British Astronomical Association

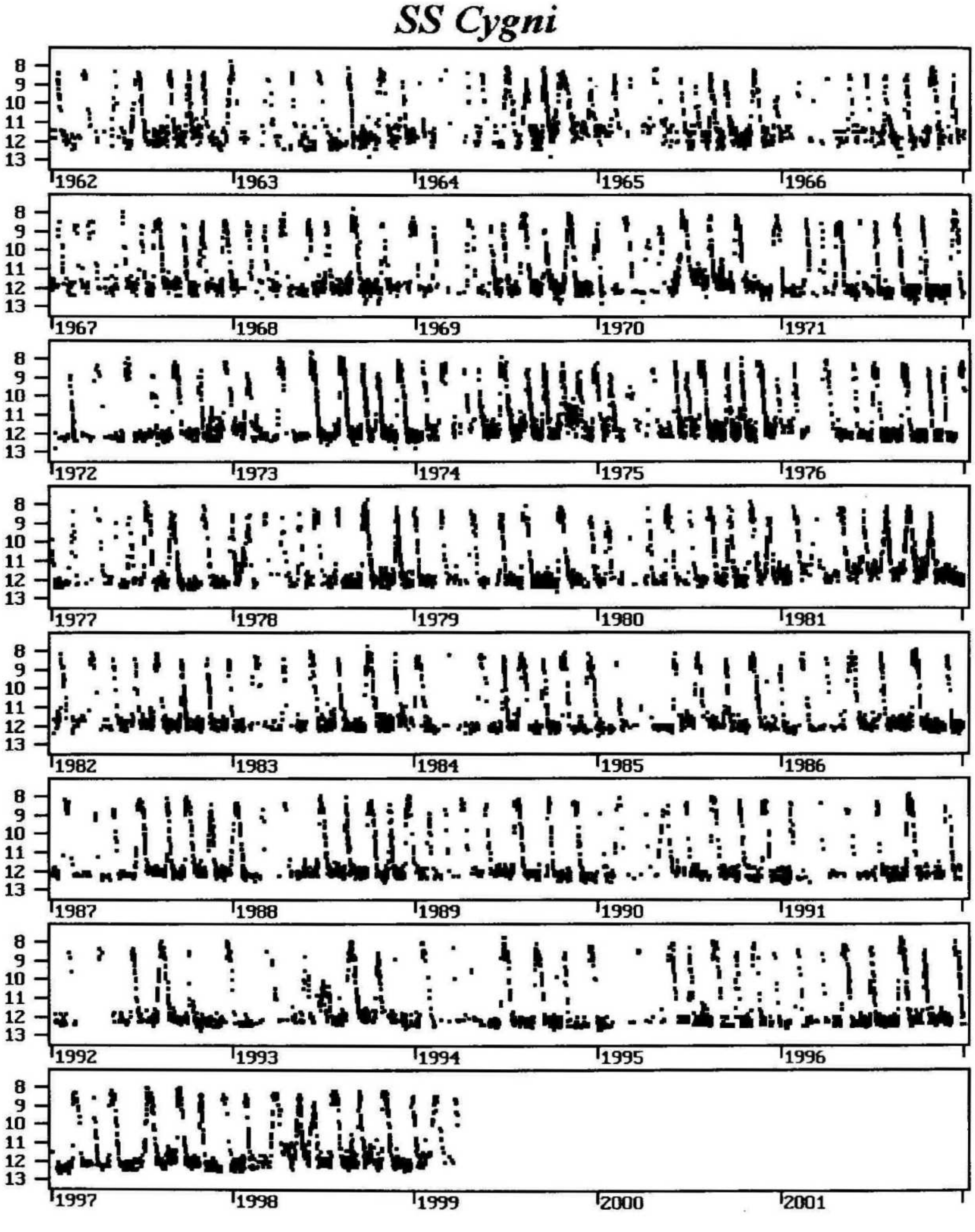
VARIABLE STAR SECTION CIRCULAR

No 100, June 1999

Contents

ISSN 0267-9272

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



LIGHT CURVES

DAVE MCADAM

Observer lists are given on page 37

A FEW WORDS FROM THE BAA PRESIDENT

MARTIN MOBBERLEY

The fact that we have reached this 100th edition of the VSS Circular is a tribute to many years of hard work and enthusiasm from successive Editors, Directors, co-ordinators and contributing observers.

The BAA is, quite possibly, the premier body of amateur observers in the world, and one only has to look at the VSS observing statistics to see the evidence.

Gary Poyner's incredible 12-15,000 annual variable star estimates must surely rank him as the world's leading observer of faint cataclysmics. In addition, a dozen other UK observers contribute over 1,000 estimates per year each, and there are over 50,000 total annual estimates from a hard core of 70 VSS observers.

The VSS contains more than just visual observers though; CCD and PEP observers are doing valuable, precision work, and the recent BAA purchase of four photometric filter wheels from Norman Walker will allow more observers to indulge in this technology.

If our observing activities were not impressive enough, the VSS archive of 1.3 million observations is a resource of which we can be truly proud, and is a tribute to the work of Dave McAdam and his helpers.

Pro-Am liaison officers, including Guy Hurst and Roger Pickard (the incoming VSS Director), have also guaranteed that VSS activities are targetted to maximise the usefullness of observations to professional astronomers.

With all the ability and enthusiasm in the VSS, it is not hard to see how the Section Circular has reached this bumper 100th edition! In the capable hands of the current Editor, Karen Holland, we can look forward to many more excellent editions dropping through our letterboxes.

FROM THE VSS DIRECTOR

GARY POYNER

After nearly five years as Director of the VSS, I have decided that now is the time to stand down and hand over to someone else, to take over the reins of the section. I am delighted to announce that Roger Pickard has accepted the invitation, and will become the new Director from September 1st. I will continue in the post until then.

Roger is well known to most VSS members, having being an active member of the section for many years. He is both an experienced visual and photoelectric observer, and is currently starting on the long and complex road of CCD photometry, so he is well qualified to lead the VSS forward into the next millennium. He will, I am sure, make an excellent Director!

I will continue to maintain the Recurrent Objects Programme, and the International OJ287 campaign for the BAAVSS/TA after Roger has taken over. I will also continue to receive any Variable Star alerts and queries, by telephone throughout the night.

I have enjoyed my role as Director immensely over the past few years, especially dealing with new observers and professional astronomers. I am sure Roger will derive as much satisfaction from the job as I have done.

I would like to take this opportunity to thank the other VSS officers who have helped me during my time as Director. If a section is run well it's usually the Director who receives all the praise, but without an experienced dedicated team behind him/her, the Director's job would be an impossible one. The VSS is without question the most important section within the BAA, and this is due to an excellent team of section officers, and of course dedicated observers.

THE CIRCULAR

This edition of the VSS Circular reaches a milestone with issue number 100, and I would like to pass on my congratulations to Karen Holland for maintaining the high standard of editorship which VSS members have been accustomed to over the years. I am sure that readers will agree that the Circular provides essential information and feedback to all observers, and is an important reference source to all members of the VSS. Long may it continue!

As part of the celebration for the issue of VSSC 100, a complimentary copy of VSSC 1 has been included with this issue. Many thanks to Bob Marriott for the excellent job he has done in reproducing these.

REMINISCENCES

JOHN ISLES - DIRECTOR VSS SECTION 1972-1977, AND 1987-1991

It is a pleasure to be writing something once more for the BAA Variable Star Section. It was a great privilege for me to be twice appointed Director of the Section. I'd like to thank Gary for his leadership during the past five years, and wish Roger every success in the post.

I've been astonished to see the numbers of observations Gary has been able to make from the UK. Although I was able to make upwards of 10,000 observations a year for a short period, whilst I was in Cyprus, my output has been much lower since I moved to Michigan in the USA. In part this is because of the exigencies of married life, and also, as I become interested in more and more things, I find I have less and less time for any of them, but by way of further excuse, I give below some relevant weather statistics from my own records.

My meteorological records began simply as regular checks every three hours, to see whether observations are possible, but they've taken on a life of their own. I strongly recommend the practice of keeping such records, which can be used to answer all sorts of interesting questions. For example, *'If it's cloudy at 6pm but clear at 9pm, how likely is it to remain clear until midnight?'* More likely than you'd guess, I think.

Monthly numbers of clear nights recorded in Cyprus and Michigan
(Skies clear for part of the night are counted as 0.5.)

	Cyprus 1987-92	Michigan 1998	Av. min. temp. on clear nights (dg. C)
Jan.	12.9	1.0	-10
Feb.	11.0	3.5	-8
Mar.	13.9	3.0	-3
Apr.	14.2	4.5	-5
May	19.8	8.0	+9
June	24.4	6.5	+9
July	28.4	7.5	+12
Aug.	29.1	8.5	+12
Sept.	27.8	11.0	+11
Oct.	20.9	6.0	+1
Nov.	13.2	4.5	-2
Dec.	6.8	8.0	-6
Total	222.4	72.0	

The figures in the table show how easy I had it in Cyprus. I don't have my temperature records for Cyprus to hand, but I recall that they were hardly ever below zero. Here in southern Michigan, on the other hand, clear nights are much fewer, so it is hard to obtain satisfactory continuity in one's own variable-star observations. Observers in the UK will no doubt say the same thing; but in Michigan the winter temperatures are an additional adverse factor, especially for one who is at last becoming conscious that he is no longer a teenager.

Observing variable stars has always been mainly something for me to do whilst I'm out enjoying the night sky. Increasingly, I'm becoming an astronomical sightseer, rather than a scientist. I'm not at all interested in doing my observing slumped in front of a computer screen. I do not by any means wish to denigrate CCD astronomy, which is bringing many new observers into the fold., but I'd like to make a few points that may encourage visual observers:

1. New variable stars: nowadays it's very hard for a visual observer to discover these, but electronic surveys are revealing new variable stars by the thousand, so the scope for useful work in following up these discoveries is continually increasing.

2. Visual observations can be made in appalling conditions: passing cloud, twilight, etc. Consequently, visual light curves of slowly-changing variables are often more continuous than photoelectric ones. Will CCD curves compete in this respect? I wonder.

3. Let's continue to observe well, those stars that have long been observed by amateurs: Mira, R CrB, SS Cyg (see page 1 for light curve since 1962), etc. For stars like these, it's the continuity of the observations over a long period that counts,and if we continue the work of past observers, visual observers ALWAYS WILL have the longest light curves.

VSS OBSERVATIONS AND THE HUBBLE KEY PROGRAMME

IAN HOWARTH - DIRECTOR VSS 1977-1980

The 100th edition of the VSSC prompted an exercise in self-indulgence; I went back to my old issues of the Journal to remind myself of just what I'd got up during the few years I'd enjoyed the privilege of directing the Section. It was a salutory experience to be confronted with just how long ago that was, and I don't suppose that the compact format and sober grey covers of the Journal in those days would be recognized by all that many of today's observers. On the other hand,it was pleasing to realise that the team of workers analysing the data back then, might still understandably succumb to the sin of pride, for the productivity they displayed in publishing VS material in the Journal. For a few years, people like Jeremy Bailey, Edward Collinson, John Isles, and George Munford made sure that almost every issue of the Journal included a paper on a VS topic. Looking just at the Section Reports that I prepared, we published analyses of more than 44,000 observations - and this at a time when *computations* were done on hand-calculators, home computers were largely unheard of, and the leading edge of technology was embodied by data storage on punched cards!

Of course, then, as now, there was a dedicated crew of *backroom boys* (they were indeed all male) making all this possible, by assiduously checking and logging the records. It's perhaps invidious to single out one such contributor, but, even so, I'd like to take this opportunity to record the particular debt of gratitude that we owe the late, lamented Doug Saw, not only for the considerable burden of administrative and data-processing chores that he shouldered, but also for the personal qualities that he displayed. He was everything the Section (or its Director) could ask for in a Secretary.

Nowadays, I follow the Section's progress merely as an interested outsider. While I find it slightly disappointing that, in recent years, the Section hasn't used the Journal to promote its work as actively as it might (which means that, even within the Association, people outside the Section aren't necessarily aware of just how active it is), it's nonetheless very clear that it is a thriving, and vigorous concern; the work, by Dave McAdam and others, that has gone into making both historical and current observations available in machine-readable form, is particularly laudable. But the heart of any BAA Section is its observers, and with variable stars we usually only ever get one chance to record the vagaries of a light-curve. A good illustration of this came up very recently, with a paper that brought together the results of back garden eye-estimates, and the continuing search for the precise value of the Hubble constant.

Back in April 1974, light from an exploding supernova in the Sc spiral galaxy NGC 4414, in Coma, reached Earth. At discovery, SN 1974G was around magnitude 13, bright enough to be seen in amateur telescopes. Although the supernova wasn't formally added to the Section programme, Walter Pennell - another highly talented, modest observer, whose untimely death deprived amateur astronomy of one of its most skilled proponents, constructed a photovisual comparison star sequence, that was used by a number of UK observers to follow the supernova through maximum, and well into the decline phase. At the time it was quite a thrill just to be able to see a star some 20 Mpc distant; of course, some of today's observers aren't content merely to see supernovae, but successfully set out to discover them! A light-curve and brief discussion were published in the Journal (**85**, 352, 1975).

There things lay until, two decades later, the Hubble Space Telescope turned to NGC 4414 to obtain observations for the *Key Programme* on the distance scale of the Universe. Most readers will be familiar with the concept of the *ladder* of distance determinations in the Universe: loosely speaking, direct trigonometric methods such as parallax can be used to determine the distances, and hence intrinsic luminosities, of only relatively nearby stars. Knowing those luminosities, the distances of similar stars at greater range can be estimated, and used to calibrate the luminosities of rarer, brighter objects at the same distance. This process is gradually extended to larger and larger scales, ultimately to establish the relationship between redshift and distance for the most remote galaxies - and hence to estimate the handful of numbers which succinctly describe the entire evolution, and future fate, of the universe (like the Hubble constant, and the deceleration parameter).

