BINOCOLAR CHART FOR UGEMINORUM ISSN 2631-4843 N= 2815 Ch:, 074922 H.C.O., R.A. (1900) 7 49" 10", Det + 22" 15.8 -11-(1925) 7 50 39, -11 + 22 12.0

The British Astronomical Association

Variable Star Section Circular

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No. 191 March 2022

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Cover Picture

Blueprint binocular chart for <u>U Geminorum</u> E. E Markwick, March 1923 Welcome to the March 2022 Variable Star Section Circular. I write this just after the UK has been hit by three severe storms in quick succession: Dudley, Eunice and Franklin. I hope this finds you safe and well, although I know damage was caused to some people's observatories. Let's hope for a calmer period ahead.

Thank you to Roger Pickard

Roger Pickard has recently announced that the time has come for him to stand down as a VSS Officer. I would like to thank him for his long service to the Section, including 20 years as Director and then as Assistant Director.

Roger's contributions to the VSS have been immense, as was recognised by the well-deserved award of the BAA Merlin Medal & Gift in 2020. As the longest serving VSS Director, Roger has seen many changes in variable star astronomy and has ensured that the Section remains relevant to today's variable star enthusiasts. He has promoted the VSS far and wide and encouraged many people to take up VS observing. Do read Roger's article later in this Circular.

I am sure all members of the Section will join me in wishing Roger well in his retirement, with many clear skies ahead for him to continue doing what he loves: observing variable stars.

CG Dra campaign

Observations continue to come into the VSS photometry database in support of the campaign on the dwarf nova, CG Dra. The light curve since the beginning of the campaign shows the star continually varying between magnitude 15.5 and 17.0 in a what appears to be a succession of small outbursts.

Although the star is circumpolar from the UK, observations tend to tail off during the winter months as the field becomes less accessible. With Spring soon upon us, things will get easier. We will continue the campaign until at least the end of the year. It is anticipated that an analysis will then be prepared for the *Journal*.

Many thanks to all those that have submitted observations. Of course, further observers are most welcome. If you need further guidance, please do contact me.





Contributors: P Bouchier, G D Coates, N D James, P C Leyland, R Pearce, R D Pickard, G Poyner, R Sargent, J Shears, F Tabacco, M Usatov, I L Walton

ER UMa systems

The observing campaign on ER UMa systems continues. Although it's getting towards the end of the season for **V1159 Ori**, see how far you can continue to follow it into the twilight skies. Other ER UMa systems available include **RZ LMi**, **DI UMa**, **ER UMa** itself and **IX Dra**.

Northerly novae still under surveillance

March 18 marks the first anniversary of the discovery of the remarkable nova **V1405 Cas** (N Cas 2021) by Yuji Nakamura. The nova has kept many of us entertained and it is still bright (10th mag at the time of writing).



Light Curve for V1405 Cas

Contributors: P G Abel, S W Albrighton, D Boyd, I Bradley, D S Conner, D Dobbs, C J Evans, G Fleming, R B I Fraser, K Gurney, G M Hurst, N D James, M L Joslin, D Matthews, M Mobberley, W Parkes, R Pearce, G Poyner, J D Shanklin, I Sharp, J Shears, J Toone, T Vale

Several other novae which erupted in 2020 and 2021, including V1391 Cas, V1112 Per, V1674 Her, and V606 Vul, are still above quiescence and continue to be monitored by members of the Section.

Nick James continued to perform photometry on **V606 Vul** until the end of January when it disappeared into the twilight. He reported that the nova was brightening during January. Gary Poyner found it 14.59C on Feb 23.249 on a SLOOH image, showing the brightening had continued. If you have a good horizon, see how soon you can pick it up.

A Section report on these novae has been submitted to the Journal.

Hind's variable nebula

Richard Sargent has reported significant changes in the apparent morphology of Hind's variable nebula in Taurus, NGC 1555, in recent weeks. The changes in the features just south-west of **T Tau** are especially noteworthy. The accompanying images were taken with Richard's Celestron 14 and an Atik 460EX camera (N to the top and W to the right). T Tau is a triple system which hosts three catalogued Herbig–Haro flows.



Variable nebulae and their stars have long been popular targets among observes of the VSS and the Deep Sky Section. Another variable nebula, NGC 6729, and its associated star, **R CrA**, are discussed in a paper by Terry Evans and Grant Privett in the February edition of the *Journal* (J. Br. Astron. Assoc. **132**, 1, 2022).

SPRING MIRAS

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| RW And | m=Apr |
|-------------|-----------|
| R Agr | m=Mar |
| R Aql | M=May/Jun |
| X Cam | m=Apr |
| SU Cnc | M=Apr |
| U CVn | M=Mar |
| RT CVn | m=Mar |
| omicron Cet | m=Mar |
| R Com | m=Mar |
| S CrB | m=Mar |
| V CrB | m=Apr |
| chi Cyg | M=Apr |
| S Cyg | M=Mar |
| RU Her | m=May/Jun |
| SS Her | M=Mar |
| | m=Apr/May |
| R Hya | m=Apr |
| SU Lac | M=Mar |
| RS Leo | M=May/Jun |
| | m=Mar/Apr |
| W Lyn | M=May |
| X Oph | m=Mar |
| U Ori | M=May |
| R Ser | M=Apr/May |
| T UMa | M=May/Jun |
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Source BAA Handbook

Roger Pickard – Assistant Director, retires.

