slope just means that the assumed period is wrong. From examination of a diagram of this form, Hill et al deduced that the period had changed several times since 1916; they derived separate periods for intervals 0-20000, 20000-40000, 40000-67000 and 70000-79000 (data from 67000-70000 were excluded owing to the large scatter). Effectively, this procedure considers figure 3 as a series of straight line segments. So, the next improvement in the model is to have different periods for the above intervals, as well as including the effects of orbit light-time.

In figure 4, I show O-C's from such a model; however, the ephemeris (period and epoch) derived for the interval 79000-93000 has been used for all data after 79000. It is immediately obvious that a significant period change took place about 1986, amounting to -11 parts per million (shortening of period). In figure 5, I show O-Cs from a model which includes an appropriate ephemeris for cycles >93000. The scatter of O-Cs about zero in figure 5 for cycles >93000 is still, perhaps, more than might be expected from the accuracy of the eclipse timings. A possible explanation for this increased scatter is that some of the eclipse light curves are distorted by the presence of star spots.

The 1986 period change is the largest yet observed for 44 Bootis. The total change in the late 1960's was -7 ppm and in 1974 -9 ppm. The period appears to have remained more or less constant from 1986 to the present.

Considerable confusion exists in the literature concerning 44 Bootis period changes since many authors have ignored the orbital motion of A-BC. Said another way, the orbital period observed from Earth is not generally the same as the true (intrinsic) period of 44

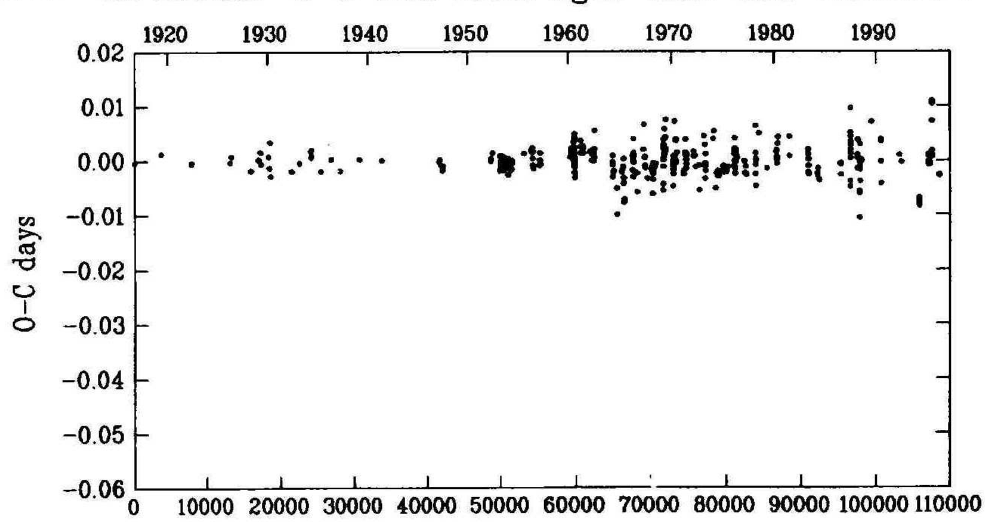
Figure 5 44 Bootis: O−C with orbit light−time and variable P



Bootis BC. Consequently, many of the reported period changes are spurious. It is indeed possible (and convenient) to use a linear ephemeris to predict eclipses over a short time interval, but orbital motion must be taken into account if eclipse timings are to be compared over a long time interval. Oprescu et al (1991) did indeed report a period change in 1986, but gave it as about +4 ppm; it has been shown here that once orbital motion is considered, the intrinsic period change is about -11 ppm.

It is perhaps appropriate to finish by emphasising that, despite the small amplitude (about 0.17 in V), 44 Bootis does display a range of phenomena - such as changes in orbital period and distorted light curves - which are accessible to observers who can make observations of sufficient precision. The star can be commended for further study.

Figure 5 44 Bootis: O−C with orbit light−time and variable P



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PHOTOELECTRIC MINIMA OF ECLIPSING BINARIES, 1990 - 1991

TRISTRAM BRELSTAFF

This report covers photoelectric timings of minmum of eclipsing binaries made in the years 1990 and 1991. The names of the observers and the numbers of observations and timings contributed by each are listed in Table 1.