The most luminous *standard candles* available - and hence those observable to greatest distances - are supernovae, and specifically Type Ia supernovae. (The enigmatic gamma-ray bursters may briefly be more luminous than any supernova, but they don't qualify as standard candles). An important aspect of the Hubble Key Programme is the determination of the distances of (relatively!) nearby galaxies, in which such supernovae have been observed, in order to determine accurately the intrinsic brightness of those supernovae. This is done through the observation of Cepheid variables, which provide reliable distances through the well-calibrated relationship between their pulsation periods and absolute magnitudes. Knowing the distance to the host galaxy (from its Cepheids), the intrinsic luminosity of any supernova in that galaxy, past or present, can be estimated. Knowing the intrinsic luminosity of the supernova, the distances to similar, but more distant, supernovae can be estimated from their light-curves.

The rub comes because there aren't many galaxies well suited to calibrating the supernova luminosities. In the nearby universe - the Local Group of galaxies - there just aren't many well-observed Type Ia supernovae in the records. There are plenty of supernovae observed in very remote galaxies, but they're too distant to reveal their Cepheids. It turns out that there are only a dozen or so galaxies which contain well-observed Type Ia supernovae, and which are also close enough to allow their Cepheids to be measured; NGC 4414 is one of those galaxies, and SN 1974G is one of those supernovae. So those old observations suddenly take on a new significance, and indeed Brad Schaefer has recently undertaken a careful re-analysis of those observations, using a new CCD-based calibration of the comparison-star sequence. He published the results in the Astrophysical Journal at the end of last year (ApJ 509, 80, 1998), finding the peak V magnitude to have been 12.30±0.05, and a corresponding Hubble constant of 55±8 $kms^{-1}Mpc^{-1}$. (Our old value for V_{max} was 12.2, so Walter Pennell's original sequence was not at all bad!) The paper contains a particularly noteworthy comment: *'It must be realized that without reliable light-curves, the large amount of time used by the Hubble Space Telescope has only poor utility for calibrating the supernovae'.*

When the supernova observations were made by Section members, the SpaceTelescope was a pipe-dream, the value of the Hubble constant was uncertain by at least a factor of two, and the use of the observations to investigate the structure of the universe was undreamt of. The moral is clear: ***theories come and theories go, but good observations, and particularly good observations of time-dependent phenomena, stand the test of time***. On the occasion of VSSC 100, I wish all Section members clear skies in their endeavours to secure those observations,and the current Director (and his designated heir) every success in co-ordinating the programme.

SOME IDLE THOUGHTS ON THE VSS CIRCULARS

STORM DUNLOP

The Variable Star Section's *Circulars* were originally introduced when the experienced Belgian observer, Felix de Roy, became Director of the Section in 1922. (From its very inception, shortly after the BAA itself was formed in 1890, the Section has always had substantial contributions from observers overseas.) Felix de Roy issued 11 *Circulars* in all, the last being dated 1935 April 6, but there appears to be no record of why they were then discontinued, although de Roy remained Director until 1939.

These early *Circulars* have now become collector's items, as has the one *Binocular Group Circular* and the accompanying *blueprint-like* chart that were issued by Patrick Moore in the early 1970s. For some years, there had been problems with the administration of the Section, and it had been largely held together by the Secretary, Gordon Patston. (I well remember how frustrating it was when I first wanted to contribute observations: information, advice and charts were extremely hard - nay, impossible - to obtain.) The Section's difficulties had contributed to the formation of the Binocular Sky Society, and partly as a response to this, Council sanctioned the formation of a separate Binocular Group. Luckily things eventually took a turn for the better when John Isles was appointed Director in 1972. He reintroduced the *Circulars*, after a 37-year hiatus, in typical dead pan fashion: '*We deeply regret the delay since the last Circular.*'

Eventually, of course, the Binocular Sky Society (BSS) and the later North West Association of Variable Star Observers (NWAVSO) amalgamated with the Section, which took over responsibility for the analysis, publication and retention of their observations. The BSS had issued its own *Circulars*, so the combined publication preserved the same name. For some years, however, the title of NWAVSO's original publication, *Light-Curve*, was included as part of the *Circular's* masthead.

I have already described (*VSS Circular*, **74**, December 1992) how the Circulars evolved from quarto, duplicated sheets to a professionally printed publication, so there seems little point in repeating the story here. It is, however, salutary to recall that the Section's publication has sometimes, unbeknown to the membership at large, been produced under considerable difficulty, and has also been the subject of considerable debate, and even vitriolic argument. After publication was resumed in 1972, one major difficulty became the use of a duplicator.

The Association's finances were unable to meet the cost of a machine for every Section, so Council tried to encourage those Sections that already had machines to collaborate with those that did not. This met with little success, with one Section violently repudiating the suggestion that VSS *Circulars* should be produced on *their* machine. For some time, production was on a rather hand-to-mouth basis, with the editor leading a peripatetic existence wandering from duplicator to duplicator, laden with reams of duplicating paper. The occasion when a (non-VSS) Section Officer refused to allow a BAA duplicator to be borrowed over a weekend, which, combined with a car breakdown, led to a harrowing journey on four different buses on a sweltering hot day, remains an indelible memory.

Finances, too, were frequently an issue. It may come as some surprise to learn that for a number of years, questions of costs, and of which individuals or institutions should receive complimentary copies, were raised with monotonous regularity at Council. There was considerable pressure - largely from members associated with the less scientifically orientated Sections - for publications to be entirely self-financing. The VSS *Circulars* were singled out for particular criticism, because a large proportion of the circulation consisted of complimentary copies. Luckily, although sometimes after protracted debate, Council always came to the conclusion that because of the exceptional scientific value of the Section's observational work, it was important for the *Circulars* to be made widely available, free, to important individual researchers and organisations, both in the United Kingdom and abroad. This was, of course, merely extending the principle that the Association should bear the costs of disseminating the BAA's observational work to the wider scientific community.

There is one final point that I will venture to make. The *Circulars* should never be regarded as ephemeral. Over the years, a vast amount of extremely useful and interesting information has been published in them. It is becoming rather difficult to locate some of this material, particularly when it relates to individual stars. All the Circulars to No.70 (including the BSS Circulars) have been fully indexed, with those from 12-70 being included in an excellent cumulative index, produced after a great deal of hard work by Peter Wheeler. Dare I suggest that a further index is overdue?

THE HISTORY OF PALC

ROGER PICKARD

The seeds of Pro-Am and of the Professional Amateur Liaison Committee - Variable Stars, started at Crayford way back in the early 1980s, following lectures on photoelectric photometry (PEP) by John Mason and Adrian Lyons.

These lectures precipitated a growing interest in PEP, which was further kindled by the formation (in the U.S.) of the International Amateur Professional Photoelectric Photometry organisation (IAPPP). The Third European Symposium of the IAPPP, organised by Norman Walker and held at the RGO, Herstmonceux, and jointly sponsored by the BAA, stimulated this interest still further and resulted in several follow-up meetings being held at Crayford.

The joint RAS/BAA meeting in March 1987 on Professional-Amateur collaboration was a disappointment, as it touched only briefly on variable stars. However, discussions with Dr. David Stickland of the Rutherford Appleton Laboratory at a BAA VSS meeting in Swansea later that same year, gave a necessary impetus to the project. In close collaboration with Dr. Stickland and with John Isles, the BAA VSS Director at that time, the foundations were laid for a Pro-Am meeting devoted exclusively to variable stars to be held at University College, London in May 1988. This meeting, organised by Crayford, attracted over 40 astronomers, a third of whom were professionals from 9 institutions.

At the meeting, Dick Chambers (Crayford) proposed the formation of a liaison committee, which would operate within existing organisations, to establish better communication between professionals and amateurs, to maximise the scientific value of the work of amateurs in the study of variable stars. After discussion, it was agreed that the Professional Amateur Liaison Committee - Variable Stars (PALC-VS) and usually known as just PALC, be formed and the following agreed to serve (see also VSSC No. 68 for January 1989):-

Professional	Dr. Constanze la Dous (Cambridge) Dr. Robert Smith (Sussex) Dr. David Stickland (RAL)
Amateur	Mr. Guy Hurst (The Astronomer) Dr. Richard Miles (BAA) Mr. Roger Pickard (Crayford)

The Director of the BAA VSS would be an ex officio member, and Roger Pickard would act as Secretary.

Since the formation of PALC, Constanze la Dous has moved (eventually to Sonneberg, Germany), and Dave Stickland requested to stand down to make way for some "fresher blood". They have been replaced by Dr (now Professor) Ian Howarth of UCL, and Dr Tim Naylor from Keele. In addition, work commitments forced Richard Miles to relinquish his place, and he was replaced by Storm Dunlop. More recently, Dave McAdam, the BAA VSS Computing Section Secretary has joined the Committee.

The Committee has now sat 19 times during this period, the last occasion being on April 7th this year.

SOME EXAMPLES OF CO-OPERATION

Although some of the early co-operation between professionals and amateurs was directly stimulated by the committee, this has more generally been the province of Guy Hurst and the TA team (see the separate article by Guy on page 10). In addition, with the advent of the Internet and the WWW, almost any amateur now has access to the same type of data as the professional.

Some early examples of co-operation included:-
Immediately following the Pro-Am meeting, Ian Griffin (UCL) asked for 4 carbon stars to be added to the VS programme to complement his own (professional) observations (full details can be found in VSSC No. 68 for January 1989).

Dave Stickland assisted John Howarth by obtaining an exhaustive reference list on the star W Cyg which enabled him (JH) to conduct a full search of the literature of earlier years, when analysing the data on this star.

One of the greatest assets to come out of Pro-Am initially, was for Guy Hurst to have been given authority to use the STARLINK electronic mail network. This allowed the rapid dissemination of information between professionals and amateurs. Again, with the advent of the Internet, many amateurs are now able to co-operate more directly and rapidly with professionals. More recently, the Committee was active in obtaining permission to archive the Section's database on Starlink. The Committee was also very active in obtaining funding from the RAS for help in maintaining and extending the Section's impressive database in machine-readable form and in helping towards the cost of a new PC.

Nowadays, the Committee still offers advice on the best way that a particular problem may be tackled. This can vary from the types of star the professional is interested in observing, and hence what the amateur could observe, if he or she wished to partake in any collaborative programme, to advice on archiving the Section's database. A copy of the Agenda from the 18th Meeting is given below, as witness to the variable (no pun intended!) subject matter discussed:-

1	*Matters arising*
2	*Computer archive update*
3	*CCD Photometry*
4	*Software for CCDs*
5	*Linux software*
6	*The WWW*
7	*Pro-Am exchanges*
8	*VSS-AAVSO Sequences*
9	*VSS Binocular Sequences*
10	*Astronomical computing and PPARC*
11	*AOB*
12	*Date of next meeting*

SUMMARY

The most important role PALC has played since its formation, is to allow professionals and amateurs to meet on a regular basis to discuss what is needed, the best way to achieve it, and to disseminate that information to others. In addition, the professionals have given the amateurs much needed credibility when applying for help (monetary or otherwise) from other professional institutions.

PROFESSIONAL-AMATEUR CO-OPERATION ON OBSERVING PROJECTS

GUY HURST

I became editor of 'The Astronomer' in 1975, and quickly decided to forge strong links between 'TA' observers and those in the BAA. But in addition, I saw strong possibilities for closer ties between all these observers, and the professional astronomical community. Although this co-operation exists in many areas of astronomy, it is in the field of variable stars that it excels the most.

Variable stars are, of course, a very popular area of study for amateur astronomers, probably because they can be studied with the whole range of equipment, from small binoculars, through to the large telescopes and CCD cameras that are now in the hands of many amateurs.

Professional astronomers are very interested in a wide range of variable stars, but especially eruptives. The difficulty is that they do not readily have access to telescope time, unlike the amateur, who does not need to book his time with his equipment out in the back garden! So amateurs can make long term studies of variable stars, which, when added to short term intensive studies by professionals, can produce very meaningful data on a variable star.

The other area of fruitful exchange relates to the real-time monitoring of stars. A professional may have booked time to study some variables using a satellite. The measurements are often taken at various wavelengths; they then seek help from amateurs to simultaneously monitor in the visual, or to alert professionals to recent patterns in the star's behaviour, before the main run starts. Some observing runs demand that an outburst is due, and others, curiously, prefer the star to be in quiescence during the study. Either way, amateurs can usually pool all their recent results, and provide a guide to future behaviour for the period when the professionals are planning the study.

Aside from these areas of co-operation, I have been greatly encouraged during my many years as TA editor, and in my role as UK Nova/Supernova secretary, by the remarkable spirit that exists between amateurs and professionals. It is extremely rare that I have contacted a professional for advice and help, and have not had a speedy and helpful reply. Despite their time constraints, most appear willing to stop and give help and encouragement to both myself and the observers in TA and BAA. I am not sure this spirit is as strong in all hobbies or sciences. Amateurs do, of course, get quite a *kick* out of knowing that their observations may be used by professionals. It is probable, that in reality, single observations may often not be used. But the amateurs have the great advantage of pooling their results.

In my specialist area of nova study, it is quite remarkable how some objects have almost continuous coverage every night for long periods. This has been particularly enhanced in recent years by pooling results from international observers, which effectively beats the problems of badweather! Increasingly, the BAA database, so ably computerised by Dave McAdam and his helpers, has been a key factor in satisfying the demands for data from professionals. This has also led to regular references in papers and in professional journals quoting the BAAVSS as the source. In some cases, where a major contribution has been made by an amateur, the latter has sometimes been quoted as a co-author.

