British Astronomical Association

VARIABLE STAR SECTION CIRCULAR

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Contents

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Office: Burlington House, Piccadilly, London, W1V 9AG

NEW CHART

JOHN TOONE

004·03 30′ FIELD INVERTED

Z CAMELOPARDALIS 08h 25m 13·2s +73°06′39″ (2000)

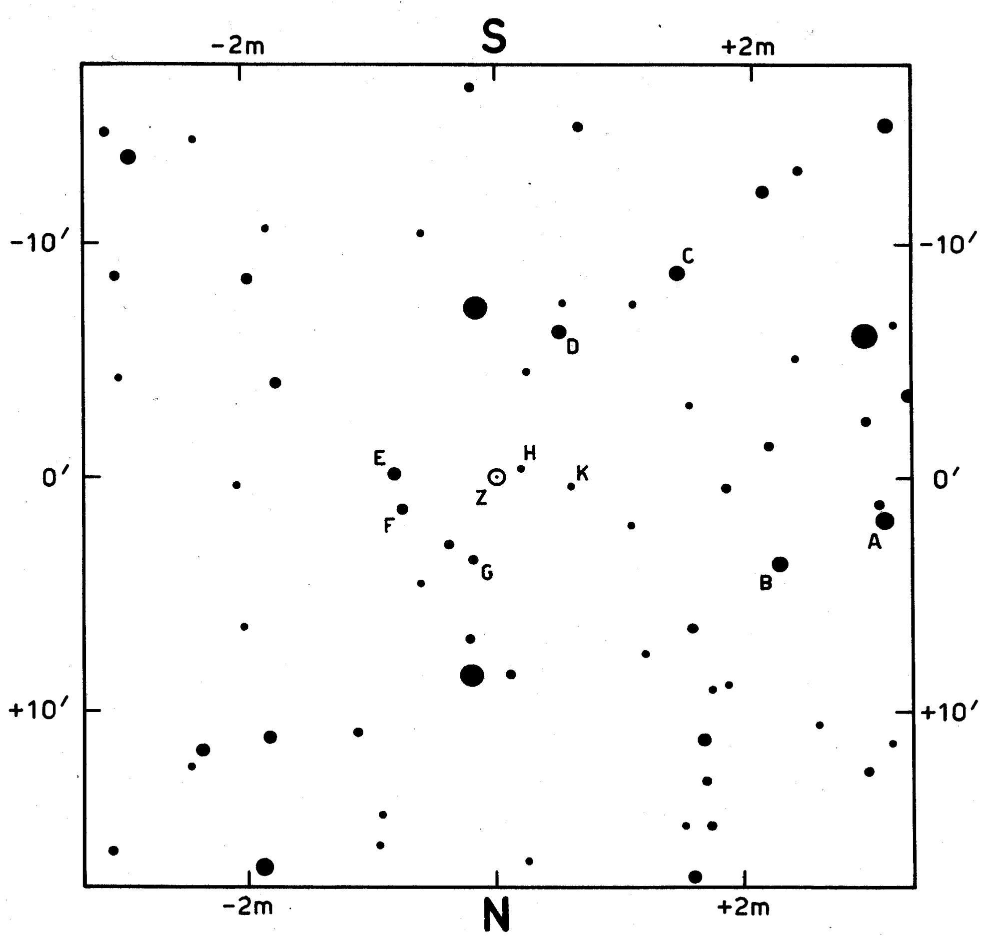


CHART:
GUIDE 8

SEQUENCE:
A-C LENOUVEL & DAGUILLON.
D-K ZISSELL

A 10·2
B 10·8
C 11·0
D 11·9
E 12·5

F 13·1
G 13·8
H 14·7
K 15·2

BAA VSS
EPOCH: 2000
DRAWN: JT 26-01-03
APPROVED: RDP

FROM THE DIRECTOR

Roger Pickard

Circulars Subscriptions

Recently our Editor advised me that there is a large discrepancy in the cost of production of the Circulars, and income from subscriptions, in the sense that income falls well short of expenditure. It is with some regret therefore, that I must advise members that the Officers of the Section have agreed an increase of 1 pound per annum from 1st January 2004, on all levels of subscription. This will not mean that income now covers expenditure, as we have a large number of non-paying individuals and organisations (professionals are not charged, nor are astronomical libraries, for example). However, I'm sure that members will not be too upset, as this is the first increase for over eight years! Also, see the note below about receiving the Circulars in pdf format.

Submitting Observations

I've had some queries recently about submitting observations - how and to whom?

If you're new to the Section (or don't keep up to date with the Circulars!), I must admit it's easy to miss the fact that John Saxton now has an Excel spreadsheet programme to aid the inputting of observations. Just contact John and he will send you a copy. And of course, even if you don't use John's programme, you should still submit observations directly to him in one of the approved formats. (Binocular observations in paper format still go to Melvyn though). Electronic submissions should be made monthly and paper ones six-monthly. I will also see that this information is clearly displayed on the Web Pages.

Another query relates to the fact that AAVSO sequences and ours often do not match; a common misunderstanding appears to be that if the AAVSO sequence has been used there is no point in submitting the observations to the VSS. This is not so, as John (Saxton) has a database of most known sequences with which he can match your observation, to ensure that it is entered into the database correctly.

A further query in this connection was whether an observation that has been submitted to the AAVSO should be sent to the VSS as well? The answer here is *yes*, as the AAVSO do not record the full estimate in their database, and therefore are unable to re-engineer any light curves in the event that a comparison is found to be badly in error, for example.

So, please send in all your observations to the VSS, but PLEASE make sure they are in the correct format and the best way to do this is to use John's Excel programme. Even if you're not on email but have a PC, this is the best way to enter data - a floppy can subsequently be sent to John.

Circulars in PDF format

Thanks to the efforts of David Griffin for converting the Circulars back to issue 88 so far, and to Gary Poyner for checking the conversion, I'm pleased to advise that the Circulars are now available in pdf format which is easily read by the freely available Adobe Acrobat software.

This also means we can now offer the current Circular in pdf format as from the next issue (No. 119) as an alternative to hardcopy, although the subscription rate will remain unchanged. In addition, if you are in receipt of a Circular for which you do not have to pay, would you be prepared to receive just a pdf version as this will obviously help in reducing costs? Please let either Karen or myself know if this option is of interest to you. We are also planning to make the Circulars available in pdf format via the website, about 6 months after their publication.

Colin Munford

And finally, congratulations to Colin Munford, long time member of the VSS who has been a member of the BAA for 50 years and so qualifies for Honorary Membership. Colin made 14085 observations between 1953 and 1985. Well done and thank you Colin.

Forthcoming Meetings - Advance Notification

There will be a joint **VS/I&I Section Meeting on CCD photometry**, in Northampton on May 15th, 2004. Full details of the programme will be in the March circular. Meetings organisers are Karen Holland and Bob Marriot.

The **VS Section Annual Meeting** in 2004 will be a weekend meeting at Alston Hall Preston during October. More details will be included in the circulars. The meetings organisers are Roger Pickard and Denis Buczynski.

VARIABLE STAR OF THE YEAR - A CORRECTION

JOHN TOONE

A late correction to the text of *Variable Star of the Year* was omitted from page 89 of the 2004 BAA Handbook. The text in the Handbook states that **Z Cam** has never been seen to rise to outburst directly following a standstill. However, VSS data indicates that it did in fact rise from two separate standstills in 1959 and 1960. In addition, it was seen to rise from minimum to a standstill in 1958. This contradicts Coel Hellier in his book *Cataclysmic Variable Stars*, where he states that standstills are always initiated by an outburst and always end with a decline to quiescence. This is undoubtedly still the case in virtually all standstills but it seems not to be an absolute rule.

The above, yet again, illustrates the continued importance of the VSS monitoring this famous star. Our knowledge of the long term behaviour of Z Cam and most other variables is entirely dependent upon the efforts of visual observers over the past Century or more. The VSS of course, is fortunate to have established the longest observational database of all the current worldwide variable star organisations, and we would very much encourage scientific researchers to make full use of it.