The times of minimum derived from the observations are listed in Table 2. A colon (':') following a timing indicates that it is uncertain, either because the observations show unusually large scatter or else because the rising or fading limb was poorly covered.

The epoch and O-C values are relative to the linear elements given in the 4th Edition of the GCVS.

For various reasons, this report has been published after those for 1992-1995. To help clear up any confusion that might arise from this, Table 3 explicitly lists where the photoelectric results for these years can be found. Before 1990, the photoelectric results were included with the visual ones in the main Eclipsing Binary Program reports. The visual results for 1990 onwards will be published in the future.

Table 1:Observer Totals

Observer	No. Obs.	No. Timings
A J Hollis (HO)	131	3
J E Isles (IS)	407	15
R D Pickard (PI)	87	3
J Watson (TW)	188	11
Total	813	32

Table 2: Observed Minima

Star	Epoch (244...)	JD Hel (d)	O-C	No	Obs	Filter	Notes
OO Aql	19456	8473.2919:	0.0070:	8	IS	B	
OO Aql	19456	8473.2931:	-0.0058:	8	IS	V	
Sigma Aql	13341	8505.3274	0.1117	9	IS	V	
VW Cep	15626.5	8506.4332	-0.0630	16	PI	V	
VW Cep	15627	8506.5776	-0.0578	19	PI	V	
VW Cep	15842	8566.4124	-0.0606	11	TW	V	
VW Cep	15857	8570.5836	-0.0641	14	TW	V	
VW Cep	15953	8597.3031	-0.0628	10	TW	V	
VW Cep	15978	8604.2602	-0.0636	14	TW	V	
VW Cep	16032	8619.2908	-0.0620	12	PI	V	
GK Cep	9981	8038.5514	0.0621	24	TW	V	1
GK Cep	10051.5	8104.5485	0.0601	22	TW	V	2
AI Dra	4008	8096.4832	0.0073	19	TW	V	
SW Lac	8784	8092.5473	-0.0128	17	TW	V	
CM Lac	13131	8097.5184	-0.0030	15	TW	V	
UV Leo	16540.5	8366.4373	0.0087	43	HO	V	
WZ Oph	3060.5	8452.3967	0.0016	71	IS	V	
V451 Oph	1658	8476.3237	0.0023	19	IS	V	
V451 Oph	1658	8476.3243	0.0029	19	IS	B	
V502 Oph	16046	8449.3324	-0.0477	36	IS	V	
V502 Oph	16121	8483.3310	-0.0536	19	IS	V	
V502 Oph	16121	8483.3349	-0.0497	19	IS	B	
V566 Oph	16203	8473.3720	0.0212	15	IS	V	
V566 Oph	16203	8473.3743	0.0235	15	IS	B	
V839 Oph	19577	8455.3877	0.0734	31	IS	B	
V839 Oph	19577	8455.3895	0.0752	31	IS	V	
V839 Oph	19638	8480.3365	0.0735	22	IS	V	
V839 Oph	19638	8480.3370	0.0740	22	IS	B	
W UMa	6740	8014.4417	-0.0135	12	TW	V	
W UMa	6743	8015.4435	-0.0126	11	TW	V	
AG Vir	4595	8385.4400	0.0452	17	HO	V	
AH Vir	6311.5	8386.5062	0.0524	71	HO	V	

Notes:
1. Includes 9 observations from JD 2448084.
2. Includes 11 observations from JD 2448091.

Table 3. Publication of the 1990-1995 Photoelectric Timings

Year	Where Published
1990-91	This report
1992-93	VSSC 81, 4-5, 1994
1994	VSSC 84, 2, 1995
1995	VSSC 90, 16, 1996

RECENT PAPERS ON VARIABLE STARS

TRISTRAM BRELSTAFF

Time Dilation in the Light Curve of the Distant Type Ia Supernova SN 1995K
(Leibundgut et al., Astrophys. J. Lett., 466, L21-L24, 1996) - SN 1995K
This supernova appeared in a distant galaxy at redshift z=0.479. It is unique in that it appears to be a normal type Ia supenovae with an unusually stretched-out light-curve. The authors propose that SN 1995K is a normal type Ia SN and that the expansion of the universe at that distance has dilated its light-curve by a factor of (1+z) = 1.479. This provides a useful check on the expansion of the universe.