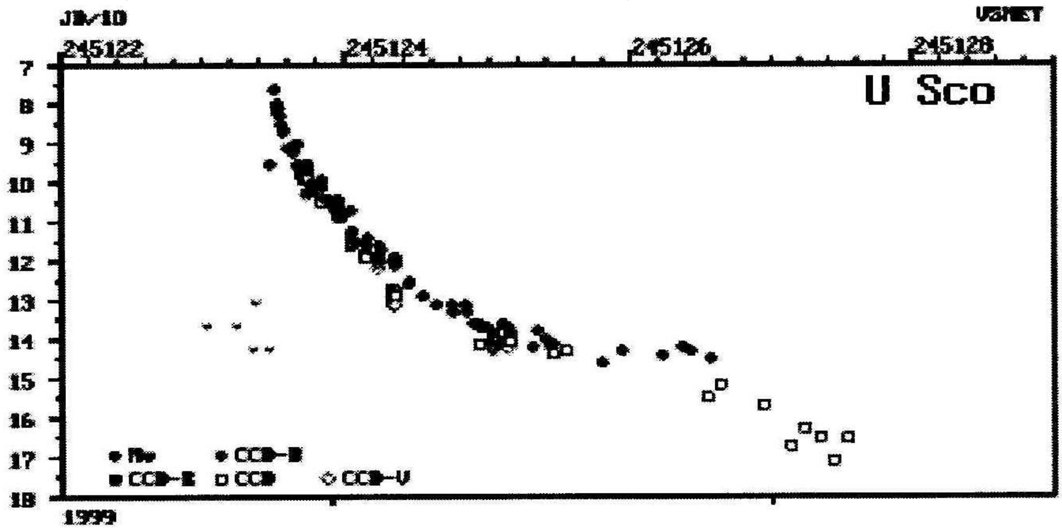
The future looks strong for continued professional-amateur co-operation. I have logged just over 1,000 exchanges since 1988, when the first Pro-Am meeting took place, and there are no signs of a fall-off in activity (see page 33 for the latest report). However, I believe the time has come for amateurs to consider more sophisticated approaches to studying variable stars. CCDs, in amateur hands, have recently reached magnitude 20 and beyond. Filter sets have been purchased by BAA funding, and a whole new world of study in variable stars beckons. The professional moves on to more and more complex studies, and we, as amateurs, cannot afford to stand still. This makes the future for both amateurs and professionals an exciting prospect in the field we love the most, that of variable stars.

RECURRENT OBJECTS PROGRAMME NEWS-U SCO

GARY POYNER

A rare outburst of the Recurrent Nova U Sco was detected by the German amateur Patrick Schmeer on February 25th, and confirmed in the USA by Lance Shaw. This is the first outburst detected since 1987, and only the 6th on record (others are 1863, 1906, 1936 and 1979). U Sco was found to be an eclipsing system after the 1987 outburst, by Shaefer and Bradley in 1990. Eclipses were observed during the current outburst by K Matsumoto and T Kato on March 16th/17th with a 25cm SCT + unfiltered ST-7 CCD. They report in VSNET-ALERT 2785 that the depth of the eclipse was of 0.6 magnitude in total, with broad ingress and egress profiles.

The light curve for U Sco shown here is derived solely from VSNET reports.



BAAVSS WWW UPDATE NUMBER 6

DAVE MCADAM

BAAVSS home pages can be found at http://www.telf-ast.demon.co.uk/
The following items have been added since 14/03/99
Observing Campaign for QR And - Petr Sobotka and Dr Vojtech Simon
NSV 13262: Detected in CCD Nova Patrol - G M Hurst
R Leo: Spectrum near minimum light - M Gavin
Variable Star Spectra Compared - M Gavin
SS Aurigae: Recent Activity (1998-1999) - J Toone
Four Spectra obtained at WPO - M Gavin
New Current lightcurves: RX And, TAV J0218+507 And, SS Aur, TAV0556+55 Aur, Z Cam, CG Cam, V727 Cas V386 Cep, SY Cnc, W Com, WX CrA, R CrB, TT Crt, SS Cyg, J0712+296 Gem, AH Her V1159 Ori, GK Per, U Sco, BZ UMa, CH UMa
Long-term lightcurves updated, **27 Other detailed lightcurves**, **65 Observing charts**, BX Mon (076.01) - X Oph (099.01) - W Ori (105.01) CK Ori (221.01) - AG Peg (094.01) - GO Peg (103.01) - AX Per (073.01) plus latest lists, observing totals, and other details
Email stating subscribe/unsubscribe BAAVSS update notices to:dave@telfast.demon.co.uk

SPOTTY STARS - AN EXPLANATION

RICHARD MILES

Kevin West published an interesting account in VSSC #99 (p.8), summarising some of his recent photoelectric photometry results of the RS CVn variable, Lambda Andromedae. His results, which spanned the period 1998 November-December, show that this bright star varied in brightness by about 0.22 magnitude, and appeared to exhibit a period of close to 50 days. However, Kevin had noticed that Douglas Hall, in an old article, had quoted the orbital period to be 20.52 days. He therefore posed the question, *'Can anybody explain this apparent anomaly, and provide me with some up-to-date information?'*

On reading the short article, I remembered that some of the very first PMT-based photometry I carried out included Lambda And, way back in August 1982! My observations and those obtained at 15 other observatories in the USA and in Europe were written up and published in an article entitled, ***Photometric changes and spot motion in Lambda Andromedae***, by F. Scaltriti et al, Astron. Astrophysics. 139, 25-29 (1984). At that time it had been noted that there was indeed a remarkable difference between the photometric (rotational) period of 53.952 days, and the spectroscopic (orbital) period of 20.52 days, just as Kevin also noted from his own observational data.

The basic reason for the difference in these periods is that although the object is binary in nature, it is not an eclipsing binary as seen from the Earth. The photometric variation arises because the main G8III-IV star possesses starspots (as noted by Kevin in his article), which transit across the stellar disk with a period close to the rotational period of the star. Also, although the secondary star is relatively close, and the primary is *spun up* to a degree, the interaction has not caused the orbital and rotational periods to become equalised. The observed variability slowly evolves, varying in amplitude between about 0.12 magnitude and about 0.25 magnitude. The mean magnitude also varies by more than 0.07 magnitude over periods of years. These changes arise because of long-term variations in the proportion and location of starspots present. Indeed, by participating in the observing campaign for this star, the spotted photosphere can be better mapped and spot motion monitored.

Observers interested in monitoring Lambda Andromedae should note that the preferred comparison star is Psi Andromedae (V=4.95), which is located 1.5° due East of the variable and is similar in color index [(B-V)Lambda =+0.98, (B-V)Psi = +1.08]. Note that the system could usefully be monitored using a CCD camera equipped with a V filter and a short-focus lens providing a coverage of about 2° or more. A 135 mm focal length lens working at about f/8 should be about right for this project. Do not use too short a focal length as the comparison star has two fairly close comparisons some 3-4 arcmin distant: the CCD image must adequately resolve these. Exposure times should also be fairly short, so as to keep the maximum pixel intensity of the variable less than about 50% of saturation. Aim to derive a single magnitude determination per night, by averaging at least 4 successive frames together with dark frames and flat frames taken on the same night whenever possible. Only use flat-fields taken on a different night if the configuration of the CCD camera, lens and V filter has remained unaltered throughout the intervening time.

REPORT ON THE WARNER (60TH BIRTHDAY) SYMPOSIUM ON CATACLYSMIC VARIABLES,12-16 APRIL 1999, OXFORD, U.K.

BILL WORRAKER

Brian Warner left Oxford for the USA about 33 years ago as a young Coudé spectroscopist, with a background in measuring element abundances on the Sun. He little suspected at the time that he would become a leading figure in developing the current theoretical picture of cataclysmic variables, viz. interacting binary systems, in which mass transfer is taking place, in many cases via an accretion disc, onto a white dwarf primary star. The development of high-speed photometry in the 1960s and 70s, notably by pulse counting, was instrumental in providing the observational support for this theoretical advance. In the early 1970s, Brian was also at the forefront in the discovery of superhumps during superoutbursts of SU UMa-type dwarf novae. His book on Cataclysmic Variable Stars (CUP, 1995) is the most comprehensive and authoritative review of the subject currently available.

There were about 100 participants (corresponding to the capacity of the lecture theatre) at the symposium, which was held in honour of Brian's 60th birthday, not primarily to review past developments, but rather to address the current state of knowledge in the field of Cataclysmic Variables (CVs), with emphasis on active research areas and major outstanding problems. Each day there were several invited half-hour talks, plus numerous short talks, with poster sessions in the morning and afternoon breaks. I was allowed to give a short talk on amateur contributions to CV research.

The main topic areas covered in the symposium were (after a general introductory session): ***Accretion Discs; Outburst Mechanisms; Superhumps; Magnetic Systems; Novae; Cataclysmic Variable Evolution; White Dwarf Binaries; SW Sex Systems; Supersoft X-ray Sources; Low States in CataclysmicVariables; Properties of Cataclysmic Variables; What we still don't know about Cataclysmic Variables***. Below I summarise highlights from the talks, not comprehensively, but mainly according to what I could appreciate and understand best, and what seems likely to be of most interest to readers of the VSS Circular. Thus, there is no attempt to cover detailed discussions of magnetic systems, or of CV evolution, nor of some of the more esoteric theoretical discussions in other areas.

INTRODUCTION

In the introductory session, Brian Warner (Cape Town) outlined some of the current areas of ignorance in the study of CVs. First, he suggested that it would be useful to know more about related non-CVs, e.g. the magnetic properties of isolated white dwarfs; some do not have centred dipole fields, and the field of REJ 0317-853 is quadrupole. Some late main sequence stars are rapidly rotating, while some N-type stars have very strong (many kilogauss) magnetic fields and magnetic moments comparable to the primaries of polars. Brian also mentioned pre-CV stars (e.g. HW Vir), which are simpler than CVs because there is no exchange of mass or angular momentum; these are characterised by magnetic cycling in the secondary, and a high rate of change of the orbital period. Better knowledge of such systems, he suggested, would help in understanding CVs.

With respect to CVs themselves, Brian mentioned the diagram in which magnetic moment is plotted against accretion rate; polars appear at the top and full disc-bearing systems at the bottom, the intermediate region being populated by polaroids (e.g. U Gem, which is suspected of being in synchronous rotation, implying that the spin of the primary is locked to the orbital motion). A major problem, is understanding the cause of the angular momentum loss from binary systems -gravitational radiation is an inadequate explanation. Another major problem concerns the observed 2-3 hour gap in the orbital period distribution of CVs; it is uncertain whether this can be explained by a change in magnetic torque when the secondary star (usually a cool main-sequence star) becomes convective. The nova-like VY Scl stars (e.g. MV Lyr), which typically have orbital periods of 3-4 hours, are generally bright (a *high* state), but can suddenly fade (into a *low* state); the problem here, is why they remain in a low state for significant periods of time.

With respect to the physics of accretion discs, Brian noted that the classical theory of boundary layers (where the disc material reaches the primary star) fails, because the temperatures it predicts are too low; realistic disc models are probably beyond reach at present. Outburst mechanisms are not fully understood either; some intermediate polars (e.g. V1223 Sgr) show very short outbursts which are not due to the standard dwarf nova disc instability. Tilted accretion discs have been invoked to explain phenomena such as negative superhumps (superhumps with a period *shorter* than the orbital period); do these also occur in low-mass X-ray binaries? Another recently-observed phenomenon is that of non-radial oscillations in white dwarf primaries (e.g. in the dwarf nova GW Lib), akin to those observed in ZZ Cet stars. This requires further investigation. Finally Brian noted that the meeting held in Cambridge in 1975 had been seminal for CV research, notably in the area of common envelope evolution, which refers to the evolution of a CV system following a nova eruption. The material ejected in the nova eruption forms an extended envelope, which exerts frictional drag on the secondary star. The envelope material is thus ejected from the system, in an outflow concentrated near the orbital plane, which removes angular momentum as well as mass from the system. This phase in the life cycle of CV systems is an area of current research interest.

Keith Horne (St. Andrews) spoke on the subject of ***More Surprises from CVs***. He first noted the significance of CVs in the more general astrophysical context, namely that studies of CV accretion discs provide useful insights into other systems (e.g. star formation, active galactic nuclei), and that the problem of angular momentum transport in CVs is generic rather than specific to CVs. He noted that with respect to dwarf nova outbursts, the disc instability (DI) model makes specific predictions for the radial distributions of temperature and surface density. These can be tested by eclipse mapping (e.g. as in Z Cha). However, the observed distributions are too hot and too thin compared with the predictions of the DI model. He suggested that chromospheric emission might play a role in producing the observed distributions. He also noted that IP Peg, in decline from outburst, differs markedly from the predictions of the DI model; there is no sign of the predicted cooling fronts.

Keith noted that for nova-like systems (with high mass accretion rates), one would expect gaussian (bell-shaped) eclipse light curves, but in fact SW Sex systems show more V-shaped eclipses (e.g. UX UMa, RW Tri), implying flatter temperature profiles than expected. These systems (e.g. BT Mon) also show anomalous, single-peaked trailed spectra, known as the *SW Sex syndrome.*

As for dwarf novae in quiescence, multi-wavelength eclipse observations of OY Car have allowed extraction of the white dwarf spectrum, but it looks unlike any *standard* white dwarf!

The best fit to the observed spectrum is provided by assuming simple absorption by gas in the outer disc.