UK ALERT GROUP

GARY POYNER AND ROGER PICKARD

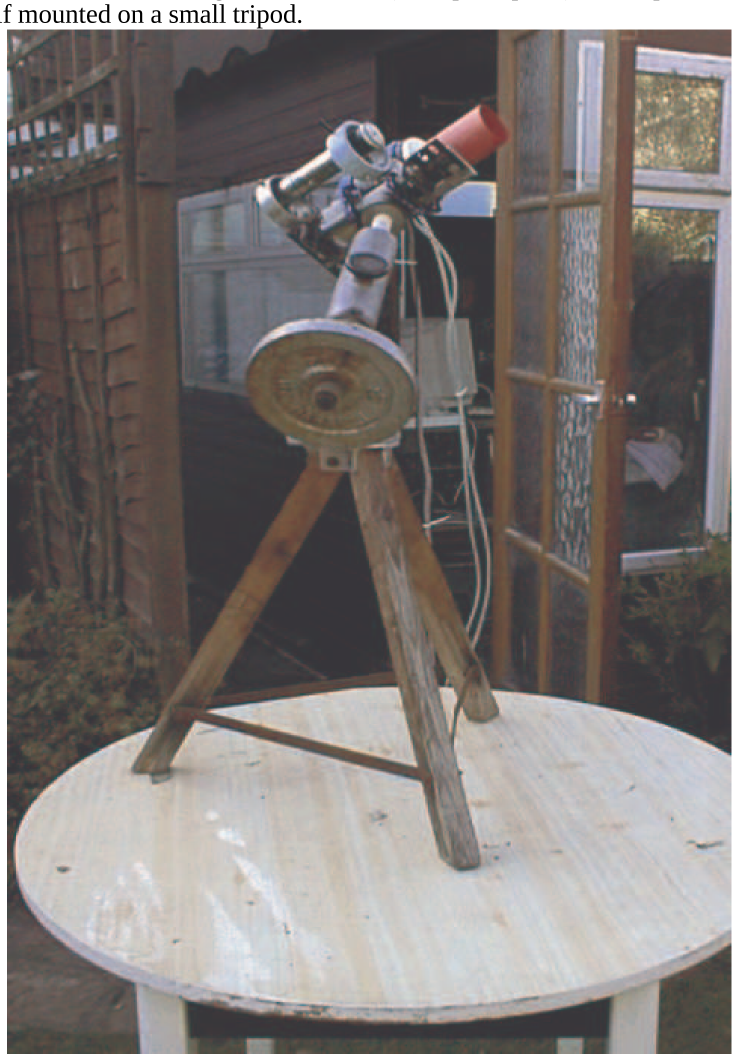
At the recent VS Section meeting there was a brief discussion regarding the possibility of setting up an UK Alert group as a Yahoo discussion group. This service would aim to provide fast notification of significant or noteworthy events relating to variable star observing, such as unusual or rare outbursts of cataclysmic variables, or upcoming maxima of Miras, for example. If there would be interest in setting up such a group, both Roger Pickard and Gary Poyner would be interested to hear from you. If there is sufficient interest, then efforts will be made to set up such a group.

PICKARD'S NEW OBSERVATORY

Roger Pickard

Following removal to darker skies in Herefordshire, it seemed sensible to say goodbye to the faithful old 16" Newtonian (which was sold to a friend at the Crayford Manor House AS), and purchase one of these all singing all dancing Meades. Unfortunately, there has been a delay in obtaining the Meade, and so I must make do, for the moment, with a smaller set-up. (Note: The Meade arrived just one week before the deadline for this Circular but it will still be a few weeks before I'm observing with it).

The current set-up consists of a camera mounted on an old equatorial head, shown below, (Fullerscope Mk II), which unfortunately does not have any sort of slow motion control be it manual or electric, and was designed for a small (4" or perhaps 6") telescope. The equatorial head is itself mounted on a small tripod.

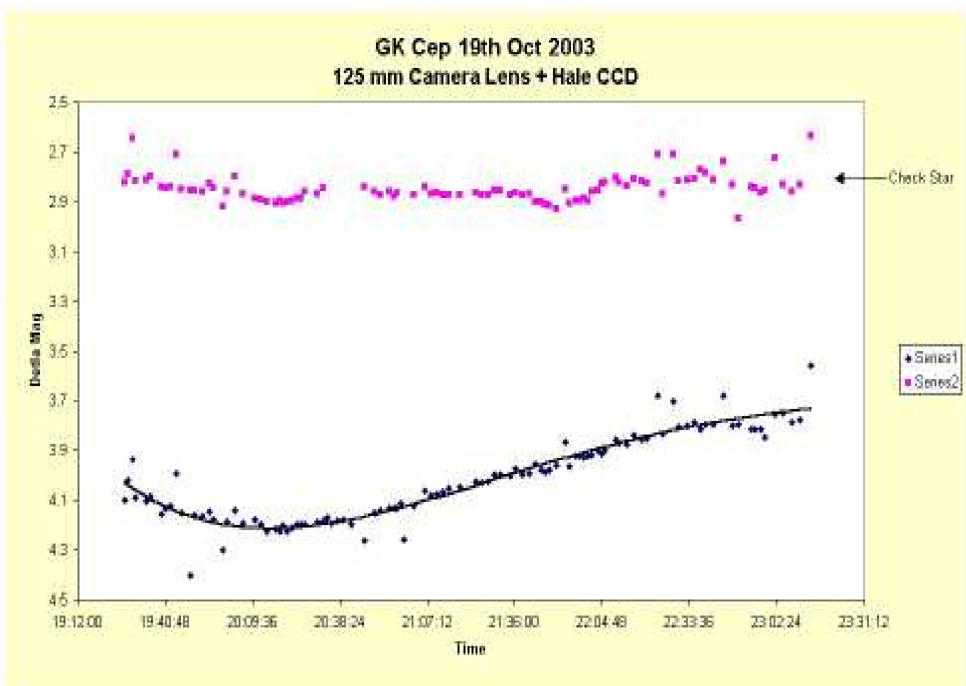


Some comments on the new observatory

I needed something to raise the small tripod to make it easier to find the stars. A table was just one of the many pieces of furniture kindly(?) donated to us by the previous owners. We had taken it along to a boot sale on one occasion but it poured with rain and we never got rid of it. Then we used it for a barbecue one evening and found it quite useful. Finally, when it came in very useful as an astronomical mount, its life was spared. Fortunately, being circular, the table is polar aligned no matter what direction you have it in!

Despite this seeming simplicity, the system is actually quite sophisticated. The equatorial head on the tripod has an expensive CCD camera attached to it, with my original finder scope from the late Henry Wildey next to it - heavens, that's 40 years old now! Tubes lead from the camera to the water cooling supply, whilst wires run to the camera control box and ultimately to a PC, from where the camera is controlled.

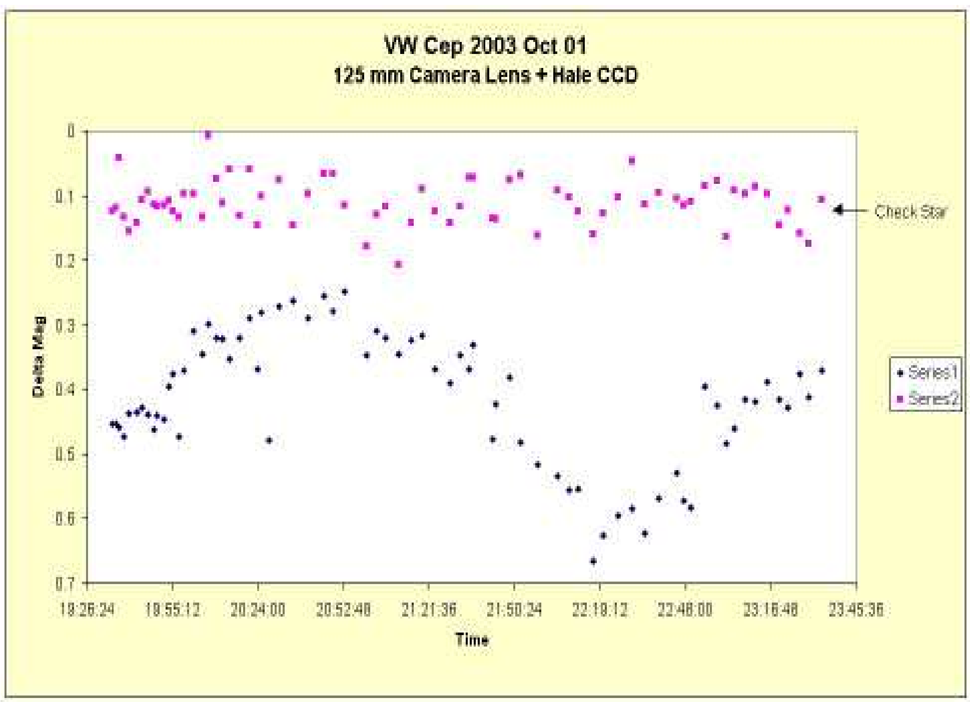
To achieve focus on the CCD chip it has proved necessary to use a 2-3X teleconverter operating at about 2.5X with a standard 50 mm camera lens. This means it is effectively operating at about 125 mm focal length. The system also incorporates a Johnson V filter purchased from Norman Walker.



I sit in the *shed* (now renamed the *observatory control room*) whilst taking images, but venture out to move the camera to the next object. I usually take four images of each object, before moving onto the next one, which gives me some idea of the accuracy of my observation. Stars hardly drift at all across the CCD in the time it takes to do this. I only have a small programme of bright binocular objects at the moment, because I know that once I have my main telescope up and running, I will not be able to sustain any larger programme. Therefore, given a few clear nights on the trot, I have finished this programme and am looking for something else to observe. I have now found that if I choose an eclipsing binary near the pole, it will take about an hour for it to drift across the CCD. In readiness for the new telescope, I've also networked the PC in the *control room* to one in the warmth of my study. I now find that I can observe an eclipsing binary near the pole whilst sitting in the warm, and only have to go outside once an hour to move the camera. In between times, I'm reducing all those earlier observations (or replying to emails!). This is really proving to be quite a productive way of observing.