HS Virginis - A Dwarf Nova with 8-day Outburst Cycle Length (Kato et al. Inf. Bull. Var. Stars 4193, 1995)
CCD photometry shows 1.1-1.8 mag dwarf nova eruptions at 8 day intervals. These are similar to the normal outbursts of SU UMa stars and the authors suggest it is monitored for superoutbursts.

Jet-like Structures in Beta Lyrae. Results of Optical Interferometry, Spectroscopy and Photometry (Harmanec et al., Astron. Astrophys., 312, 879-896, 1996) -Preliminary analysis suggests that H-alpha and He I emission comes from two jets perpendicular to the orbital plane. These jets probably originate from the hot-spot on the disk around the obscured component of the binary system. Some emission also comes from between the two components - maybe from the gas stream or from the hot-spot directly. The 282d period in the light-curve is confirmed using 2852 V-band observations covering 36 years. There are variations in the profiles of the H-alpha and He I emission lines which may have a period of 4.70-4.75d. They may also be connected with the 282d period.

TAV J2106+194: A New Deeply Eclipsing Binary in Delphinus (Collins et al., The Astronomer, 33, 183-184, 1996)
Reports a preliminary analysis by Chris Lloyd of photographic, CCD, and visual observations by Mike Collins, Nick James and Geoff Kirby. Find a range of about 10.5-13.5V. Primary eclipse lasts just over 1 day. The following ephemeris is derived:
Min =JDHel 2450307.705 + 10.3526. This gives times of minumum about 4 hours earlier than predicted in VSSC 89.

The 340-d period in Beta Lyrae (Peel, Mon. Not. Roy. Atron. Soc, 284, 148-150, 1997)
This shows that a 340 day period found in the visual observations of the French observer M. Luizet from 1898-1916 is probably not an artefact. This period has apparently also been found in some recent photoelectric observations. When present the 340day period interferes with the 283 day period found by Guinan (see VSSC 87, page 9) to modulate the amplitude of the latter.

IBVS's No. 4368-4395

Gary Poyner

4368 CH Cygni - A tenth magnitude object. (Mikolajewski et al, 1996)
4369 The 1994 Superoutburst of RZ Sagittae. (Kato, 1996)
4370 Photometry and Astrometry of Variable Stars. (Argyle, 1996)
4371 1995 BVRI Photometry of CG Cygni. (Heckert, 1996)
4372 HD 112082: A new Semiregular Variable. (Lebzelter & Kerschbaum, 1996)
4373 Long term behaviour of the eclipsing binary PX Cephei. (Heerlein, 1996)
4374 A new ephemeris for ER Cephei. (Branly et al, 1996)
4375 Photoelectric BVRc observations and new elements for the Cepheid HD32456. (Berdnikov et al, 1996)
4376 Photoelectric BVRc observations of the peculiar Cepheid V473 Lyr. (Berdinkov et al, 1996)
4377 Photoelectric BVRc observations and classification of NSV 10183. (Berdnikov et al, 1996)
4378 Photoelectric Photometry of the red supergiant alpha 1 Her. (Wasatonic & Guinan, 1996)
4379 Photometric investigation of Y Canum Venaticorum. (Dusek, 1996)
4380 Photoelectric minima of some eclipsing binaries. (Muyesseroglu et al, 1996)
4381 New elements of V628 Cygni. (Agerer et al, 1996)
4382 Photoelectric minima and maxima of selected eclipsing and pulsating variables. (Agerer & Hubscher, 1996)
4383 Photoelectric minima of selected eclipsing binaries. (Agerer & Hubscher, 1996)
4384 1996 Photometry of RT Andromedae. (Heckert et al, 1996)
4385 XZ Lac = NSV 14114. (Martignoni, 1996)
4386 NSV 6177: First elements and lightcurve. (Frank et al, 1996)
4387 New ephemeris and light curves of DD Monocerotis. (Qian Shengbang et al, 1996)
4388 The period behaviour of BL Eridani. (Qian Shengbang et al, 1996)
4389 Photoelectric BVIc observations and new elements for the RR Lyrae star SU Col. (Berdnikov & Turner, 1996)
4390 Photometric and Polarimetric observations of seven Miras. (Magnan et al, 1996)
4391 New type and elements for V939 Cygni. (Agerer & Moschner, 1996)
4392 The new RR Lyrae star NSV 00461 in Andromeda. (Vidal-Sainz, 1996)
4393 NSV 04411, a new eclipsing binary system in Cancer. (Vidal-Sainz & Garcia-Melendo, 1996)
4394 Discovery of an SX Phe star in NGC 5897. (Wehlau et al, 1996)
4395 HBV 479 = V745 Her. (Collins, 1996)