IP Peg has provided other surprises too. Emission line spectroscopy (presumably in quiescence) shows double-peaked lines, which imply supersonic velocities in the disc. In outburst, observations suggest that two spiral shock waves develop in the disc. These are predicted by dynamical analysis of particle motions, and the implied presence of gas out of the orbital plane may affect the interpretation of observations in the outburst state.

One of the most remarkable phenomena noted by Keith, is the *magnetic propeller* effect exhibited, for example, by AE Aqr. Here the white dwarf spin period is 33 seconds, while the orbital period is 9.88 hours. Many freak phenomena are observed in this system, notably the 33 second oscillations, which have now been under observation for 15 years, and the very large flares which are seen from time to time. The spin is slowing down, and it is believed that this is associated with an exit stream of material being flung outwards from the system along magnetic field lines anchored in the white dwarf; there is no accretion disc in AE Aqr. Keith speculated whether such a mechanism could work for SW Sex stars, with the magnetic field rooted in the accretion disc - in my view, this cannot work because angular momentum exchange with accreting material will quickly eject the field-retaining material from the system.

ACCRETION DISCS

These are a general feature of CVs, apart from the strongly magnetic systems such as polars. Thus, even intermediate polars such as V1500 Cyg and YY Dra have accretion discs, but they are truncated at the inner edge by the magnetic field of the white dwarf primary.

The first talk under this heading was by Koji Mukai (Goddard Space Flight Center), on ***X-ray Observations of Non-Magnetic CVs in the ASCA Era and Beyond***. He noted that ASCA had a much wider spectral range (0.4-10 keV in energy terms) than Einstein or ROSAT, and that the SIS (solid state imaging spectrometer) instrument had a 2% spectral resolution. He then noted that soft X-ray/EUV is often seen in dwarf novae, SS Cyg and U Gem being the best-studied examples. He suggested that all bright disc (BD) CVs (dwarf novae in outburst, nova-like systems) probably have optically thick discs at temperatures of order 10,000K, while quiescent disc (QD) systems have optically thin discs, but a compact hard X-ray source; thus for example, OY Car does not show soft X-ray eclipses during super-outbursts, but shows sharp X-ray eclipses (as does HT Cas) in quiescence. It is not clear how an optically thick boundary layer produces hard X-rays, as for example in the bright disc system V603Aql.

John Hameury then spoke on ***Disc and Secondary Irradiation in Dwarf Novae***. He noted that the Shakura-Sunyaev disc viscosity parameter, α, cannot be constant in transient systems; really it is just a parameterisation of our ignorance of angular momentum transport in accretion discs! However, the standard model in which α, and the inner and outer disc radii are allowed to vary over the outburst cycle, reproduces dwarf nova outbursts reasonably well. On the other hand, it does not predict UV/X-ray delays in soft X-ray transients, nor the superoutbursts in SU UMa systems or in U Gem. The tidal instability theory, introduced by Osaki, can predict superhumps and the outburst pattern typical of SU UMa stars, but not the U Gem superoutburst of 1985, or the short supercycle of DI UMa. The speaker suggested that disc illumination and irradiation of the secondary star might play important roles, the former in explaining re-brightenings after superoutbursts,and the latter increased accretion rates, and that these effects, together with inner and outer disc radius variations, should be included in future modelling of dwarf novae.

In a subsequent talk, Erik Kuulkers (Oxford) addressed the subject ***WZ Sge Stars, TOADs and SXTs: Close Encounters of the Same Kind***. He considered these phenomena (SXTs are Soft X-ray Transients) in terms of five basic characteristics: (1) large amplitude outbursts; (2) long outburst intervals; (3) almost all outbursts are superoutbursts; (4) the re-brightening or re-flare phenomenon; (5) an orbital superhump and/or a long growth time for superhumps. He noted that for superhumpers, the superhump period excess (expressed as a fraction of the orbital period) correlates closely with the secondary/primary mass ratio q. For relevant systems such as EG Cnc and WZ Sge, q is less than 0.1. A survey of various systems including these stars and the X-ray transient GRO J0422+32 (V518 Per), led him to the conclusion expressed in the title of the talk.

OUTBURST MECHANISMS

Chris Tout addressed the subject of ***Accretion Disc Viscosity***, noting that in terms of the Shakura-Sunyaev α formulation for disc viscosity, α must be very low, of order $^1/_{1000}$, for WZ Sge stars. As to how disc viscosity (radial transport of angular momentum) actually works, simple turbulence in the disc leads to inward transport of angular momentum, i.e. the wrong way. Magnetic effects have been investigated as the possible cause of disc viscosity, but it is not clear that these are adequate either. One point with regard to modelling outburst cycles, is that the effect of hot-spot heating has not been investigated - why not? Chris speculated that outbursts might disappear altogether at very low accretion rates.

Steve Howell (Arizona) gave a talk entitled ***TOADs have WARTs***, explaining that WARTs are Weird Anomalous Red Things, or very low mass, low temperature secondary stars. He discussed the possible evolution of CVs in terms of orbital period, and then gave details of a K-band spectrum of the polar system ST LMi (which is below the period gap). The spectrum contained absorption bands due to water, implying a low surface temperature; he speculated whether there might be a dark region on the secondary star due to a star-spot group. He mentioned that Hubble Space Telescope optical and infra-red data on WZ Sge indicated a surface temperature of below 1700 K on the secondary star.

SUPERHUMPS

Darragh O'Donoghue (Oxford) reviewed superhumping systems in a talk entitled ***Superhumps - the State of Play***. He noted that superhumps occur not only in superoutbursts of SU UMa stars, but also in short-supercycle systems like ER UMa, RZ LMi, DI UMa etc, and in V1159 Ori, which has a very short supercycle and where superhumps can continue from a superoutburst to the next outburst and beyond. Negative superhumps (where the superhump period is shorter than the orbital period) occur, for example, in V503 Cyg. *Pre-superhump modulations* at the orbital period (and at its first harmonic) occur in such systems as WZ Sge, AL Com, HV Vir and EG Cnc. T Leo also shows superhumps at the orbital period in normal outbursts. Dips are seen in WZ Sge and AL Com, but not in HV Vir. *Late* superhumps have been observed in VW Hyi, EG Cnc etc (i.e. continuing through their brightening events). He also noted that superhumps are found in systems other than SU UMa -type stars, e.g. the nova-like star BK Lyn, which shows negative superhumps, plus harmonics and modulations at the beat frequency. Other systems exhibit permanent positive superhumps; such *permanent superhumpers* all lie to the top right in a diagram of fractional period excess against orbital period. To summarise, it is clear that CVs with accretion discs exhibit a complex variety of superhump phenomena, but that these are incompletely understood at present.

MAGNETIC SYSTEMS

In the CVs with the strongest magnetic fields, the polars (e.g. AM Her), the magnetic field of the primary prevents the formation of an accretion disc, while in the intermediate polars (IPs, e.g. YY Dra, GK Per, V1500 Cyg), where the field is weaker, there is an accretion disc which is truncated at its inner edge.

David Buckley, in speaking on ***The Power in Intermediate Polars***, noted that these systems show periodicities in the optical and X-ray regions, generally at the orbital period, and at the spin period of the primary; thus YY Dra has an orbital period of 3.91 hours and a spin period of either 529 seconds or 550 seconds. In most IPs the spin period dominates the power spectrum. In some cases (e.g. TX Col) the power spectra change with time. In some systems the optical polarisation is modulated at the spin period of the primary. David noted that only two deeply eclipsing IPs were known (XY Ari, DQ Her); more would be very welcome!

NOVAE

The first talk specifically on novae was by Sumner Starrfield, who spoke about ***The Nova Outburst: Thermonuclear Runaways on Degenerate Dwarfs***. In the course of this talk he showed the latest light curve of Nova Cas 1993 (V705 Cas) taken from the BAAVSS web pages. Whilst the basic theory of nova outbursts is fairly well-established, fitting the observed spectra of novae is becoming an extremely complex exercise, requiring the inclusion of literally millions of atomic transitions.

Mike Shara (Space Telescope Science Institute) then spoke on ***The Recovery and Characterisation of Old Magellanic Novae***. In fact he covered work on globular clusters, both Magellanic Clouds, and the galaxy M81, using archive plates and modern searches. Photographs of the globular cluster M80 (where the nova T Sco erupted) showed how incredibly difficult it is to locate the remnants of novae in such crowded fields. However the remnant of T Sco has now been identified by very careful astrometry, and the tally from 17 searches covering 47 Tuc and M80 is now 15-17 CVs, including two dwarf novae. As for the Large and Small Magellanic Clouds, there were 7 certain recoveries of novae (all but one in the LMC), with a further 4 or 5 possible recoveries. This is about half the expected total. The work on M81 was done with the help of archive plates only recently released to Mike by Allan Sandage. This resulted in the recovery of 24 novae in M81, mainly in the disc (spiral arms) of the galaxy, implying that such novae are associated with relatively massive Population I systems. This is a very similar conclusion to that recently obtained by Ciardullo et al in a CCD study of novae in M31.

The light curve of one of the M81 novae studied by Mike enabled a distance measurement based on the MMRD (Maximum Magnitude/Rate of Decline) relationship for classical novae, which yielded a distance modulus of 27.8 (3.63 Mpc or 11.8 million light years). This is within 0.1 of the distance modulus obtained from observations of Cepheids in M81! However Mike said he would only be truly convinced that this agreement was not accidental if something like 20 such nova distance estimates were available.

In a short talk in the Nova session Thomas Zwitter (Lubliana, Slovenia) reviewed the photometric and spectroscopic data on the recurrent nova U Sco, which had been detected in outburst by Patrick Schmeer in February 1999. All three recent outbursts (1979, 1987, 1999) were photometrically very similar, but spectroscopically the 1999 outburst was very different from the 1987 one. In the recent outburst, the width of the Hα line had decreased linearly with time as a result of thinning of the ejecta, and the white dwarf became visible again 22 days after maximum light. The profile of the Hα line at this point strongly suggested a high-velocity bipolar outflow of material from the white dwarf. There was some consensus that outbursts of U Sco may have been missed - its outburst interval may be shorter than the minimum of 8 years recorded to date. It is an eclipsing system with an orbital period of 1.3 days.

WHITE DWARF BINARIES

Tom Marsh (Southampton) spoke on ***Detached White Dwarf Close Binaries -CVs' Extended Family***. Tom noted that there were now 22 double-degenerate systems (consisting of two white dwarfs) known with measured orbital periods, the range being 1.5 hours to 8 days. Most are helium white dwarfs. He suggested that they might be the progenitors of AM CVn stars (which have very short orbital periods down to 18 minutes), and possibly of Type Ia supernovae. He also suggested that they might be the dominant source of low-frequency gravitational waves, and may be important in providing constraints on binary evolution. He further considered detached binaries consisting of a white dwarf and an M-type star. 27 such systems have known orbital periods ranging from 2.5 hours to 15 days. None have strong magnetic fields, and they provide clean examples of irradiated M stars. Such systems may be the progenitors of CVs, and the eclipsing systems (5 are currently known) could be a useful probe of angular momentum loss. Although both types of white dwarf binaries are probably common (with space densities several times higher than the space density of CVs), they are hard to find, looking rather like isolated white dwarfs. Measured white dwarf masses in such systems are typically 0.3-0.4 solar masses,with a peak of about 0.55 solar masses. These figures are not derivable from models based on steady state evolution.

Knox Long then discussed ***The White Dwarfs in CVs***. He noted that it is often difficult to separate out the white dwarf contribution to the ultraviolet spectra of dwarf novae such as U Gem, VW Hyi and WZ Sge. The spectral quality obtained from IUE (International Ultraviolet Explorer) and HUT (Hopkins Ultraviolet Telescope) were inadequate for good results on white dwarfs, but the data from GHRS (Goddard High Resolution Spectroscope) is much better. As a result the key parameters of some systems are now better determined than ever before; thus for U Gem the orbital period is 15285 seconds, the primary mass 1.04±0.04 solar masses, and the K1 velocity (the line-of-sight velocity amplitude due to orbital motion) 107.1±2.1 kms^{-1}. The main uncertainty in this, and other dwarf novae is the systemic velocity (i.e. its motion through space). Figures for white dwarf temperatures were quoted for WZ Sge (14,800 K) and for RX And (35,000 K before an outburst, 36,000 K afterwards), but data on SS Cyg was more difficult to obtain using GHRS.

SW SEX STARS

The SW Sex stars are nova-like systems of the VY Scl sub-class, but are characterised by peculiar radial velocity curves (derived spectroscopically) suggesting considerable penetration of the accretion stream across the disc.

Coel Hellier (Keele) addressed the subject ***The SW Sex Stars - Observations and Models***. He noted that these systems have orbital periods in the range 3-4 hours, and that several are eclipsing. Examples are PX And, which has distorted emission-line wings in its spectrum, which can be modelled by stream overflow across the disc- there is a bright region extending well into the disc (V795 Her and LS Peg are similar). V1315 Aql shows noticeable absorption at phase 0.5; modelling by stream absorption in the outer/mid-disc region gives a reasonable fit to the observed spectra. Coel noted that the dwarf nova EX Hya behaves like a SW Sex star when in outburst; its eclipses can be modelled by a simple stream without a disc.

Paul Groot then spoke on ***The Spectroscopy of SW Sex.*** If the out-of-eclipse spectrum of SW Sex in its excited (*high*) state is compared with a standard emission-line spectrum, an extra blue continuum is seen corresponding to the disc hot spot. All of the absorption dips can be matched by the spectrum of a B0 star. The hot spot region is optically thick with a temperature of about 25,000 K. Trailed spectra of several lines show a second component due to the irradiated side of the secondary star. The speaker's concluding comment was to the effect that adequate eclipse mapping of this system has to be 3-dimensional, with an optically thick disc rim, though this would have to be done very carefully. [Comment: This seems to be related to the problem of mapping the disc in outbursting dwarf novae, notably IP Peg, which also requires a thick disc rim.]