I've included a couple of graphs of some EBs (see below) to show what can be done with a 1" telescope!

It is a bit of a shame that I'm not outside all the time, as I miss the wonders of the night sky - apart from when setting up and closing down, that is, when I take time to look up. But at least I can now observe for longer.



THE COSMOS IS THE CLASSROOM

John Toone

The High Energy Astrophysics Workshops held in Huntsville in 2000 and Hawaii in 2002 afforded me the opportunity to meet and get to know many of our astronomical colleagues based in the USA and also from many other parts of the world. Many friendships were forged, and much learned in wonderful background settings. I was absolutely delighted, therefore, to receive an invitation to return to Huntsville in July 2003, to attend NASA's workshop for teachers entitled *Chandra 101, The Cosmos is the Classroom*. The workshop formed part of one of NASA's government funding conditions for scientific endeavours, where they are required to participate in education and public outreach activities. There were actually two workshops that operated simultaneously over four days, the other being at Tufts University in Massachusetts. These workshops covered many aspects of basic astrophysics and space science. So that the teachers could relax a little, there were also astronomy-related lessons and evening observing sessions planned, which is where my role came in.

Teachers had applied for these workshops many months before, and such was their popularity that the courses were oversubscribed many times over. The 40 persons finally selected for the Huntsville workshop were not solely from the USA, and I soon found myself mixing with teachers from Australia, Canada, Chile, Ecuador and Portugal.

On day one, we undertook a tour of the Space and Rocket Center. This was a very impressive place, with IMAX cinema (telling the story of the construction of the International Space Station) and rocket hardware dating from the Mercury, Gemini and Apollo programmes. In the evening we went onto the roof of the local university building where there was small observatory. I was charged with leading the informal observing session but it had to be abandoned prematurely due to cloud, thick haze and light pollution.

Day two opened with a video conference talk by Dr Janet Mattei, who was at the other workshop at Tufts University. The talk was on variable stars and the work of the AAVSO. It was Janet's first talk by video link, and I thought she put on a good show and got through a lot of material in the limited time permitted. Lauren Ball followed this up with a talk on CCD's and his method of detecting faint asteroids, which is highly effective, as he has been credited with 80 confirmed discoveries to date, all made from Huntsville. There were then several presentations on basic astrophysics by the NASA Marshall Space Flight Center team. The day ended with the teachers making visual magnitude estimates from simulated variable star images drawn from the AAVSO web page. The teachers then pooled their estimates and drew light curves. It was good to see that NASA recognised the importance of variable stars in scientific research, and that the contribution from amateur astronomers in this regard is crucial. The evening was overcast so no observing was attempted on this night.

Day three got very heavy with the space science, and I found some of the teachers asking me lots of questions during the presentations. Tony Phillips of NASA started the proceedings by explaining how space science can be readily accessed. This proved to be one of the highlights of the workshop for many of the teachers. A large chunk of the day was then devoted to DS9 (http://chandra-ed.harvard.edu/), which is a software package for data analysis, initially developed for use with data from the Chandra X-ray Observatory. Highlights of the results from the Chandra X-ray Observatory were presented, and to me these seemed pretty awesome. Light relief was provided by a telephone conference with Andre Bormanis, the science advisor on the current Star Trek (Enterprise) series, while he was enroute to his office at Paramount Studios. In the evening we attended a barbeque at the Von Braun Astronomical Society (VBAS) observatory and planetarium. The sky was clear and after a planetarium show, I could finally do some astronomy with the teachers. Armed with a green (very bright) laser pointer, the summer constellations were all outlined, and astronomical distances explained. A group of teachers, who were attending a separate workshop at the Marshall Space Flight Center, also turned up, and at one time I had a queue of nearly 50 people waiting for a look through the observatory C16 telescope that I had trained upon M57, and later Epsilon Lyrae. Smaller telescopes, which were manned by teachers newly trained in telescope handling techniques, were set on M6 and M7.

The fourth and final day commenced with a splendid talk by astronaut Don Petit. He explained his recent experiences aboard the International Space Station, and then described his eventful return to Earth aboard a Russian descent capsule. It was a rough landing, off course and he briefly experienced 9 G (yes nine!) during re-entry. The climax of the workshop was a tour of certain elements of the nearby Marshall Space Flight Center, which was under heavy security. The workshop then officially closed and the teachers started to leave. I stayed on in Huntsville for a couple of days, and had the opportunity to use the C16 telescope again at the VBAS one evening. It felt good to be doing some real astronomy without having dozens of people asking me questions about the sky. At the same time I reflected that it was a wonderful experience meeting all these people who were both eager to learn, and then fully able to teach many others. At the end I asked Mitzi Adams, the workshop organizer and host, why I had been invited to be the resident amateur astronomer as there were perhaps dozens of AAVSO people (non aliens) who could have done a similar job. Mitzi's response was *I thought the teachers would find you exotic and enjoy your funny accent; besides, David Levy wasn't available.* That tongue in cheek comment (at least I think it was) sent me home thinking NASA research scientists do have a sense of humour after all. All in all it was a memorable trip capped by a splendid aurora and NLC display on the return flight home.
Further details on the 2003 teachers workshops can be located on **http://highenergyteaching.com**

VARIABLE STARS IN THE CEPHEUS FLARE

MICHAEL POXON

The Cepheus Flare (CF) is the name given to a large region of gas and dust concentrated roughly between the bright diamond formed by a, i, b and z Cephei, with the areas most noteworthy for our purposes being in the region of Beta. The giant molecular clouds which comprise it are in a state of kinetic flux, and it is thought that this whole region may at some time have been the site of multiple supernova explosions. It includes nebular material of many kinds, including NGC 7129 (part of the *Cepheus Bubble*) and reflection nebulae like NGC 7023.

This may be an area known to some Variable Star observers already, since the Mira stars **T** and **AX Cep** also lie in this part of the sky. However, involved with the nebular material of the CF are several irregular variables: YSOs (Young Stellar Objects) of early spectral type whose light variations have not been very well studied. Indeed a paper on early-type irregular variables (which includes three stars discussed here) stresses that *...only the study of the long-term behaviour of the light variations provides information on the statistical properties of the cloud ensemble and the structure of the circumstellar envelope* (Gnrtler et al, Astron. Astrophys. Suppl. 140, 293-307, 1999)

The whole issue of how to classify the various types of YSOs is rather more complicated than it appeared only a few years ago. Stars such as **FU Orionis** or **RT Serpentis** which were previously thought to be some aberrant type of mega-slow Nova, have turned out to be a peculiar variety of *toddler* star like the T Tauri objects. Probably the best-known star of this type is **V1057 Cygni**, which is involved with the North America Nebula (NGC 7000). The star **BD+67°1300** lies near Beta Cephei and is a star-plus-reflection nebula system of visual magnitude 10.8 (B-V 1.3), similar to FU Ori. It illuminates a little nebula called VDB141. **AS507** is another bright system, a T Tauri variable of around the tenth magnitude.

Among the more interesting group of YSOs are the stars typified by **UX Orionis**. These show fairly gentle, small-amplitude variations interspersed with irregular fades. Three bright examples of these stars lie close together in the region of Beta Cephei: **SV**, **BH** and **BO Cep**. **SV Cephei** varies visually around eleventh magnitude for most of the time, and the others are slightly fainter. BO Cephei especially shows Algol-like fades, and indeed at one time was classed as an eclipsing binary. This classification may not have been quite so misguided as you may think; the UX Orionis stars, it has been suggested, are surrounded by embryonic planetary systems in the form of circumstellar accretions of matter (discs or otherwise). As these accretions condense, the ensuing clumpy material causes the light of the parent star to vary, therefore not unlike an eclipsing system.

The CF contains YSOs in all stages of evolution, and it should be borne in mind that sites of star formation are manifested in different ways depending on age and environment. The dark molecular clouds are detectable only by observations in the far infra-red, since their temperatures are around 15K. These observations show several hundred potential *theatres of creation* in the Cepheus Flare. As the star formation process gets underway, we see other evidence of starbirth such as the presence of Herbig objects, which are young, often variable early spectral type stars, frequently associated with streams of nebulous matter. As we have seen, there are also a fair number of fully-formed stars, though they are still young enough to throw the occasional unpredictable tantrum.