ECLIPSING BINARY PREDICTIONS

TRISTRAM BRELSTAFF

The following predictions are calculated for an observer at 53 degrees north,1.5 degrees west but should be usable for observers throughout the British Isles. The times of mid-eclipse appear in parentheses with the start and end times of visibility on either side. The times are hours GMAT, that is UT-12h. 'D' and 'L' are used to indicate where daylight and low altitude, respectively, prevent part of the eclipse from being visible. Charts for all of the stars included in these predictions (17 in all see below for a list) are available from the Eclipsing Binary Secretary at 10p each (please enclose a large SAE).

1997 Apr 1 Tue
Z Per D08(03)08
X Tri D08(05)08
RZ Cas D08(08)10
ST Per 08(12)11L
Z Vul L11(14)16D
Z Dra 16(18)16D

1997 Apr 2 Wed
TW Dra 08(13)16D
V640 Ori 08(11)09L
RZ Cas 10(13)15

1997 Apr 3 Thu
RW Gem D08(09)12L
U Cep D08(10)15
TX UMa 13(17)16D
RZ Cas 15(17)16D
SW Cyg 15(22)16D

1997 Apr 4 Fri
Z Per D08(04)09
RW Tau D08(10)11L
V640 Ori 09(11)09L
Z Dra 09(11)14

1997 Apr 5 Sat
TW Dra D08(08)13
U Sge L12(10)16
S Equ L15(12)16D

1997 Apr 6 Sun
RW Gem D08(05)11
Z Vul L11(11)16D
TX UMa 14(19)16D

1997 Apr 7 Mon
RW Tau D08(05)09
Z Per D08(06)10
RZ Cas D08(07)10

1997 Apr 8 Tue
TW Dra D08(03)08
U Cep D08(10)15
SW Cyg L08(11)16D
RZ Cas 10(12)15
Z Dra 11(13)15
U Sge 14(20)16D

1997 Apr 9 Wed
ST Per D08(10)11L
RZ Cas 14(17)16D
TX UMa 16(20)16D

1997 Apr 10 Thu
Z Per D08(07)11L

1997 Apr 11 Fri
Z Dra D08(06)09
Z Vul L11(09)15

1997 Apr 12 Sat
Z Dra 12(15)16D
S Equ L14(09)14

1997 Apr 13 Sun
RZ Cas D08(07)09
Z Per D08(08)11L
U Cep D08(10)14
TW Dra 13(18)16D
Z Vul 15(20)16D

1997 Apr 14 Mon
RZ Cas 09(12)14

1997 Apr 15 Tue
Z Dra D08(08)10
RW Tau D08(12)10L
U Sge L11(14)16D
RZ Cas 14(16)16D
S Equ L14(19)16D

1997 Apr 16 Wed
Z Per D08(10)11L
TW Dra 08(13)16D
Z Vul L10(07)12
Z Dra 14(16)16D

1997 Apr 17 Thu
ST Per D08(09)10L
SW Cyg 09(15)16D

1997 Apr 18 Fri
RW Tau D08(06)10L
U Cep D08(09)14
Z Vul 13(18)16D

1997 Apr 19 Sat
RZ Cas D08(06)09
TW Dra D08(09)14
Z Dra D08(10)12
Z Per D08(11)10L
Z Per L15(11)16D

1997 Apr 20 Sun
RW Gem 08(13)11L
RZ Cas 09(11)13

1997 Apr 21 Mon
Z Vul L10(05)10
RZ Cas 13(16)16D

1997 Apr 22 Tue
TW Dra D08(04)09
SW Cyg D08(05)11
Z Per D08(12)10L
U Sge L11(08)14
S Equ L13(16)16D
Z Per L15(12)16D

1997 Apr 23 Wed
U Cep D08(09)14
RW Gem D08(10)11L
Z Dra 09(11)14
Z Vul 11(16)15D

1997 Apr 25 Fri
TX UMa D08(04)09
ST Per D08(08)10L
Z Per 09(14)10L
U Sge 12(17)15D
Z Per L15(14)15D

1997 Apr 26 Sat
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RZ Cas D08(10)13
RW Tau 09(14)09L
SW Cyg 12(18)15D

1997 Apr 27 Sun
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RZ Cas 13(15)15D
TW Dra 14(19)15D

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Z Vul L10(14)15D
Z Per L14(15)15D