SUPERSOFT SOURCES

S. Rappaport spoke on ***Supersoft X-ray Sources as Super-Cataclysmic Variables***. Supersoft X-ray sources (SXs) are characterised by a nuclear energy source and a shorter lifetime (~10 million years) than CVs (lifetime ~1 billion years). Most supersoft source optical identifications are with active galactic nuclei, or with single white dwarfs. Of the individual known sources he mentioned Cal 87 , which is a binary system with an orbital period of 10.6 hours (visually it is magnitude 19-21); RXJ00198+2156 which has an optical spectrum characterised by several sharp Hydrogen and Helium emission lines, and Cal 83, a nebula shining with OIII and H-alpha light with about 100 times the solar luminosity. The standard model of such systems is of steady hydrogen burning (H-He by the CNO cycle) on the surface of a white dwarf. The donor star is generally more massive than the white dwarf, and the orbit shrinks as a result of the mass transfer. Exactly how the nuclear burning takes place is very important; above some threshold accretion rate (depending on the mass of the white dwarf), an expansion or explosion is inevitable, corresponding to a type Ia supernova, while at very low accretion rates, nova explosions are expected. It is not clear what should happen at intermediate accretion rates.

Boris Gaensicke (Goettingen, Germany) gave an observational update in his talk ***Towards a New Model for Supersoft X-ray Binaries (SSXBs)***. In this context *supersoft* means that 90% of the photons from a source are below 0.5 keV, with an effective temperature of 10^5-10^6 K. Boris said that there were 11 optically identified SSXBs with known orbital periods, including T Pyx, V Sge and QR And. The nature of the central object is difficult to determine because of interstellar absorption. SSXBs are characterised by bipolar jets of up to 4,000 kms^{-1} from the central object, which is probably a white dwarf. In some supersoft X-ray sources there is no evidence that a secondary star is present at all. He noted that there are problems with current models of SSXBs,and is working on a *boot-strapping model,* which involves evolution from short towards long orbital periods (contrary to the general course of CV evolution), although it is not yet clear how such a model will work. He posed the question of whether the classical SSXBs (QR And etc) are evolved CVs.

LOW STATES IN CVs

Jochen Greiner addressed the question ***Are VY Scl and V Sge Stars Transient Supersoft X-ray Sources?*** He noted that VY Scl stars (e.g. V751 Cyg) are mostly at maximum light with occasional dips. Orbital periods are typically 3-4 hours, distances 200-800 parsecs, absolute magnitudes (at maximum) 3-5, and accretion rates of the order of 10^{-8} solar masses per year. In the optical low state there is X-ray emission below 0.5 keV. On the basis of the observed correlation between the optical and X-ray behaviour of V Sge and V751 Cyg (and possibly other systems), he concluded that VY Scl stars are an extension of the canonical supersoft X-ray sources.

F V Hessman spoke on ***The Symptoms and Origins of CV Low States***. Low states are characterised by: (i) BIG reductions (by a factor of 10 or more) in the accretion disc luminosity, and a fall in accretion rate to negligible levels; (ii) they are seen in a large fraction of ALL types of CVs; (iii) they occur at irregular intervals, and last for days to months; (iv) the drop in accretion luminosity occurs rapidly, typically within a few days. All polar systems exhibit low states, there being no correlation with magnetic field strength, orbital period or any other parameter, and the changes in luminosity directly reflect the changes in accretion rate. In polars there can be long periods of high, intermediate or low accretion rates. Thus, for example, the light curve of AM Her reflects the activity of the secondary star. The speaker noted that low states can be useful, in that the normal veiling of the white dwarf caused by accretion is removed. He raised the possibility that low accretion rates might be induced by starspots (or starspot groups) on the secondary; a reasonable power-law model could give around 55% global coverage of the secondary, with the required statistical properties to explain low states

PROPERTIES OF CVs

In a short talk on the final morning on ***Structure, Spectra and Time Evolution of Accretion Discs in CVs***, Raymundo Baptista (Brazilian State University, SaoPaulo) presented spectral and continuum eclipse maps of three systems which he had observed. Spectra of the disc in the nova-like UU Aqr (which has an orbital inclination of 78°) showed it to be bright and blue in the inner region, and cooler and red in the outer region. 60% of the un-eclipsed light was coming from optically thin out-of-plane material (chromospheric emission?). The hydrogen line profiles were clearly not due to a disc in Keplerian rotation; rather they showed evidence of stream overflow. Eclipse maps of the disc in EX Dra through an outburst were shown; it was clear that the rise to outburst maximum was outside-in, and the later cooling also seemed to progress from the outside inwards. Continuum eclipse maps of IP Peg in outburst were shown; tomograms based on two Helium lines (HeI at 4471 Angstroms and HeII at 4686 Angstroms) showed the presence of a gas ring at half-radius in the disk.

WHAT WE STILL DON'T KNOW ABOUT CVs

In the final session Jozef Smak (Warsaw) spoke on ***Unsolved Problems of Dwarf Nova Outbursts***. Joe mentioned four basic remaining problems: (1) Model lightcurves between outbursts show gradually increasing brightness which is not observed. In terms of the disc instability/thermal limit cycle model of DN outbursts, this could be remedied by reducing the slope of the lower branch in the log (effective temperature)/log (surface density) diagram, which is equivalent to an attempt to measure the viscosity parameter α; (2) Outburst shapes are not as predicted. While type A (fast rise) outbursts are quite regular, as expected, type B (slow rise) outbursts vary in amplitude much less than predicted. Joe suggested that this might possibly be explained by an irradiation-induced enhancement of the mass transfer rate from the secondary star; (3) Narrow and wide outbursts (noted as a problem in the early 1980s); although apparently resolved by the TTI (thermal tidal instability) model of Osaki to account for superoutbursts, the observed superhumps occur too late in the outburst compared to model predictions. Systems such as TU Men and U Gem (the latter having undergone one so-called superoutburst in 1985) are rather awkward to model; (4) What outer boundary conditions should be imposed on disc models? The required boundary conditions relate to the tidal removal of angular momentum, the addition of stream material and local (hot spot?) accretion. While theory suggests that the effective tidal radius should be about 0.9 of the Roche radius (distance to the inner Lagrangian point), in actual dwarf novae the figure is about 0.6-0.8 of the Roche radius.

NOTES FROM THE POSTERS

It was noteworthy that two of the posters on display featured a very *old* type of observation, namely astrometry of CVs in order to measure their geometrical parallaxes (in one case infra-red spectroscopic parallaxes are also involved); the motivation for this is the concern to pin down absolute magnitudes of CVs as accurately as possible. This requires milliarcsecond astrometry, with a whole host of systematic errors needing correction, but encouraging results are now being obtained. High-precision astrometry is alive and well amongst cataclysmic variable enthusiasts!

For those interested in the eclipsing dwarf nova EM Cyg, Rachel North (Southampton) displayed a poster showing trailed high-resolution spectra from which it was clear that the light from the system contains a contribution from a third star of late spectral type (and hence similar to the dwarf nova secondary star). This finding resolves longstanding confusion over the masses of the binary components. It is not clear whether the third star is physically bound to the dwarf nova.

A poster by Steve Howell drew attention to the Faint Sky Variability Survey (FSVS), an ongoing photometric survey towards moderate to high galactic latitudes. It is intended to detect and/or place constraints on the number of faint CVs in the Galaxy. Theoretically most CVs should be faint with short orbital periods and have very low mass transfer rates. Such systems are strongly discriminated against in conventional colour-based surveys. The FSVS limit is a V magnitude of 24 and can detect V-band variabilty on time scales down to about 15 minutes. Watch this space!

This article is on the BAAVSS web page at http://www.telf-ast.demon.co.uk/warner.html

PERIOD EVOLUTION ANALYSIS OF 13 VARIABLES

JOSÉ MARIA FERNÁNDEZ ANDÚJAR

Introduction

The evolution of the period with time has been analyzed for 13 stars using *MPMAMOV (Minimum Phase Method Analysis)*, an algorithm based on the minimization of the phase between times of extrema. *MPMAMOV* yields an optimal period for the active set of extrema or, if the extrema are split into groups, it can give period as a function of time.

Table 1 shows a summary of the data for analysis

	Maxima	Type	Period	Initial P	Final P	step	no. of maxima per bin	Extremes by	Source
R And	25	M	409.33	390	425	0.1	6	Andújar	AFOEV
R Aql	105	M	284.2	270	320	0.1	6	Greaves	BAA/AFOEV
X Cam	165	M	143.56	139	159	0.1	6	Greaves	BAA
R Cas	30	M	430.46	410	450	0.1	6	Andújar	AFOEV
O Cet	73	M	331.96	325	340	0.1	6	Greaves	BAA
T Cep	89	M	388.14	368	408	0.1	6	Greaves	BAA
R Dra	73	M	245.6	225	265	0.1	6	Andújar	AFOEV
R Leo	38	M	309.95	290	330	0.1	6	Andújar	AFOEV
R Lyn	28	M	378.75	360	400	0.1	6	Andújar	AFOEV
U Ori	46	M	368.3	360	380	0.1	6	Greaves	BAA
R Sct	45	RVa	146.5	126	166	0.1	6	Andújar	AFOEV
R Sge	14	RVb	70.77	50	90	0.1	14*	Andújar	AFOEV
R Tri	49	M	266.9	245	285	0.1	6	Andújar	AFOEV
T UMa	66	M	256.60	245	265	0.1	6	Greaves	BAA

The period is that given in the GCVS 1985. *For R Sge I used all maxima with *MPMA* to find the best single period, not the evolution of period with time.

In all Miras the period of the individual light cycles sometimes differs from the star's mean period by several percent. This is shown in table 2.

Table 2

	Max Period	Min Period	Range	Range /Period[1]	Mean Period	Deviation	*MPMA* Period
R And	418.5	405.5	13	0.03	411.11	3.36	410.2
R Aql	319.9	276.6	43.3	0.15	295.70	11.86	
X Cam	154.4	140	14.4	0.10	143.79	1.60	
R Cas	435.9	425.3	10.60	0.02	430.42	2.89	430.5
O Cet	339.9	326.1	13.79	0.04	332.61	2.83	333.0
T Cep	402.1	372.9	29.20	0.08	390.06	7.43	
R Dra	256.5	239	17.5	0.07	245.66	2.98	246.1
R Leo	316.1	306.7	9.39	0.03	311.83	2.29	311.4
R Lyn	381.2	375.1	6.1	0.02	378.54	1.42	378.6
U Ori	376.8	361.6	15.19	0.04	369.98	4.07	371.7
R Sct	166.0	132.8	33.2	0.23	144.31	7.25	143.9
R Tri	269.3	257	12.3	0.05	266.59	2.02	266.9
T UMa	262	249.1	12.9	0.05	255.90	2.63	255.7

The data are derived from the analysis by *MPMAMOV*. The last column gives the real period using *MPMA* with all maxima (minima for R Sct). The mean period and deviation are statistical values derived from periods obtained by *MPMAMOV.* We can find a secular evolution increasing or decreasing the length of the period, or a sinusoidal variation. Also an abrupt change of period and an abrupt shift of epoch can exist. In some M stars we can find a modulating period P2 where P2/P1 is near 9.4, although this value is very general. However, many short period stars (less than 150 days) show changes in their periods.

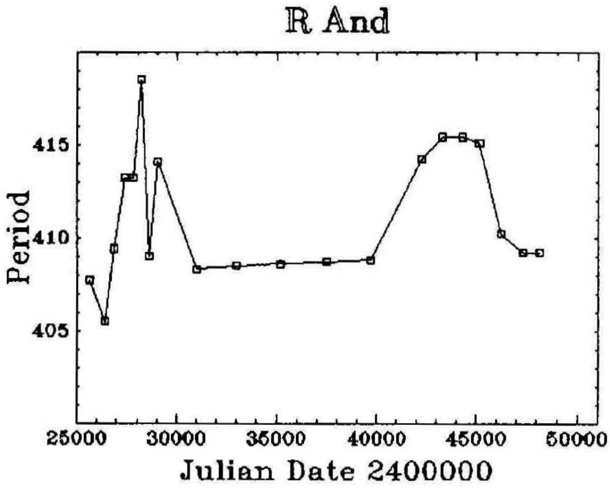
Stars

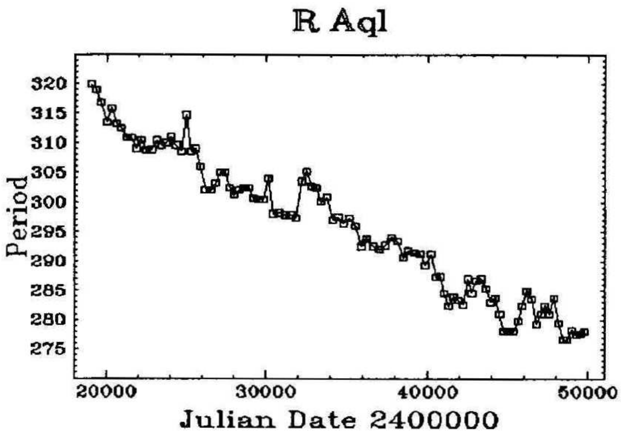
For many stars I could not obtain a long sequence of maxima from AFOEV data. So some curves show little detail.

Notes:

1 Range=Maximum period - Minimum period = dP
Range/Period = dP/p = Percentage variation of the period

R And
Prager and Schneller (1934) noticed that R And showed sinusoidally changing periods. With 25 maxima, I can only find a secular change. R And could have increased its period, then returned later to a stable period near 409 days.