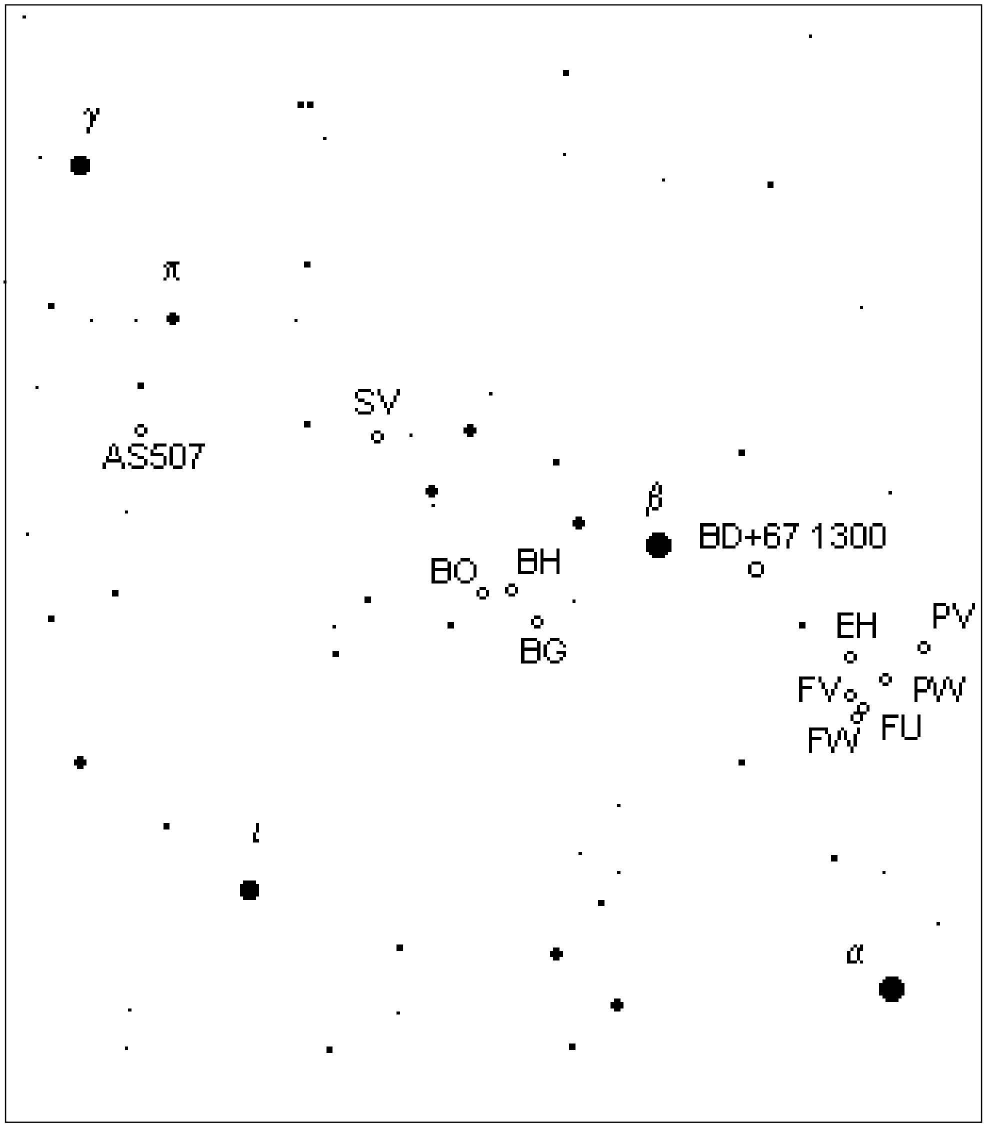


Diagram 1. The Northern part of the Cepheus Flare region showing some objects named in the text.

Observing the stars mentioned above is not difficult, though since their variations can be both rapid and unpredictable, they need to be observed as often as possible. For much of the time, in my experience, you may not see a fade (in this regard, think of them as inverse Dwarf Novae!), but even so, bearing in mind the quote earlier, we need good runs of observations of these objects. One recently-discovered star, probably of the UX Ori type (it is so new it has no official name yet), is called **MISV1147**, also in Cepheus. Extremely deep and rapid fades (hours, possibly even minutes from magnitude 13 down to 16!) have been observed by the author, and others on this star, and who knows how many similar objects are waiting to be observed?

Only a few of the stars mentioned here have been followed for any length of time by bodies such as the AAVSO (and sometimes the author was the only observer!). **VX Cas**, **DI** and **SV Cep** have AAVSO preliminary charts. **BH**, **BO** and **BG Cep** have charts drawn up by the author, who encourages others to begin the visual observation of these neglected but fascinating classes of variable.

Table 1. Named variable stars in Cepheus from the GCVS in the CF Region. (Stars asterisked are too faint for amateur instruments but are shown on the diagram to demonstrate distribution)

Star	Type	Spectrum
BG	IA:	B8:
BH	ISB	F5IVeα
BO	INSB	F2:eα
EH	INSB	G2eα-K2e
FU*	INS	eα
FV*	INSB	K7e
FW*	INS	eα:
PV*	INT	A5Ve-Koe(T)
PW*	INS	eα
SV	ISA	Aoeα

Letters

ECLIPSING BINARY NEBULAE.
Alex Vincent.

No variation in brightness of nebulae have been observed in the case of eclipsing binary stars, which are associated with them. An example of this are two stars of the four that form the Trapezium in the Orion nebula **BM Orionis** and **V1016 Orionis**. The primary star during minima still fully illuminates the nebula and is only hidden (totally or partially) from the observer.

However during secondary minima when the primary goes in front of the secondary then the former is hidden from view from the nebula. In this case the nebula could dim somewhat because the star is at primary minima seen from it. Could observations be made at secondary minima to see if the nebula does show any dimming in the area where the primary is hidden?

SOURCES OF SCATTER AND ERROR - PART 1

TONY MARKHAM

There is a saying which goes *A man with a watch knows exactly what the time is; a man with two watches is never quite sure*. A similar uncertainty affects variable star observing. For example, you may have been observing **R Scuti** for many months, and last night you estimated it at magnitude 5.6. However, you then hear that another observer estimated it at magnitude 5.4. Which observer, if either, is correct ?

For a newcomer to variable star observing, the discovery that your own estimates don't produce the *perfect* light curves generally reproduced in books, and the discovery that your own carefully made brightness estimates can differ by several tenths of a magnitude from those of other observers can be very confidence sapping.

There is often an unrealistic expectation among observers, that with just a few tweaks to comparison star magnitudes, or adjustments to observing technique, it would be possible for all observers to report the same visual magnitude estimates, or to agree with V magnitudes measured using PEP. This is an unrealistic expectation, but we can take steps to minimise the scatter in our visual brightness estimates.

The confusion for newcomers can be compounded by unfair comparisons that are sometimes made between visual estimates and PEP measurements. Often these will compare a visual light curve combining the results of many different observers, with the PEP light curve from a single photometer. Inevitably the visual estimates show more scatter, but as will be seen in the notes which follow, most of this scatter is due to systematic differences between observers. A light curve showing the visual estimates of a single observer will show much less *scatter* than a light curve showing the visual estimates from many different observers. Similarly, a light curve showing the results from several different photometers will show more *scatter* than will a light curve showing the results from one photometer.

Examples of visual light curves

The following series of light curves illustrates the scatter that is typically seen in visual estimates.

The light curve of RZ Cas in Figure 1 (overleaf) shows the eclipse well. Based on this single set of observations, it might seem that visual estimates can accurately determine the magnitude of the variable at a particular phase in the eclipse.

The light curve appears less tidy however when the observations of more than one eclipse of a variable are combined into a single light curve. Despite the fact that all eclipses of U Cephei will in reality be of equal depth, Figure 2 (overleaf) shows that the scatter in visual estimates disguises this.

However, although it can now be seen that there is lack of agreement in the visual estimates as to the magnitude at a particular phase, the time of mid eclipse can still be estimated reasonably accurately.

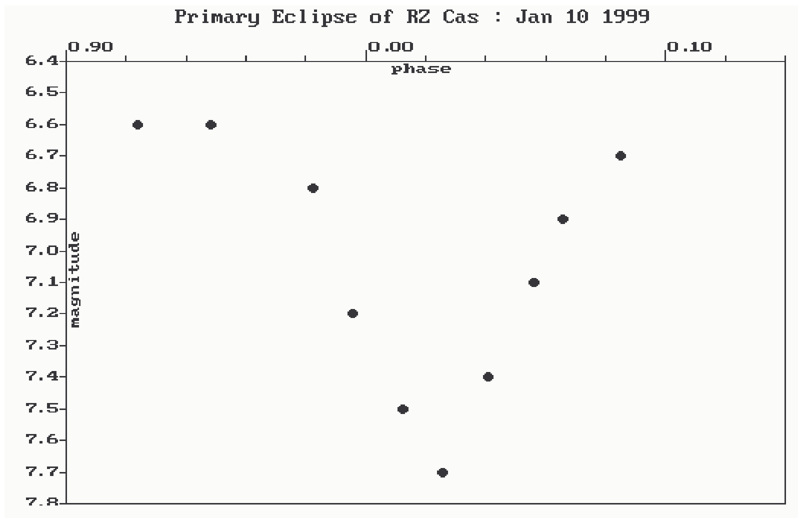
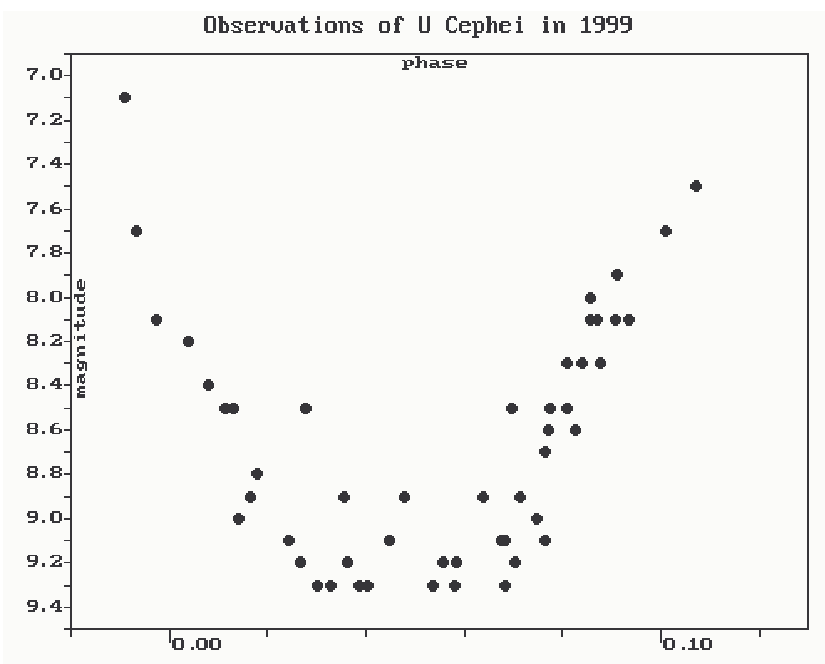