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TW Dra 09(14)15D

1997 May 1 Thu
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SW Cyg D09(08)14
Z Dra 12(15)15D
Z Per L14(16)15D

1997 May 2 Fri
RZ Cas D09(10)12
U Sge L10(12)15D

1997 May 3 Sat
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TW Dra 10(15)15D
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1997 May 16 Fri
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TX UMa 11(16)14D
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Z Vul 11(16)14D
Z Dra 13(15)14D
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1997 May 28 Wed
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TW Dra 11(16)14D
SW Cyg 12(19)14D
X Tri L14(13)14D
1997 May 29 Thu
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Y Psc L13(11)14D
ST Per 14(18)14D
X Tri L14(12)14D
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S Equ L11(11)14D
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X Tri L14(11)14
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Z Dra D10(12)14
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1997 Jun 2 Mon
U Cep D10(06)11
SW Cyg D10(08)14D
RZ Cas D10(12)14D
1997 Jun 3 Tue
TW Dra D10(07)12
1997 Jun 4 Wed
Z Vul D10(09)14D
Z Dra 11(13)14D
Z Per L12(07)12
U Cep 13(18)14D
1997 Jun 5 Thu
U Sge D10(07)13
1997 Jun 6 Fri
S Equ L10(08)14
ST Per L13(17)14D
1997 Jun 7 Sat
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Z Per L12(09)13
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U Sge 10(16)14D
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1997 Jun 9 Mon
Z Vul D10(07)13
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RZ Cas 13(16)14D
Y Psc 14(18)14D
1997 Jun 10 Tue
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SW Cyg D10(12)14D
TW Dra 12(17)14D
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1997 Jun 12 Thu
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S Equ 10(16)14D
Z Vul 11(16)14D
Z Per L11(13)14D
1997 Jun 17 Tue
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1997 Jun 18 Wed
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S Equ D10(13)14D
Z Dra 11(13)14D
1997 Jun 24 Tue
U Cep 12(17)14D
1997 Jun 25 Wed
SW Cyg D10(05)11
TX UMa D10(10)14D
U Sge D10(14)14D
Z Per 12(17)14D
TW Dra 13(18)14D
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Z Vul D10(12)14D
X Tri 14(16)14D
1997 Jun 27 Fri
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Z Dra 13(15)14D
X Tri 13(16)14D
1997 Jun 28 Sat
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TW Dra D10(13)14D
Y Psc L11(14)14D
X Tri 12(15)14D
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1997 Jun 29 Sun
U Cep 12(16)14D
X Tri L12(14)14D
SW Cyg 13(19)14D
1997 Jun 30 Mon
Z Dra D10(08)11
S Equ D10(10)14D
ST Per L11(13)14D
X Tri L12(14)14D

001·03 — 20′ FIELD INVERTED

RX ANDROMEDAE 01ᴴ 04ᴹ 36ˢ +41° 18·0′ (2000)