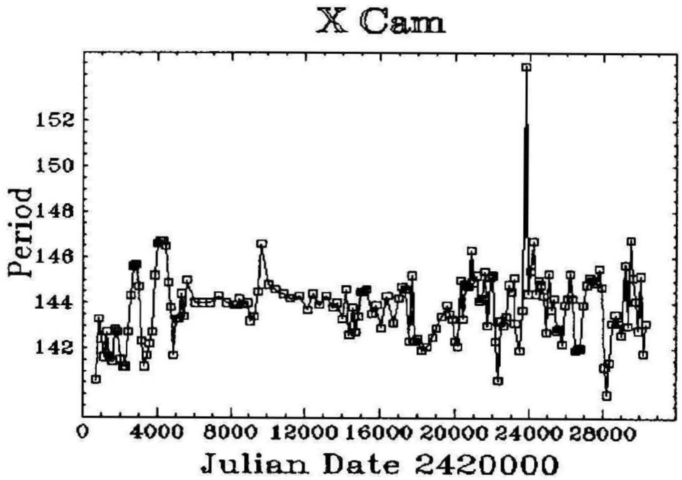




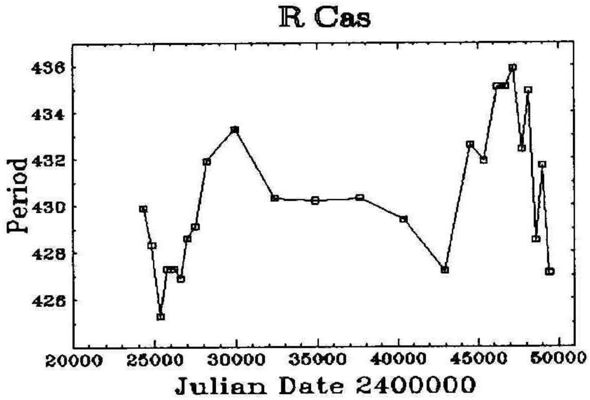
R Aql
Its regularly decreasing period had already been noticed by Hoffleit (1979) and Schneller (1965). On the other hand Paine and Campbell (1930) identifed a sinusoidal form of the decreasing period. All this can be seen in the graph.

A linear regression gives; Period = 339.637 - 1.2666×10^{-3} T where T = Julian Date - 2400000; Applying Fourier analysis to residual data gives periodicities near 13389 and 4665 days.

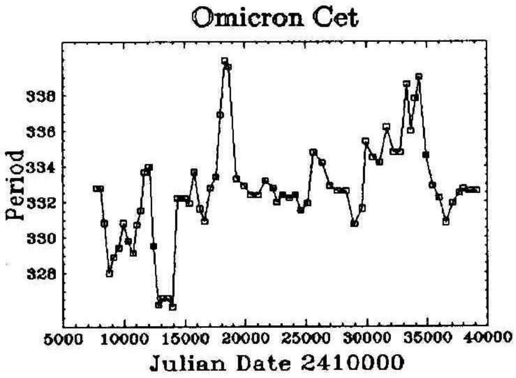
As John Greaves deduced in VSSC94, by June 2010, the regression leads to a period of around 270 days.



X Cam
There is no obvious change in period, apart from an abrupt change near the end of 1978. No second clear period was found

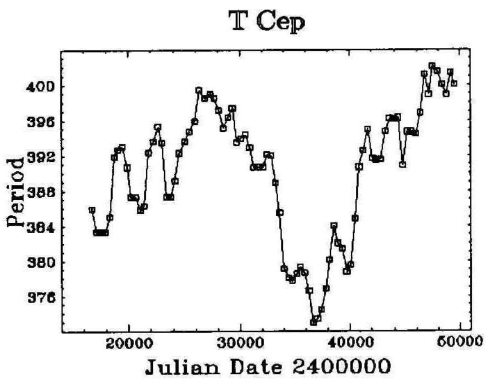


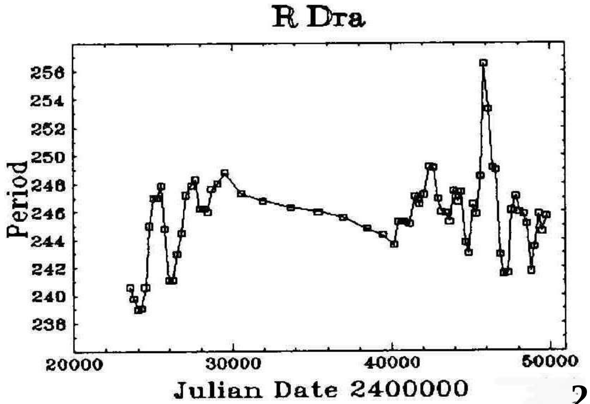
R Cas
Although there are a few maxima, the period has changed with time. A possible period would be near 7000 days if we accept the peaks as a repetitive behavior. On the other hand , a sinusoidal form appears with period near 8000 days (the second cycle could be smoothed).



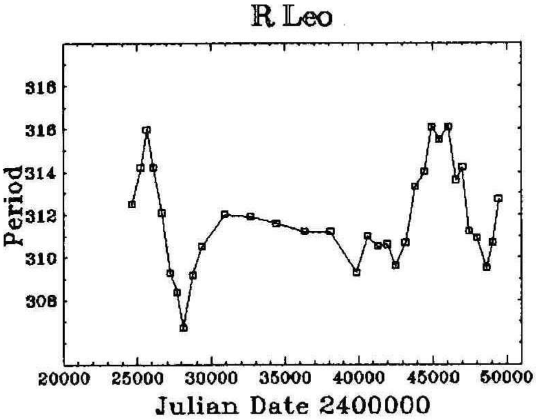
Omicron Cet
It also has a changing period, and analysis gives two distinct periodicites in in the period versus time relationship: one of about 14300 days, representing the time between the two peaks, and another of about 3900 days.
In 1934 Prager and Schneller showed 12 discrete periods from 222.5 to 335.4 days, and Leung in 1980 found three periodic components in the behavior of this star.

T Cep
A unambiguous example of changing period. The O-C diagram covering the period 1901-1974 from observations by the BAA already suggested that the period may be varying. In 1979 Hoffleit noticed that T Cep decreased its period. In reality, T Cep has increased and decreased its period sinusoidally. A large period near 25000 days and others near 3000 days modulate the behaviour of the period of T Cep.

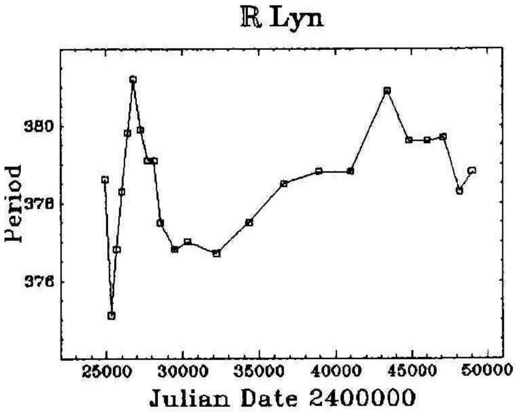




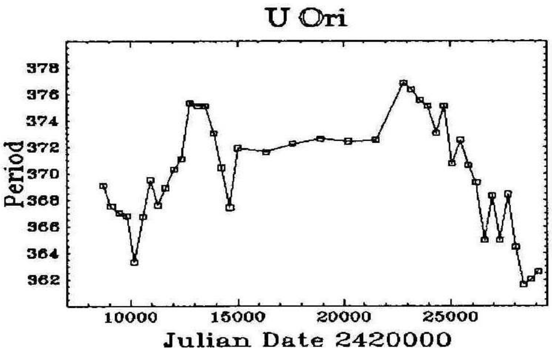
R Dra
A wide gap containing a few maxima appears between two zone where a period of about 2100 days dominates the behavior of R Dra.



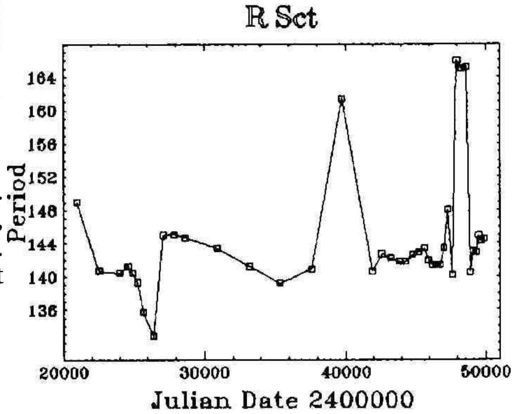
R Leo
Increasing and decreasing periods exist, but no periodic form of the changes is seen.



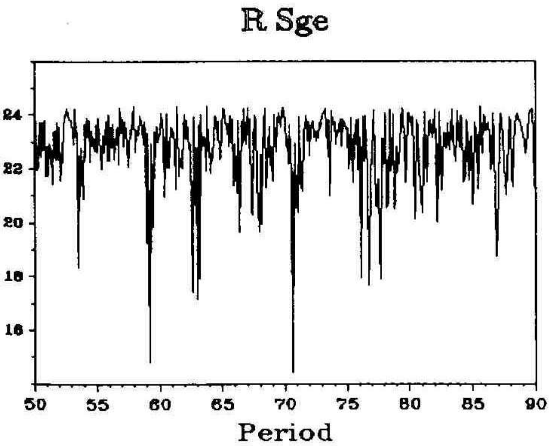
R Lyn
Similar to R Leo, but with a smaller range in period. The small variations in period can be neglected.



U Ori
Only a decreasing period during the last 22 years is indicated from the analysis.

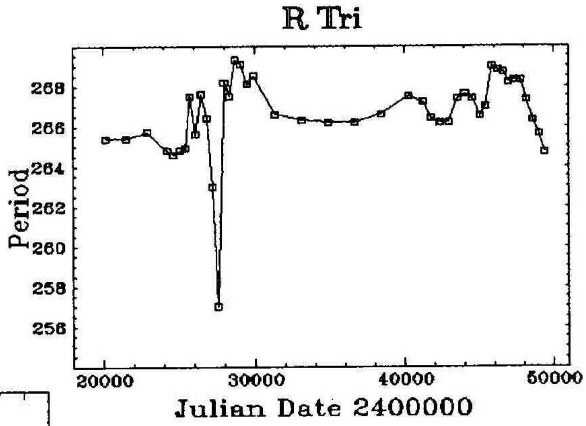


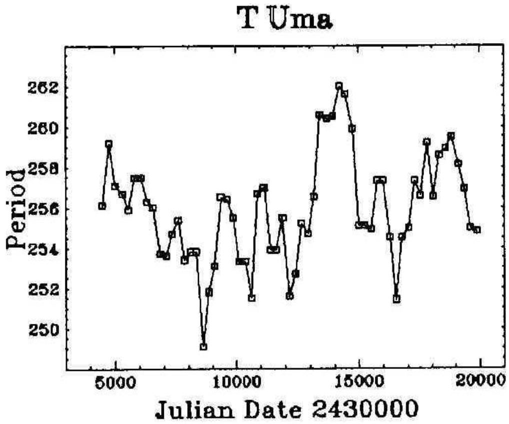
R Sct
An RVa star with a moderately steady period.. From the graph we can only deduce that small, sudden changes have occurred at several epochs. However, those changes were important (the last occurred around the Summer of 1990)



R Sge
For this RVb star I have only used MPMA to find a mean period from minima times. The primary period found was 70.77 days but a secondary period of 59.20 days also features strongly in the periodogram.

R Tri
Except for an abrupt change, the period is fairly constant. The sinusoidal behavior of low amplitude shows a periodicity near 3400 days.





T UMa
A large amplitude in period is shown by this star, but a period near 4300 days was found.

Conclusion

Few stars exhibit a constant period during their lives. On some occasions these changes are more easy to detect than at other times, but in general, low amplitude changes are always present.

Acknowledgements
I thank John Greaves who sent several lists of maxima of stars and several files containing data from the AFOEV database. This paper could not have been written without this data.
I also thank all observers (although a list of names could not appear here) who over the years have been observing these stars from night to night.
Finally, I thank John Howarth, Roger Pickard and Karen Holland for their corrections to my original text.

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THE 1998 MEETING OF THE VARIABLE STAR SECTION (CONTINUED)

TRISTRAM BRELSTAFF

After the tea break, Tonny Vanmunster gave his talk on ***EG Cancri and the Center for Backyard Astrophysics (CBA)***. The CBA is a group of professional and amateur astronomers who use CCDs to study the short-period photometric cycles of cataclysmic variables. Tonny first described his own observatory, which he referred to as *CBA-Belgium*. He had two Schmidt-Cassegrain telescopes (35cm and 25cm), and computer hardware for recording the CCD images. At the start of each clear night he sets up the larger telescope to automatically track a particular star of interest, and record images every minute or so. At the end of the night, he uses software to derive magnitudes from the recorded images. Since 1996 he had performed 1279 hours of photometry in this way, and had obtained some 48000 usable images in the process.

Tonny then described EG Cancri. This star is normally about magnitude 19, but had been found in outburst at magnitude 13 in 1977 by Huruhata. There was also an unconfirmed report of it at magnitude 13.4 in 1995 by Watanabe; that was all, that is, until 1996 November 30th when Patrick Schmeer found it again in outburst at magnitude 12. This discovery sparked a campaign of intensive observations by the CBA and other groups. The resulting light-curve showed a characteristic SU UMa type superoutburst, lasting about 20 days, followed closely by a series of six *echo* outbursts at intervals of about 6 days. These *echo* outbursts were smaller and narrower than the main one, and reached only magnitude 13-14.

Photometry by the CBA team showed the presence of *superhumps* with a period of about 0.06 days at the maximum of the main outburst. This is unusually early for superhumps - normally they don't develop until about 5 days into an outburst. Their amplitude then increased as the outburst developed, but they faded away again on the decline. Superhumps were not present on the first few echo outbursts, but they did appear again on the later ones.