Figure 1 : Light curve showing visual observations of a single eclipse of RZ Cas by a single observer

Figure 2 : Light curve combining visual observations of several eclipses of U Cephei by a single observer



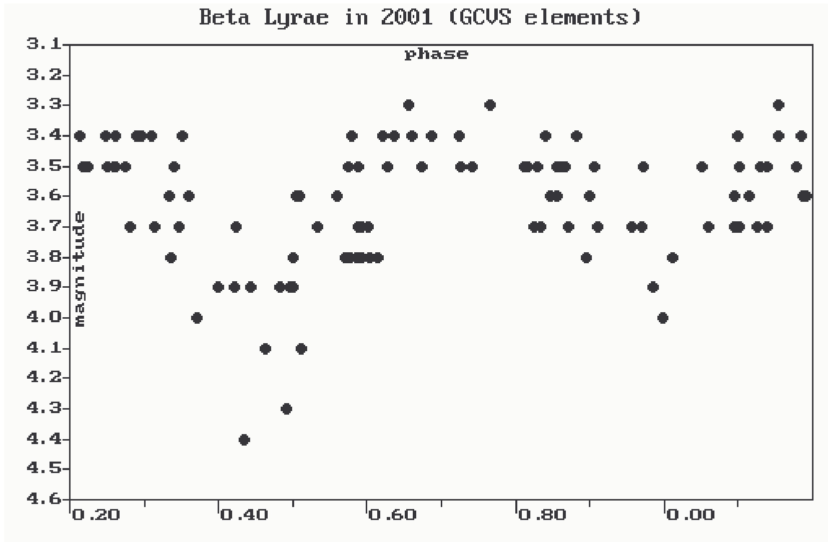


Figure 3 : Light curve combining the visual observations of several eclipses of Beta Lyrae made by several observers from the Society for Popular Astronomy

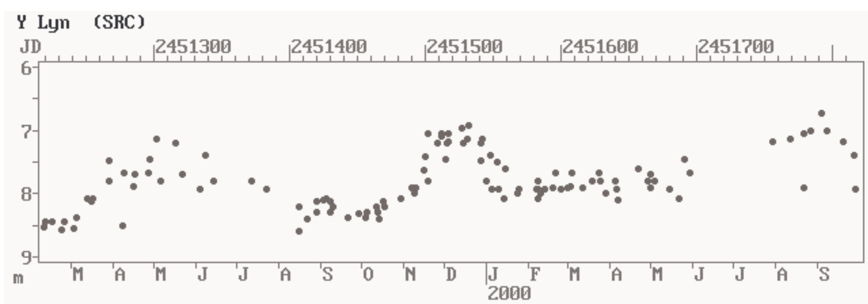


Figure 4: visual observations of the red semi-regular variable Y Lyncis by several BAA VSS observers

Combining the observations of more than one observer increases the scatter, as Figure 3 (above) shows. However, this can be offset by including the results of yet more observers as these will help define the shape of the light curve and the times of minima more clearly.

For red variables, the scatter between observers is greater, as is shown in Figure 4 (above). However, once again, the more observations that are made, the better defined the shape of the light curve becomes. In addition, as the later sections of this article describe, the scatter can be reduced by allowing for systematic differences between observers.

Factors which introduce scatter

The aim of this article is to describe various factors which can produce such differences, and hence lead to scatter in light curves. Some of these will only be applicable to visual observations (naked eye, binocular and telescopic); some will also be applicable to photometric measurements.

It should be noted that not all of the items listed are errors; some are merely reasons for which the results of different observers will not be identical. In any case, don't be put off by the number of factors listed.

At the end of the day, the most important rule is to always report what you see. Don't be influenced by what you believe you should be reporting. If an estimate from a previous night looks out of step with later estimates then don't go back and change your record of that observation to make it *fit*.

Human Factors

There are two main *human* sources of scatter: one is the eyes, the other is the brain. The eye collects the light, which is focussed by its lens on to the retina. There are two types of light detecting cells in the retina of the eye. Cone shaped cells are good at detecting colours and seeing fine detail, but are less responsive to low light levels. Rod shaped cells are more receptive to low light levels, but lack resolution and colour sensitivity. Cone cells are most numerous in the centre of the field of vision, whereas away from the centre rod cells provide most of the light detection.

Only about 10% of the light reaching the retinal cells actually reaches the photo-detectors. When the photo-detectors are stimulated by light, signals are passed along the optic nerve to the brain. The brain *interprets* the information that it receives from the eyes. We need to bear in mind that the information received by the brain is always incomplete: we only see clearly at the centre of the field of vision, and our off-centre vision is more blurred. Hence the brain is used to *filling in* detail based on previous experience. As we will see there are many reasons why the brain will not correctly *fill in* the detail, and thus can misinterpret the information passed from the eyes.

As an example of the influence of the brain, consider the fact that each of your eyes has a blind spot: a gap in the coverage of light detectors behind the retina at the location of the optic nerve. However, you are not aware of this, even when you close one eye, because the brain *fills in* the hole in your field of view. You can, of course, demonstrate the existence of the blind spot to yourself, closing one eye, and then looking at a constellation and positioning your line of sight so that one of the bright stars will disappear because its image falls on the blind spot.

Here is a summary of the human factors that affect brightness estimates:

Lack of dark adaption

Lack of dark adaption affects your ability to see fainter stars. It is also the case that the dark adapted eye has a different sensitivity to different colours, than does the unadapted or partially adapted eye. The peak sensitivity of the dark adapted eye is at around 510nm compared with 550nm during the daytime.

The retina at the back of the eye contain two types of photosensitive cell. Cone cells, which are most numerous around the centre of the field of view provide colour vision but are less sensitive to low light levels. Rod cells are sensitive to lower levels of light but lack colour sensitivity. They are located away from the centre of the field of view, peaking in numbers about 20 degrees off-centre

During daylight and in artificially lit rooms, we use photopic vision in which light detection is primarily provided by the cone cells. Indeed, on bright days, the pigment epithelium cells around the rod cells may even expand to try to shield the rod cells from excessive light levels.

Lower light levels, such as in moonlight, are less able to stimulate a response from the cone cells, and thus mesopic vision takes over in which the contribution of cone cells is decreased and the contribution of rod cells is increased. Indeed as the light level falls during twilight, the eyes lose their colour sensitivity, as the light level is no longer able to stimulate the iodopsin pigment in the cone cells. Red sensitivity is lost first, and blue and violet sensitivity is lost last, the order being a consequence of the longer wavelength red photons carrying less energy than the shorter wavelength blue and violet photons.

Finally, the light levels become too low for the cone cells and the eye switches to scotopic vision in which the light sensitivity is provided by the rod cells.

At this stage the distribution of cone and rod cells across the eye becomes particularly relevant. We can see faint objects more easily using averted vision, by making the image fall away from the centre of the field of view on to a part of the retina that is richer in rod cells.

Often, however, prior to an observing session your eyes will not have slowly adjusted during twilight, as you will have been in an artificially lit room. Thus your eyes will be adjusting to a sudden drop in the surrounding light level.

There are three steps to achieving dark adaption :

•Within a couple of seconds, the pupil dilates to let in more light. The amount of dilation that can occur depends on the age of the observer ,and peaks at about 8mm before the age of 20, dropping to about 6mm by age 50. Hence although light pollution is an increasing problem, we lose some of our ability to see fainter stars for other reasons.

•A second process is *Neural Adaptation* in which, within a second, the brain effectively switches to *bundling together* the signals from nearby receptors in the retina. This has the downside of reducing the resolution by a factor of about 10.