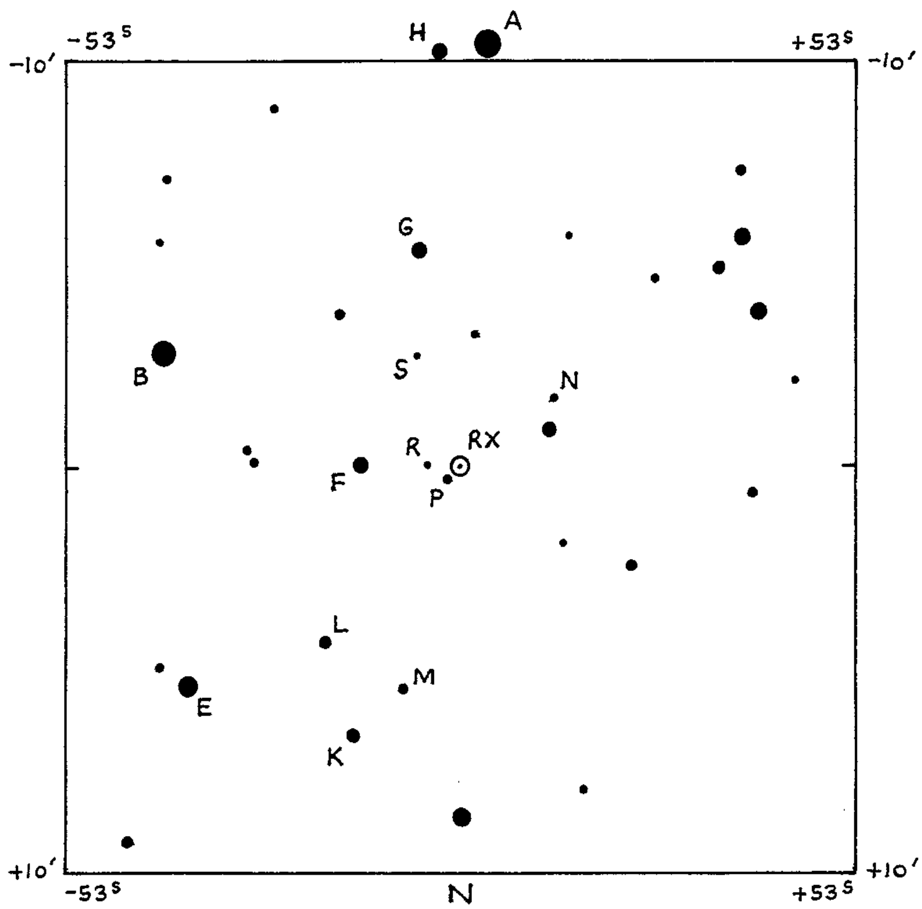

CHART: BOREALIS.
SEQUENCE: A–N
IDH. P,R,S KATO.

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E	11·46	M	13·77
F	12·01	N	14·52
G	12·09	P	14·31
H	12·57	R	14·89
K	12·58	S	15·62

BAA VSS
EPOCH: 2000
DRAWN: JT 20-10-96
APPROVED: G. Poyner

SECTION OFFICERS

Director Gary Poyner
67 Ellerton Road, Kingstanding, Birmingham, B44 0QJ.
Tel: 0121 6053716 Internet:gp@star.sr.bham.ac.uk
Section Secretary Melvyn D. Taylor
17 Cross Lane, Wakefield, West Yorks., WF2. 8DA. Tel: 01924 374651
Chart Secretary John Toone
Hillside View, 17 Ashdale Road, Cressage, Shrewsbury, SY5 6DT. Tel 01952 510794
Computer Secretary Dave McAdam
33 Wrekin View, Madeley, Telford, Shropshire, TF7 5HZ.
Tel 01952 432048 Internet dave@telf-ast.demon.co.uk
Nova/Supernova Secretary Guy M Hurst
16 Westminster Close, Basingstoke, Hants, RG22 4PP .
Tel & Fax 01256-471074 Internet Guy@tahq.demon.co.uk
Pro-am Liaison Committee Secretary & Photoelectric Photometry Advisor
Roger D Pickard, 28 Appletons, Hadlow, Kent TN11 0DT
Tel 01732-850663 Internet rdp@star.ukc.ac.uk
Eclipsing Binary Secretary Tristram Brelstaff,
3 Malvern Court, Addington Road, Reading, Berks, RG1 5PL Tel 01734-268981
Circulars Editor and CCD Advisor Karen Holland
136 Northampton Lane North, Moulton, Northampton, NN3 7QW
Tel 01604 671373 Internet kho@star.le.ac.uk
Recurrent Objects Co-ordinator - as Director

TELEPHONE ALERT NUMBERS

Nova and Supernova discoveries

First telephone the Nova/Supernova Secretary. If only answering machine response, leave a message and then try the following: Denis Buczynski 01524-68530, Glyn Marsh 01772-690502, or Martin Mobberley 01245-475297 (weekdays) 01284-828431 (weekends).

Variable Star Alerts

Telephone Gary Poyner (see above for number)

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