Spectroscopy during the outburst confirmed that the star was a dwarf nova. The spectrum at minimum was very similar to the minimum spectrum of WZ Sge, another dwarf nova which only erupts every few decades. An early onset of superhumps was also observed in WZ Sge and in the WZ Sge-like stars AL Com and HV Vir. Maybe this is characteristic of these stars?

However, the strangest feature of the 1996-97 outburst of EG Cnc was undoubtedly the six *echo* outbursts. Echo outbursts have been seen before - in UZ Boo, T Leo and GO Com - but only one or two at a time. Tony mentioned two theories which have been proposed to explain similar echo outbursts seen in X-ray sources. In one theory they are due to episodic accretion from the disc onto the compact component. Each such accretion event heats up the primary enough to cause more matter to be deposited into the disc . This matter then takes about 6 days to spiral in to the inner edge of the disc, where it causes the next accretion event. In the other theory the echo outbursts are due to heating waves *reflected* from cooling waves accompanying the decline from the previous outburst.

Next Albert Zijlstra of UMIST (University of Manchester Institute of Science and Technology) spoke on ***The Hesitant Mira R Doradus***. He started off by discussing planetary nebulae. First he showed an image of the Egg Nebula, in which the central star is invisible because it is undergoing catastrophic mass loss. Such a star is probably suffering from something like 30 magnitudes of extinction in visible light - rather like forgetting to open the dome of your observatory! The Egg Nebula could soon become a planetary nebula. A few years ago Shklovsky had suggested that if you were to compress a planetary nebula back onto its central star, then what you would be left with would be a Mira star. Albert showed an image of NGC 7027, saying that this could well have been a Mira star, just a thousand years ago.

The catastrophic mass loss, or super-wind, that leads to the formation of planetary nebulae is thought to be related to the mass loss from red giant stars, especially Mira stars. Mira stars are pulsating red giant stars with amplitude variations of greater than 2.5 magnitudes, and periods of about 200 - 500 days. This makes them easy for amateurs to observe but awkward for professionals (they would prefer 2 - 5 days!). Semiregular (SR) variables are similar but have amplitude variations of less than 2.5 magnitudes. There are also the so-called OH/IR stars which have periods of 700 - 3000 days, and radiate predominantly in the infra-red. An evolutionary scheme has been proposed that goes: SR > Mira > OH/IR > PN, however, Albert added that *this was so neat it cannot be true*.

Turning to R Dor, this star has a range of magnitudes from 5 - 7, and a period of 300 days. It is very bright in the infra-red; indeed in the K-band it is the brightest star in the sky after the Sun. Its angular diameter at 55 milliarcsecs (mas) is even larger than that of Betelgeuse (40 mas). At the Hipparcos distance of 62pc, this corresponds to a radius of 380 solar radii. From these properties one would expect the star to have a period of about 150 days.

Albert said that he became interested in R Dor when he saw some observations of it by the New Zealand amateur Albert Jones. Jones' observations covered the years 1944 - 1967, and seemed to show a sudden change from Mira-like to SR behaviour in 1952. Before then it had an amplitude of 2 magnitudes, then the period split and this drew power from the main pulsation, and the amplitude decreased to that typical of an SR variable. Albert (Zilstra) then searched for other observations to fill the gap since 1967. Unfortunately the AAVSO observations were only available as 10-day means and showed large scatter, so he was unable to use them. However, observations by the RASNZ were available and observer corrections could be applied to to make these acceptable for filling in the gap since 1967.

Period analysis shows that there are two periods present in the whole dataset, 330 days and 170 days; the former is only present in the earlier observations, the latter only in the later ones. This proves that the 170 day period is not an alias or harmonic of the 330 day one. Albert then showed the results of wavelet analysis. This consisted of a contour plot with time in years along the x-axis and period in days along the y-axis; the contour lines indicated the *goodness of fit* of each period at each time. This plot showed that the best fit period had flipped from 330 days to 170 days and back again several times since 1944. When the 330 day period was present, R Dor was a Mira/SRa variable; when the 170 day period was present then it was a SRb variable.

Mira stars are thought to pulsate in the fundamental mode (that is all parts of the star move in and out together). However, the above periods, along with the Hipparcos distance, suggest that R Dor pulsates in the first overtone (the outer layers move out as the inner layers fall in, and vice-versa). For R Dor to be a fundamental mode pulsator it would have to have a mass of about 4 solar masses, which is unacceptably large.

Mira stars in the Large Magellanic Cloud with periods less than 400 days show a period-luminosity (P-L) relationship, rather like that for cepheids. In the past it has been thought that this relationship does not hold in our Galaxy. However, R Dor fits the Mira P-L relationship rather well, so this might have to be revised. Albert said that the Mira P-L relationship has the potential for being more useful than the cepheid one. The distance to the LMC is 52kpc according to cepheids, but only 45kpc according to RR Lyrae variables and SN1987a. One of the aims of Hipparcos was to get accurate distances to cepheids and RR stars, but in this it failed because the nearest stars of these classes turned out to be just too far away. One way to reconcile the various distances to the LMC is offered by Mira stars in globular clusters. These stars appear to be anomalous when compared with nearby Mira stars. However, this anomaly would disappear if the cepheid distance scale was slightly wrong, and the LMC was 10% further away than current estimates put it. Albert also pointed out that this would also reconcile the the problem of the universe appearing to be younger than the oldest stars. However, this is rather a long way to go based on observations of just one star (R Dor) by just one observer (Albert Jones).

To sum up: R Dor suggests that the Mira stars and semi-regular variables are closely related, and are two sides of the same type. The mass loss history of R Dor suggests that the superwinds are intermittent, not continuous, and are related to the halos around planetary nebulae. The pulsational characteristics of R Dor suggest that it is pulsating in the first overtone, rather than the fundamental mode. And finally, the Mira period-luminosity relationship could be used to calibrate the cepheid and RR Lyrae distance scales.

In answer to a question, Albert said that V Boo was *similar but not similar* to R Dor, but he recommended continued observation of it. Norman Walker asked about non-radial pulsation modes (as are found in some blue stars). Albert said in red giants these would only result from tidal effects - such as swallowing Jupiter-size planets.

The final talk of the day was given by John Howarth of CMHAS (Crayford Manor House Astronomical Society) and was entitled ***Analysis of Quasi-periodic Data***. John had been working with John Greaves on a study of changes in period, phase and amplitude in Mira and semi-regular variables. For this they used observations by the BAA-VSS and other societies. John showed a light-curve of W Cyg which is known to have periods of 130 days and 234 days. He pointed out how in different parts of the light-curve, both periods are either present together, or else one is absent and the other present by itself. There is even a stretch of what appears to be chaotic behaviour in one part of the light-curve.

John then described the use of the discrete Fourier transform to derive period, phase and amplitude information, and to distinguish true multiple periods from aliases. He illustrated this with some results for T And. He went on to show how a *moving window* could be used to generate diagrams of the variations in phase and amplitude in T Cas, Chi Cyg and other stars. The phase-time diagrams correlate closely with the O-C diagrams for these stars and actually show less scatter (they use information from the whole of each cycle - not just the maximum and minimum). For WY Cyg there also seems to be a correlation between the phase and the amplitude.

John finished off by showing some phase-amplitude diagrams, plotted using polar coordinates. In these, the points start to rotate about the origin as the period changes, getting faster and faster as the period gets further and further out of step with the original one.

LETTERS

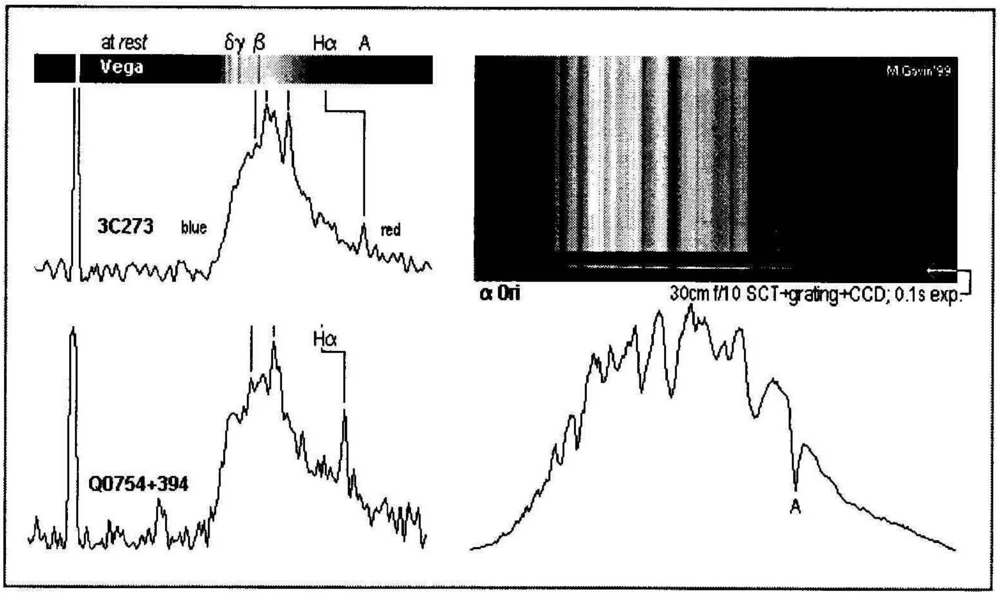
FILTERED PHOTOMETRY V SPECTROMETRY

I much enjoyed Graham Salmon's articles in VSSC numbers 98 and 99 on filtered CCD photometry. However, one aspect in the debate has consistently puzzled me -the assumption that stars have convenient black body profiles, whereas in reality they can both have emission and absorption lines superimposed, which must effect precision photometry especially where such spectral features occur at filter boundaries.

There is another effect largely ignored - the proximity of spectral lines (especially in emission), near prominent absorption lines of oxygen and water-vapour caused by the Earth's atmosphere - in particular the A line band-head at 758.4nm. I have found it is possible to make an educated guess as to the zenith distance from the weakness of blue/UV flux and strength of the A and associated lines in a stellar spectrogram. This is highlighted in the redshifted H-alpha emission line in quasar 3C273, that appears noticeably suppressed by coincidence with the A line, whilst for less redshifted Q0754+394 this emission line is clear of the A line and records much stronger as the adjacent figure shows. Such emission lines can contribute noticeably to the flux, and the altitude of the observer may also have a part to play - most professional photometry is not conducted at sea level!

I was advised at the last VSS meeting at Crayford Manor that it was not '*good form*' to conduct post photometry from low resolution spectra. Why is this? The adjacent electronically stretched spectrogram of Betelgeuse was *snapped* in 1/10s (30cm SCT f/10 + CCD) which samples the spectrum in about 260 *colours* at 1.75 nm/pixel in one *hit*. Overkill perhaps for simple 3 or 4 colour photometry, but with much lower spectral dispersion, very faint stars can be targeted in reasonable exposures.

Maurice Gavin: e-mail 100772.47@compuserve.com



IBVS

GARY POYNER

PRO-AM EXCHANGES REPORT 16

GUY HURST

Covering period 1996 January 1 to June 30.

Date	Subject Remarks	Professional
	Additions to Report 15 (1995 July 1-Dec 31)	
950712	NSV436 Cas 1974-87 1418 obs supplied NSV650 Cas 1971-88,90-95 2090 obs	Chris Lloyd, RAL
950726	U Gem 1995 297 obs and light curve supplied.	Tim Naylor, Keele Univ.
951015	R Ari 1935-74 2471 obs X Aur 1935-74 2993 obs X Cam 1924-95 7491 obs SS Her 1963-95 2887 obs X Per 1969-95 6880 obs Supplied total 22722 obs	Paul Roche, Sussex Univ.
951126	T CrB 3399 obs sent	E.O.Offek, Israeli A.A.
951129	R CrB 1921-95 39029 obs SU Tau 1962-95 5579 obs	A.Yu.Pogosyants Euro-Asian A.Soc.
951214	NSV12088 Aql (1070 obs) NO Aur (1042 obs) NSV13150 Del (1243 obs) Total 3355 obs sent.	Chris Lloyd, RAL
951218	NSV2537 Aur (4955 obs) V2048 Oph (4116 obs) Total 9071 obs sent.	Chris Lloyd, RAL
	(7 additions, totals amended in summary)	
960101	R CrB fading updated to 951230, 13.7 (Diepvens) Don confirms observing with JKT 960103	Don Pollaco, St.Andrews
960101	Nova Cas 1995 We receive report on IUE obs 951222 and 951223 confirming dust forming NOT taking place despite predictions.	Sumner Starrfield, USA

960108	OJ287 951225/26 mag 13.9 by John Toone 3C66A 960107 mag 14.0 by Gary Poyner reported	Tapio Pursimo, Finland
960111	Comet Hunting advice sought re George Alcock's techniques. Supplied.	Kazimeras Cernis, Italy
960121	omicron Cet 1988-95 (1314 obs) supplied.	Glen Peters, A.A.O. Australia
960128	UZ Boo enquiry whether our results show superhumps in 1994 outburst. Gary Poyner advised NOT the case.	Steve Howell, USA
960203	Markarian 421 I supply a review of the proposed paper for JENAM95 proceedings	Massimo Fiorucci, Italy
960130	WWW amateur CCD proposed pages by Tim	Tim Naylor, Keele Univ.
960131	V336 Vul TA charts/sequence requested by Brian	Brian Skiff, USA
960204	Possible Nova in Oph Requests check of report received from Y.Hyakutake RA 16h52.7m DEC -04 42(1950) We advise red non-var star	Brian Marsden, CBAT, USA
960210	S Apodis fade 951227, 10.8; 960128, 12.3 (Monard, Pretoria) supplied to Don.	Don Pollaco, St.Andrews
960214	AQ CMi CCD appeal to monitor received.	Joe Patterson, Columbia Uni.
960115	OJ287 960213 mag 14.3 by Gary Poyner 3C66A 960128/960208 mag 14.5-14.6 by Gary Poyner reported	Tapio Pursimo, Finland
960216	AF Cyg 1980-95 (4350) AH Dra 1971-95 (2824) RY Dra 1971-95 (6885) WZ Cas 1971-95 (2739) Total 16798 supplied	Laszlo Kiss Jozsef Attila Obsy Szeged, Hungary
960214	AQ CMi updated received. Faded to 18.3 by 990222!	Joe Patterson, Columbia Uni.