•The third process is much slower. To enable night vision, the eye secretes a pigment called rhodopsin into the rod cells of the retina in order to sensitise them. Exposure to bright light rapidly bleaches the rhodopsin from these cells. Unfortunately, it takes much longer to achieve dark adaption than it does to lose it.

The non-adapted eye will take over 15 minutes to become fully dark adapted. Indeed some improvement in dark adaption continues to occur for up to 30 minutes. The amount of time actually required for full dark adaption will, however, depend on what the observer was doing beforehand. Dark adaption is particularly poor after watching television or staring at a PC monitor. Indeed, having *stared* at a bright light source for some time, the brain will have desensitised the cells in that part of the retina. The result is that when you switch the light off or go into a dark room, you see after-images which are slow to disappear because these cells are not gaining sufficient stimulus to cause the brain to *reset* them. Often in such circumstances, it can help to look around the room to pick up (but not stare at) any slightly illuminated areas where stray light is entering, as this low level stimulation can help cause these cells in the retina to get *reset*.

However, if you get up late in the night and you are able to get outside and start observing without switching a light on, your eyes should already be well adapted to the dark.

The amount of dark adaption also depends on other factors such as the supply of oxygen to the cells of the retina. This can be affected adversely by factors such as age, smoking, stress and fatigue.

In practice, however, it should be noted that it will generally not be possible to achieve full dark adaption, as the observer's sky background may be brightened by light pollution or moonlight and, in any case, the presence of stars (including the cumulative effect of those too faint to be seen directly) together with emissions from particles in the atmosphere, means that the night sky is never completely dark. Indeed, in the early 1990s, I occasionally used an observing site accessible via a wooded area, and I was aware that the limiting magnitude appeared slightly better when I first emerged from the (dark) wooded area than it did 5 minutes later when looking at the sky with its sodium glow had adversely affected my dark adaption !

Remember, however, that dark adaption can be very quickly lost, so when referring to charts and when recording your observations, always use a dim red light as light of this colour, if sufficiently dim, will harm your dark adaption least. When a dim red light is used, the detection is carried out by red sensitive cone cells (the red light is below the 510nm absorption peak of the rhodopsin in the rod cells and doesn't significantly stimulate them). However if you use too bright a red light, you may stimulate the bleaching of rhodopsin from the rod cells and thus ruin your dark adaption.

..to be continued in the next issue....

ECLIPSE OF BM CASSIOPEIAE

ALEX VINCENT

The long period eclipsing binary star **BM Cas** will be at minimum on December 22 2003. The eclipse begins on December 3, and ends on January 10. Its magnitude is 8.78 at maximum and drops down to 9.31 at minimum. Its period is 197.27 days. It is a Beta Lyrae type eclipsing binary.

The system comprises of a high luminosity star of A6 spectral type, and its secondary is either a late K, or early M giant. Its position is 00h 54m 46s, +64° 05' 05" (Epoch 2000). Dates of future minima are on 2004 July 7, 2005 Jan 20 and Aug 5, 2006 Feb 18 and Sep 4.

BINOCULAR PRIORITY LIST

MELVYN TAYLOR

Variable	Range	Type	Period	Chart
AQ And	8.0-8.9	SRC	346d	82/08/16
EG And	7.1-7.8	ZA		072.01
V Aql	6.6-8.4	SRB	353d	026.03
UU Aur	5.1-6.8	SRB	234d	230.01.
AB Aur	7.2-8.4	INA		83/10/01
V Boo	7-12	SRA	258d	037.01
RW Boo	6.4-7.9	SRB	209d	104.01
RX Boo	6.9-9.1	SRB	160d	219.01
ST Cam	6.0-8.0	SRB	300d?	111.01
XX Cam	7.3-9.7?	RCB?		068.01
X Cnc	5.6-7.5	SRB	195d	231.01
RS Cnc	5.1-7.0	SRC	120d?	84/04/12
V CVn	6.5-8.6	SRA	192d	214.01
WZ Cas	6.9-8.5	SRB	186d	82/08/16
V465 Cas	6.2-7.2	SRB	60d	233.01
γ Cas	1.6-3.0	GC		064.01
rho Cas	4.1-6.2	SRD	320d	064.01
W Cep	7.0-9.2	SRC		83/10/01
AR Cep	7.0-7.9	SRB		85/05/06
mu Cep	3.4-5.1	SRC	730d	112.01
O Cet	2.0-10.1	M	332d	039.02
R CrB	5.7-14.8	RCB		041.02
W Cyg	5.0-7.6	SRB	131d	062.1
AF Cyg	6.4-8.4	SRB	92d	232.01
CH Cyg	5.6-10.0	ZA+SR		089.02
U Del	5.6-7.5	SRB	110d?	228.01
EU Del	5.8-6.9	SRB	60d?	228.01
TX Dra	6.8-8.3	SRB	78d?	106.01
AH Dra	7.1-7.9	SRB	158d?	106.01
NQ Gem	7.4-8.0	SR+ZA	70d?	077.01
X Her	6.3-7.4	SRB	95d?	223.01
SX Her	8.0-9.2	SRD	103d	113.01
UW Her	7.8-8.7	SRB	104d	107.01
AC Her	6.8-9.0	RVA	75d	048.03
IQ Her	7.0-7.5	SRB	75d	048.03
OP Her	5.9-6.7	SRB	120d	84/04/12
R Hya	3.5-10.9	M	389d	049.01
RX Lep	5.0-7.4	SRB	60d?	110.01
SS Lep	4.8-5.1	ZA		075.01
Y Lyn	6.9-8.0	SRC	110d	229.01
SV Lyn	6.6-7.5	SRB	70d?	108.01
U Mon	5.9-7.8	RVB	91d	029.03
X Oph	5.9-9.2	M	328d	099.01
BQ Ori	6.9-8.9	SR	110d	84/04/12
AG Peg	6.0-9.4	NC		094.01.
X Per	6.0-7.0	GC+XP		84/04/08
R Sct	4.2-8.6	RVA	146d	026.03
Y Tau	6.5-9.2	SRB	242d	84/04/12
W Tri	7.5-8.8	SRC	108d	114.01
Z UMa	6.2-9.4	SRB	196d	217.01
ST UMa	6.0-7.6	SRB	110d?	102.01
VY UMa	5.9-7.0	LB		226.01
V UMi	7.2-9.1	SRB	72d	101.01
SS Vir	6.9-9.6	SRA	364d	097.01
SW Vir	6.4-7.9	SRB	150d?	098.01

ECLIPSING BINARY PREDICTIONS

TONY MARKHAM

The following predictions, based on the latest Krakow elements, should be usable for observers throughout the British Isles. The times of mid-eclipse appear in parantheses, with the start and end times of visibility on either side. The times are hours UT, with a value greater than 24 indicating a time after midnight. D indicates that the eclipse starts/ends in daylight, L indicates low altitude at the start/end of the visibility and << indicates that mid eclipse occurred on an earlier date. Thus, for example, on Jan 4, TV Cas D17(19)23 indicates that an eclipse of TV Cas starts in daylight, but can be observed between approx 17h UT and 23h UT, with mid eclipse occurring at approx 19h UT. Please contact the EB secretary if you require any further explanation of the format. The variables covered by these predictions are :

TV Cas	7.2-8.2V	**S Equ**	8.0-10.08V	**U Sge**	6.45-9.28V
U Cep	6.75-9.24V	**delta Lib**	4.9-5.9V	**RW Tau**	7.98-11.59V
SS Cet	9.4-13.0v	**V640 Ori**	11.2-13.5V	**HU Tau**	5.92-6.70V
SW Cyg	9.24-11.83V	**Z Per**	9.7-12.4p	**X Tri**	8.88-11.27V
Z Dra	10.8-14.1p	**ST Per**	9.52-11.40V	**TX UMa**	7.06-8.80V
TW Dra	8.0-10.5v	**Y Psc**	9.44-12.23V	**Z Vul**	7.25-8.90V

Note that predictions for RZ Cas, Beta Per and Lambda Tau can be found in the BAA Handbook.

2004 Jan 1 Thu
del Lib L04(03)07D
Z Dra 06(08)07D
ST Per D17(16)21
Z Per 18(23)28
HU Tau 21(25)28

2004 Jan 2 Fri
V640 Ori 02(04)03L
Z Dra D17(17)19
TV Cas 19(23)27
RW Tau 21(26)29L
SW Cyg 24(30)24L

2004 Jan 3 Sat
SW Cyg L02(06)07D
del Lib 04(10)07D
Z Vul L05(07)07D
U Cep D17(15)20
S Equ D17(17)19L
Y Psc 22(26)22L
HU Tau 22(26)28L
Z Dra 23(25)28

2004 Jan 4 Sun
TX UMa 01(05)07D
TW Dra 01(06)07D
V640 Ori 02(05)03L
ST Per 04(08)05L
U Sge L06(10)07D
TV Cas D17(19)23
Z Per 19(24)29

2004 Jan 5 Mon
Z Vul D17(18)19L
RW Tau D17(21)25
U Cep 22(27)31D
HU Tau 23(27)28L

2004 Jan 6 Tue
TV Cas D17(14)18
Z Dra D17(19)21
ST Per 20(24)28
TW Dra 21(26)31

2004 Jan 7 Wed
TX UMa 02(07)07D
U Sge D17(19)19L
SW Cyg D17(20)24L
Y Psc D17(21)22L
Z Per 21(26)29L

2004 Jan 8 Thu
Z Dra 01(03)06
HU Tau 01(05)04L
del Lib L04(02)07D
Z Vul L05(05)07D
TV Cas 05(10)07D
U Cep D17(15)19
RW Tau D17(15)20

2004 Jan 9 Fri
ST Per D17(15)19
TW Dra D17(21)26

2004 Jan 10 Sat
TV Cas 01(05)07D
X Tri 02(04)02L
HU Tau 02(06)04L
del Lib 04(10)07D
TX UMa 04(08)07D
S Equ D17(14)19L
Z Vul D17(16)19L
Z Dra 18(20)23
U Cep 22(26)31D
Z Per 22(27)29L

2004 Jan 11 Sun
X Tri 01(04)02L
U Sge L05(04)07D
Y Psc D17(15)20
TV Cas 20(25)29

2004 Jan 12 Mon
X Tri 01(03)02L
Z Dra 02(05)07D
ST Per 03(07)04L
SW Cyg 03(09)07D
HU Tau 03(07)04L
TW Dra D17(17)22
X Tri 24(26)26L

2004 Jan 13 Tue
Z Vul L05(03)07D
TX UMa 05(10)07D
U Cep D17(14)19
TV Cas D17(20)24
RW Tau 23(28)28L
X Tri 23(26)26L
Z Per 23(28)29L

2004 Jan 14 Wed
U Sge D17(13)18L
ST Per 18(22)26
Z Dra 20(22)24
X Tri 23(25)26L

2004 Jan 15 Thu
del Lib L03(02)07D
Z Vul D17(14)19L
TV Cas D17(16)20
U Cep 21(26)31D
X Tri 22(24)26L

2004 Jan 16 Fri
Z Dra 04(07)07D
SW Cyg D17(23)23L
RW Tau 18(22)27
X Tri 21(24)26L

2004 Jan 17 Sat
Z Per 01(06)04L
SW Cyg L01(<<)05
del Lib 03(10)07D
ST Per D17(14)18
Z Dra D17(15)18
U Sge D17(22)18L
X Tri 20(23)25

2004 Jan 18 Sun
TW Dra 02(07)07D
Z Vul L04(00)06
U Cep D17(14)19
X Tri 20(22)25
Z Dra 21(24)26

2004 Jan 19 Mon
TV Cas 02(07)07D

TX UMa D17(13)18
RW Tau D17(17)21
X Tri 19(22)24

2004 Jan 20 Tue

ST Per 01(05)04L
Z Per 02(07)04L
Z Dra 06(08)07D
S Equ D17(21)18L
X Tri 18(21)23
U Cep 21(26)31
TW Dra 22(27)31D
TV Cas 22(26)30

2004 Jan 21 Wed

U Sge L05(07)07D
SW Cyg D17(13)19
Z Dra D17(17)19
X Tri 18(20)23
SS Cet 23(28)24L

2004 Jan 22 Thu

del Lib L03(01)07D
TX UMa D17(15)19
X Tri D17(20)22
ST Per D17(21)25
Z Vul D17(22)18L
TV Cas 17(22)26
Y Psc 18(22)21L
Z Dra 23(26)28

2004 Jan 23 Fri

Z Per 03(08)04L
U Cep D17(14)18
X Tri D17(19)21
TW Dra D17(22)27

2004 Jan 24 Sat

del Lib 03(09)07D
HU Tau D17(15)19
U Sge D17(16)18L
TV Cas D17(17)21
X Tri D17(18)21
SS Cet 23(27)23L

2004 Jan 25 Sun

RW Tau 01(06)03L
Z Vul 04(09)07D
TX UMa D17(16)21
X Tri D17(18)20
Z Dra D17(19)21
U Cep 21(25)30
SW Cyg 21(27)23L

2004 Jan 26 Mon

SW Cyg L01(03)07D
Y Psc D18(17)21L
HU Tau D18(17)21
X Tri D18(17)19
TW Dra D18(17)22

2004 Jan 27 Tue

Z Dra 01(03)06
X Tri D18(16)19
S Equ D18(18)18L
Z Vul D18(20)18L
RW Tau 19(24)27L
SS Cet 22(27)23L

2004 Jan 28 Wed

ST Per 00(04)03L
TV Cas 04(08)07D
U Sge L04(02)07D
TX UMa D18(18)22
HU Tau D18(18)22

2004 Jan 29 Thu

del Lib L02(01)07D
Z Dra 18(20)23
TV Cas 23(28)31D

2004 Jan 30 Fri

Z Vul L03(07)07D
SW Cyg D18(16)22L
RW Tau D18(19)23
HU Tau D18(19)23
ST Per D18(20)24
U Cep 20(25)30
SS Cet 22(26)23L

2004 Jan 31 Sat

del Lib 02(09)07D
Z Dra 03(05)07D
U Sge 05(11)07D
TX UMa D18(19)24
TV Cas 19(23)27

2004 Feb 1 Sun

TW Dra 03(08)07D
Z Vul D18(18)18L
HU Tau D18(21)25

2004 Feb 2 Mon

TV Cas D18(19)23
Z Dra 20(22)25
SS Cet 21(26)23L

2004 Feb 3 Tue

TX UMa D18(21)25
HU Tau 18(22)26
TW Dra 22(27)30D

2004 Feb 4 Wed

SW Cyg 00(06)06D
Z Vul L03(05)06D
Z Dra 04(07)06D
U Cep 20(25)30
ST Per 23(27)27L

2004 Feb 5 Thu

del Lib L02(00)06D
HU Tau 20(24)26L
SS Cet 20(25)23L

2004 Feb 6 Fri

TV Cas 05(10)06D
TX UMa D18(22)27
TW Dra D18(23)28
Y Psc 19(24)20L
Z Dra 21(24)26

2004 Feb 7 Sat

del Lib 02(08)06D
U Sge L03(05)06D
Z Per D18(15)20
ST Per D18(18)22
HU Tau 21(25)26L
RW Tau 21(26)26L

2004 Feb 8 Sun

TV Cas 01(05)06D
SW Cyg D18(20)22L
SS Cet 20(24)22L
SW Cyg L24(20)26

2004 Feb 9 Mon

Z Vul L03(03)06D
Z Dra D18(17)19
TW Dra D18(18)23
TX UMa 19(24)28
U Cep 20(24)29
TV Cas 20(25)29
HU Tau 22(26)26L

2004 Feb 10 Tue

Z Per D18(16)21
Y Psc D18(18)20L
RW Tau D18(20)25
Z Dra 23(26)28

2004 Feb 11 Wed

TV Cas D18(20)24
SS Cet 19(24)22L
HU Tau 24(28)26L

2004 Feb 12 Thu

del Lib L01(00)06D
TX UMa 20(25)30
ST Per 21(25)26L

2004 Feb 13 Fri

SW Cyg 04(10)06D
RW Tau D18(15)20
TV Cas D18(16)20
Z Per D18(18)23
Z Dra D18(19)21

2004 Feb 14 Sat

HU Tau 01(05)02L
del Lib 01(08)06D
Z Vul L02(01)06
U Sge L03(<<)05
SS Cet 18(23)22L
U Cep 19(24)29

2004 Feb 15 Sun

Z Dra 01(03)06
TW Dra 04(09)06D
ST Per D18(17)21
TX UMa 22(27)30D

2004 Feb 16 Mon

Z Per D18(19)24
X Tri 23(26)24L

2004 Feb 17 Tue

TV Cas 02(07)06D
U Sge L03(08)06D
S Equ L06(09)06D
V640 Ori D18(16)19
Z Dra D18(21)23
SS Cet D18(22)22L
SW Cyg D18(23)21L
X Tri 23(25)24L
SW Cyg L23(23)30
TW Dra 23(28)30D

2004 Feb 18 Wed

X Tri 22(24)23L
TV Cas 22(26)30D
RW Tau 23(28)26L
TX UMa 23(28)30D

2004 Feb 19 Thu

del Lib L01(00)06
Z Vul L02(<<)04
Z Dra 03(05)06D
V640 Ori D18(16)19
Z Per D18(20)25
U Cep 19(24)29
X Tri 21(24)23L

2004 Feb 20 Fri

TV Cas D18(22)26
SS Cet D18(22)22L
TW Dra 19(24)29
ST Per 20(24)26L
X Tri 21(23)23L

2004 Feb 21 Sat

del Lib 01(07)06D
Z Vul 04(09)06D
V640 Ori D18(17)19
RW Tau D18(22)25L
Z Dra 20(22)25
X Tri 20(22)23L