960228	Nova Cas 1993 (V705 Cas) 3555 obs supplied.	Schuyler Van Dyk BAIT Group UC Berkeley
960229	OJ287 960229 mag 14.4 by Gary Poyner 3C66A 960227 mag 14.6 by Gary Poyner reported	Tapio Pursimo, Finland
960302	Markarian 421 paper submitted to Astronomical & Astrophysical Transactions under authorship: Fiorucci, Tosti, Hurst	Massimo Fiorucci G.Tosti, Perugia
960302	LL And Paper has now appeared in BAAJ 1996 Feb under authorship Howell and Hurst. Copies sent to Steve.	Steve Howell, USA
960313	3C273 chart requested. Supplied.	Dave Kilkenny, SAAO
960320	HV 12842 R CrB star fading as relayed to us by Christie in New Zealand	Don Pollacco, St.Andrews
960320	SN search collaboration requested to which we agree.	Gruppo Fritz Zwicky Stefano Moretti Italy
960322	V1773 Oph; GM Ser We supply details of references on above stars.	Dave Kilkenny, SAAO
960331	Markarian 421 paper submitted also to NAM96	Dave Stickland RAL
960328	Odessa Publications Volume 7 of Odessa Astronomical Publications received from Ivan. Data on Mike Collins' stars relayed to Mike.	Ivan Andronov, Ukraine
960407	3C66A and OJ287 obs by Gary Poyner reported.	Tapio Pursimo, Finland
960412	GK Persei Outburst data 960107 (mag 13.1) to 960405 (10.8) supplied by us.	Julian Osborne, X-Ray Dept Leicester University
960413	KU Cas Skiff/Misselt sequence supplied to us.	Brian Skiff, USA

960423	Dwarf Nova Sequences Copy of paper ‘Secondary Photometric Standards in selected Northern Dwarf Nova fields by Misselt relayed to GMH by Roger Pickard.	K.A.Misselt
960425	SN 1994I Paper Astron.J. 111 (1) [1996] received.	Michael Richmond, USA
960501	AM Her (1993-96) 158 obs supplied.	Andy Beardmore, Keele
960505	R CrB Stars Clayton’s paper on these stars supplied to us.	Geoffrey Clayton, USA
960505	GRB 960409 We search Comet C/1996 B2 (Hyakutake) images from our collection as field co-incides with GRB. No positive images of GRB found.	Tom Harrison, New Mexico State University, USA
960507	AK Cancri astrometry Nick James obtains precise position: RA 08h55m21.20s DEC +11 18’14.7"(2000) Supplied to Ron to update his catalogues.	Ron Downes, USA
960512	CR Boo campaign Campaign for 23d monitoring requested by Tom.	Tom Patterson, USA
960516	EM Cygni We research long term light curve to try and establish of Z Cam type. Chart supplied to Tim.	Tim Naylor, Keele Univ.
960521	X Per (1969-96) 7002 obs supplied	Karen Holland Leicester Univ.
960612	HS Sge Offers post-outburst frame to us on this nova.	Hilmar Duerbeck, Germany
960609	SS Cygni Supplies revised sequence for this dwarf nova.	Brian Skiff, USA
960609	RS Tel Fading detected by Monard relayed to Phil.	Phil Hill, Univ.St.Andrews
960618	NSV 13806 Mike Collins supplies recovery details on this object to Dave.	Dave Van Buren, Caltech

PRO-AM EXCHANGES SUMMARY UPDATED - UPDATED APRIL 3 1999

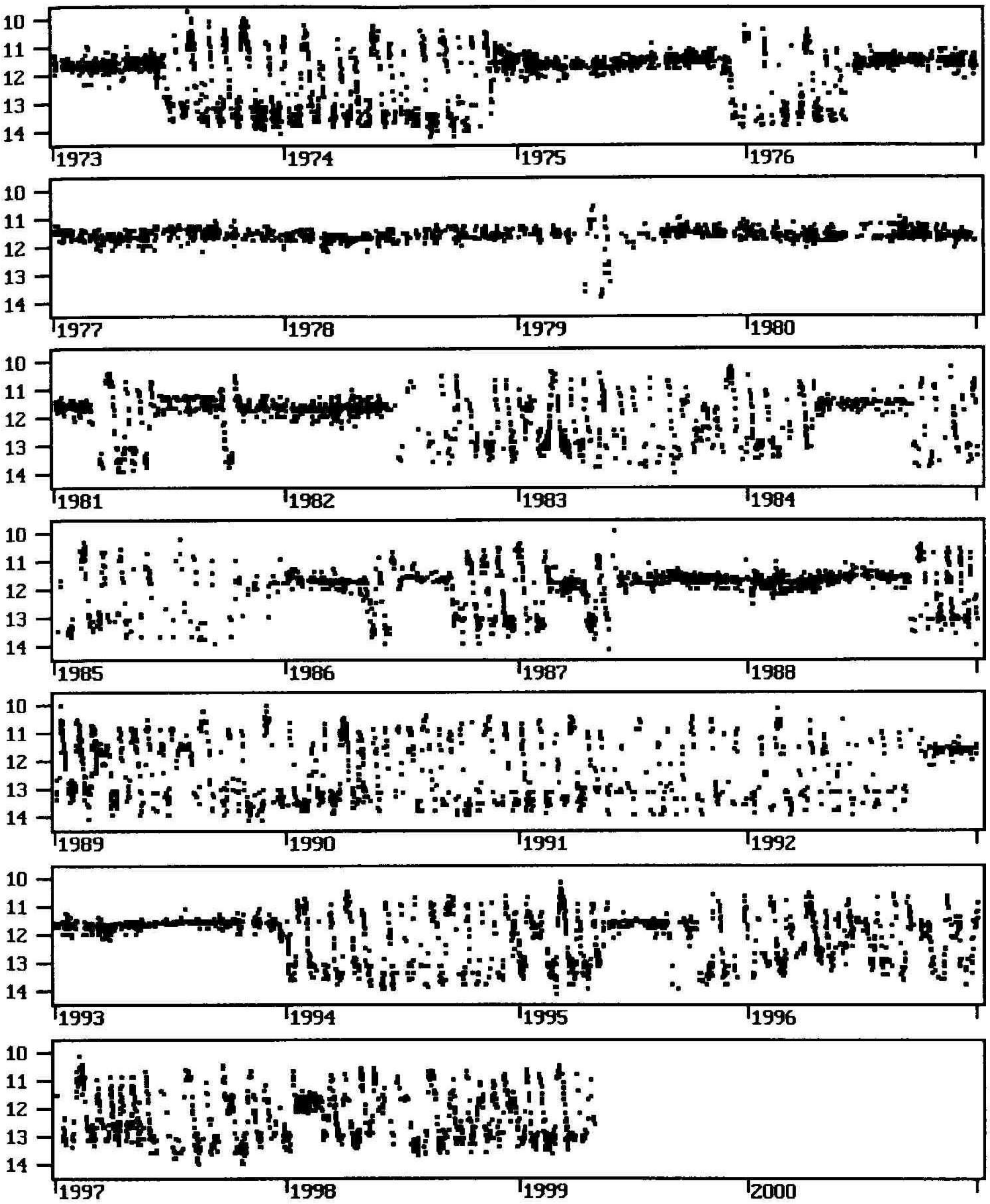
Half year ending	Number of exchanges	My Report Nos
1988 Dec 31	42	1
1989 Jun 30	51	2,3
1989 Dec 31	45	3
1990 Jun 30	69	4
1990 Dec 31	23	5
1991 Jun 30	40	6
1991 Dec 31	43	7
1992 Jun 30	52	8
1992 Dec 31	42	9
1993 Jun 30	63	10
1993 Dec 31	59	11
1994 Jun 30	58	12
1994 Dec 31	52	13
1995 Jun 30	55	14
1995 Dec 3	42	15
1996 Jun 30	41	16
To Date	777	

Observer lists for cover light curves

SS Cyg 1962 to 1999. 23027 observations by;- S W Albrighton, C M Allen, S J Anderson, Orwell Ast Soc, J A Bailey, A R Baransky, B J Beesley, D E Beesley, M R Bell, R J Bouma, K Brady, T Brelstaff, G Broadbent, C Brookman, L K Brundle, A T A Bueno, J S Bullivant, S F Burch, R S Byrne, B A Carter, R H Chambers, A Chapman, R F Churchhouse, M Clarke, G A V Coady, E H Collinson, H Colquhoun, A Connell, A Cook, P G Dixon, S R Dunlop, J W Ells, K J England, E S Farr, H Feijth, R W Fleet, A E J Forno, J I M Forsyth, James Fraser, M French, J Friends, M J Gainsford, D Gill, P Gill, M Gill, T Gough, B H Granslo, A Grayson, J Greaves, D Griffin, M A Hapgood, R S Henderson, C Henshaw, L J Higgins, G Hirst, K Holland, A J Hollis, P W Hornby, S Hoste, I D Howarth, D Hufton, G M Hurst, D R Hutchinson, J E Isles, C J Jackson, T J Jones, C P Jones, R H Jones, M L Joslin, S J Kay, I H Kennedy, B Kennedy, N S Kiernan, N F H Knight, O J Knox, Miroslav Komorous, S Koushiappas, J Lashley, K Lewis, J A Littler, R J Livesey, R S Lomas, S J Lubbock, R L Lyon, John Mackey, J W Macvey, W Maffett, J W Mason, L R Matthews, A Maudsley, D G McCartan, H W McGee, R H McNaught, J Meacham, E Metson, R Middlefell, I A Middlemist, R Miles, Roy Mitchell, P A Moore, T J C A Moseley, C R Munford, E Muyllaert, M J Nicholls, J Parkinson, M V Penston, R D Pickard, A K Porter, G Poyner, D Pye, G Ramsey, M J Ring, J H Robinson, T A Robinson, F A Roper, D A Rothery, G W Salmon, A M Savill, D R B Saw, P Schmeer, J D Shanklin, D J Shepherd, A L Smith, H W S Smith, R Steer, K Sturdy, T Tanti, M D Taylor, S Taylor, J Toone, Vince Tuboly, J C Tyacke, Petro Veleshchuk, E Waring, C Washington, E J W West, P J Wheeler, W J Wilson, J D Wise, P B Withers, W J Worraker, D L Young, P J Young

Z Cam 1973 to 1999. 11833 observations by;- S W Albrighton, S J Anderson, J A Bailey, A R Baransky, R J Bouma, S M Brincat, G Broadbent, L K Brundle, S F Burch, R H Chambers, E H Collinson, H Colquhoun, S R Dunlop, J W Ells, H Feijth, R W Fleet, James Fraser, M J Gainsford, D Gill, M Gill, R J Godden, T Gough, B H Granslo, J Greaves, A J Hollis, P W Hornby, S Hoste, I Howard-Duff, I D Howarth, G M Hurst, J E Isles, C P Jones, S J Kay, N F H Knight, O J Knox, Miroslav Komorous, K Lewis, P C Leyland, R J Livesey, S J Lubbock, R L Lyon, L R Matthews, H W McGee, I A Middlemist, C R Munford, E Muyllaert, R A H Paterson, W E Pennell, R D Pickard, A K Porter, G Poyner, D A Rothery, G W Salmon, D R B Saw, P Schmeer, J D Shanklin, A L Smith, A Snook, R Steer, D Stott, M D Taylor, J Toone, D Vest-Askew, E J W West, M Westlund, W J Worraker, P J Young.

Z Camelopardalis



The deadline for contributions to the September issue of VSSC will be August 7th, 1999. All articles should be sent to the editor (details are given on the back of this issue)

Whilst every effort is made to ensure that information in this circular is correct, the Editor and Officers of the BAA cannot be held responsible for errors that may occur.

Printed by RAMPrint 01604 233677

SECTION OFFICERS

Director Gary Poyner
67 Ellerton Road, Kingstanding, Birmingham, B44 0QE.
Tel : 0121 6053716 E-mail : gp@star.sr.bham.ac.uk
Assistant Director 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 E-mail : john.toone@dial.pipex.com
Secretary Dave McAdam
33 Wrekin View, Madeley, Telford, Shropshire, TF7 5HZ.
Tel : 01952 432048 E-mail : dave@telf-ast.demon.co.uk
Nova/Supernova Secretary Guy M Hurst
16 Westminster Close, Basingstoke, Hants, RG22 4PP .
Tel & Fax : 01256 471074 E-mail : 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 E-mail : rdp@star.ukc.ac.uk
Circulars Editor and CCD Advisor Karen Holland
136 Northampton Lane North, Moulton, Northampton, NN3 7QW
Tel: 01604 671373 Fax: 01604 671570 E-mail: 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)

BAAVSS web pages:http://www.telf-ast.demon.co.uk/

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Non-Members	£5.00	£6.00	£8.50

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Observation Report Forms	Assistant Director	Free
Inroduction to the VSS	Assistant Director	40p
Making Visual Observations	Assistant Director	40p
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