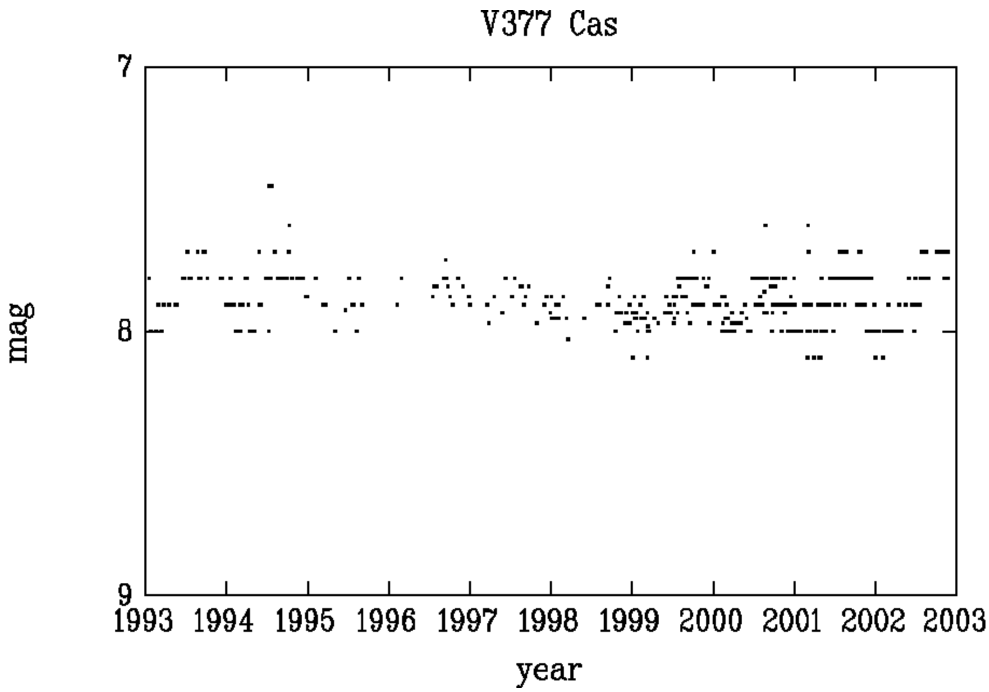
2004 Feb 22 Sun

TX UMa 01(06)06D
TV Cas D18(17)21
Z Per D18(22)26L
X Tri 19(22)23L

2004 Feb 23 Mon
Z Dra 04(07)06D
ST Per D18(16)20
V640 Ori D18(17)20
TW Dra D18(19)24
SS Cet D18(21)22L
X Tri 19(21)23L
2004 Feb 24 Tue
U Sge L02(03)06D
S Equ L05(06)06D
RW Tau D18(17)21
X Tri D18(20)23
U Cep 19(23)28
2004 Feb 25 Wed
TX UMa 03(07)06D
V640 Ori D18(18)20
X Tri D18(20)22
Y Psc D18(20)19L
Z Per D18(23)26L
Z Dra 22(24)26
2004 Feb 26 Thu
del Lib L01(<<)05
Z Vul 02(07)06D
TV Cas 04(08)06D
X Tri D18(19)21
SS Cet D18(21)21L
SW Cyg L23(27)30D
2004 Feb 27 Fri
X Tri D18(18)21
V640 Ori D18(18)21
TV Cas 23(28)30D
2004 Feb 28 Sat
del Lib 01(07)06D
TX UMa 04(09)06D
Z Dra D18(17)20
X Tri D18(18)20
ST Per 19(23)25L
Z Per 20(24)26L
2004 Feb 29 Sun
TW Dra 05(10)06D
V640 Ori D19(19)21
SS Cet D19(20)21L
U Cep D19(23)28
TV Cas 19(23)27
Z Dra 23(26)28
2004 Mar 1 Mon
HU Tau D19(16)20
2004 Mar 2 Tue
Z Vul L01(05)06D
U Sge L02(<<)03
SW Cyg D19(17)20L
TV Cas D19(19)23
V640 Ori D19(19)22
Z Per 21(26)25L
SW Cyg L22(17)23
2004 Mar 3 Wed
TW Dra 00(05)06D
HU Tau D19(17)21
Z Dra D19(19)21
SS Cet D19(19)21L
RW Tau 19(24)25L
2004 Mar 4 Thu
del Lib L00(<<)05
V640 Ori D19(20)22
2004 Mar 5 Fri
Z Dra 01(03)05D
U Sge L02(06)05D
HU Tau D19(18)22
U Cep D19(23)28
TW Dra 19(24)29D
Z Per 22(27)25L
2004 Mar 6 Sat
del Lib 00(07)05D
RW Tau D19(18)23
SS Cet D19(19)21L
V640 Ori D19(20)23L
2004 Mar 7 Sun
SW Cyg 00(07)05D
Z Vul L01(03)05D
HU Tau D19(20)24
Z Dra D19(21)23
ST Per D19(22)25L
2004 Mar 8 Mon
TV Cas 01(05)05D
TW Dra D19(20)25
V640 Ori D19(21)23L
Z Per 24(29)25L
2004 Mar 9 Tue
Z Dra 03(05)05D
S Equ L04(00)05
SS Cet D19(18)21L
HU Tau D19(21)24L
TV Cas 20(25)29
2004 Mar 10 Wed
V640 Ori D19(21)22L
U Cep D19(22)27
del Lib L24(22)29
2004 Mar 11 Thu
TV Cas D19(20)24
SW Cyg D19(20)20L
HU Tau D19(23)24L
Z Dra 20(22)25
SW Cyg L22(20)26
2004 Mar 12 Fri
Z Vul L01(01)05D
U Sge L01(00)05D
SS Cet D19(17)20L
V640 Ori 19(22)22L
del Lib 24(30)29D
2004 Mar 13 Sat
TV Cas D19(16)20
HU Tau 20(24)24L
2004 Mar 14 Sun
TX UMa D19(16)21
V640 Ori 20(22)22L
RW Tau 21(26)24L
2004 Mar 15 Mon
U Sge 04(09)05D
SS Cet D19(17)20L
ST Per D19(20)24L
U Cep D19(22)27
HU Tau 21(25)24L
Z Dra 22(24)26
2004 Mar 16 Tue
V640 Ori 20(23)22L
2004 Mar 17 Wed
Z Vul L00(<<)04
TW Dra 01(06)05D
TV Cas 03(07)05D
TX UMa D19(18)23
RW Tau D19(20)24L
HU Tau 23(27)24L
del Lib L23(22)28
2004 Mar 18 Thu
Z Dra D19(17)20
V640 Ori 21(23)22L
TV Cas 22(26)29D
2004 Mar 19 Fri
S Equ L04(07)05D
Z Vul 04(09)05D
TW Dra 20(25)29D
del Lib 23(30)29D
Z Dra 23(26)28
2004 Mar 20 Sat
TX UMa D19(19)24
TV Cas D19(22)26
U Cep D19(22)27
SW Cyg D19(24)19L
SW Cyg L21(24)29D
V640 Ori 21(24)22L
ST Per 23(27)24L
2004 Mar 21 Sun
SS Cet D19(16)20L
2004 Mar 22 Mon
Z Vul L00(<<)02
U Sge L01(04)05D
TV Cas D19(17)21
Z Dra D19(19)21
TW Dra D19(21)26
V640 Ori 22(24)22L
2004 Mar 23 Tue
ST Per D19(19)23
TX UMa D19(21)26
2004 Mar 24 Wed
Z Dra 01(04)05D
Z Vul 02(07)05D
SS Cet D19(15)20L
del Lib L23(21)28
2004 Mar 25 Thu
TW Dra D19(16)21
U Cep D19(22)26
X Tri 21(23)21L
RW Tau 23(28)23L
2004 Mar 26 Fri
S Equ L03(04)05D
TV Cas 04(08)05D
Z Dra D19(21)23
TX UMa D19(22)27
X Tri 20(22)21L
del Lib 23(29)29D
2004 Mar 27 Sat
X Tri D19(22)21L
TV Cas 24(28)29D
2004 Mar 28 Sun
Z Dra 03(05)05D
X Tri D19(21)21L
RW Tau D19(22)23L
ST Per 22(26)23L
Z Vul 24(29)29D
2004 Mar 29 Mon
U Sge L00(<<)04
X Tri D19(20)21L
TV Cas D19(23)27
TX UMa D19(24)28D
SW Cyg 21(27)28D
2004 Mar 30 Tue
X Tri D19(20)21L
U Cep D19(21)26
Z Dra 20(22)25
2004 Mar 31 Wed
TW Dra 02(07)04D
RW Tau D19(16)21
ST Per D19(18)22
TV Cas D19(19)23
X Tri D19(19)21L
del Lib L22(21)27

LIGHT CURVES

JOHN SAXTON



V377 Cas observers 1990 to 2002: M Clarke, D K Lloyd, D M Swain, G M Hurst, N Britton, T Markham, R K Hunt.

The deadline for contributions to the issue of VSSC 119 will be Februrary 7th. All articles should be sent to the editor (details are given on the back of this issue).

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Nova and Supernova discoveries

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