"I think the time has come for me to step down from my "official" work within the VSS." That said, as soon as I first mentioned this to the team by email, Gary immediately asked if this meant I wouldn't be reading though the Circular any more looking for any possible errors? Don't worry' Gary, I'm still happy to do that!

Next was John Toone who wanted to know if I was still prepared to check the Visual charts and provide new sequence stars where necessary? Yes, John, much of that is still "Observing", so still happy to do that!

This completed approximately 26 years of close affiliation to the VSS committee. This, in turn, had commenced with the formation of PALC – the "Professional Amateur Liaison Committee", for more on that see <u>VSSC No 100, June 1999</u>.



Section Officers taken at the Cambridge VSS Meeting on Saturday, 19th February 1994. Officers were Dave McAdam, Guy Hurst, Melvyn Taylor, Roger Pickard, Gary Poyner, Janet Mattei AAVSO Director, John Toone and George Alcock comet and Nova discoverer extraordinaire.

Then on 23 February 2004 Karen Holland, who was then VSSC editor and a member of the PALC team, wrote to me about PALC saying:-

"This committee had not met since meeting No. 21 on 2000 May 8 and it has been agreed that it is far easier to continue discussions via email these days rather than trying to arrange a suitable time when everyone can meet up (at UCL). In addition, there has not been the amount of material that has demanded PALC's attention since that time and therefore it has been unanimously agreed that we should terminate PALC-VS forthwith".

Pickard's Life with Variable Stars

It all started in late 1966 when I visited a Crayford Manor House AS "Open day" for new members and I immediately signed up and the following month met Jack Ells. I also recall reading a book about Jupiter on the train going to work which was quite deliberate as I'd already noted Jack catching the same train and reading the same book! Anyway, we got chatting, and in due course he invited me around to do some observing with his 12" telescope in his heated observatory – bliss!

Towards the end of the year, we were observing a few variable stars, the first being an observation of W Cas on 7 Oct 1967 at 21:36:00 and it seems I've never looked back! This was especially true when a chap called Richard (Dick) Young joined the Society and who was soon to educate me and Jack Ells into the world of Photoelectric Photometry and, with his help, I built my own instrument. But this was not enough, and in due course I had advanced to using a "proper" CCD photometer, which I still use to this day, although a much later model!

Visual variable star observing was still popular at Crayford in those early days and Dick Chambers and I both regularly gave talks to the Society there. More were to follow at the VSS Meeting at Swansea in 1987 Sept. (see VSS Circular 65, pages 30-36). Dr David Stickland, who was also editor of the professional "Observatory Magazine" also gave a talk at that same Meeting. A number of us met up for further discussions following the VSS Meeting and agreed a further meeting on Professional/Amateur liaison would be beneficial, and so the formation of PALC would begin. This gave me an excellent opportunity to meet with other professionals and so gave me the opportunity to extend my observing further.

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BAA VSS Blueprint Charts 1910-1970

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The BAA VSS pioneered the use of blueprints (Sir John Herschel invention) for copying & distributing variable star charts. This is an outline summary of the BAA VSS blueprint charts up until the blueprint process became obsolete in the late 1960's.

In-between making appeals for amateur astronomers to take up the observation of variable stars in 1833 and 1849 [1], Sir John Herschel made an important invention that had far reaching consequences beyond astronomy. In 1842 Herschel devised a method of copying drawings and written documents through a chemical process that became known as cyanotype resulting in prints containing white detail on a blue background derived from black on white original documents [2]. The blueprint process as it became known was used extensively by engineers and architects from the late 19th Century to the mid-20th Century for copying and distributing design documentation.

The process required the preparation of a master document from coated semi-transparent paper, drawing cloth or (later) polyester such as Mylar or Melinex. I had personal experience of this when upgrading substation designs in the early 1980's where many of the original design drawings were made on either cloth or polyester. The term blueprint is still in widespread use today, not so much for copying but instead for prototype/original designs.

The BAA VSS started to use blueprints for light curve reproductions in March 1908 [3]. Then in July 1908 at the Franco-British Exhibition held in London the BAA displayed a poster that included blueprint light curves of SS Cyg and 10 LPV's compiled from BAA VSS data amassed in 1906 & 1907 [4].

Colonel Markwick had earlier distributed the first BAA VSS charts as hectograph copies [5] but apparently the masters were not suitable for producing satisfactory blueprints. Therefore, during the first year of his directorship, C L Brook redrew the BAA VSS master charts on coated semi-transparent paper that allowed blueprint copies to be made. This permitted the first blueprint charts and sequences covering all of the LPV's on the VSS programme to be released at the end of 1910 [6].

The only surviving master chart (black ink on coated semi-transparent paper) from Brook's original 1910 set is the telescopic field for V Boo. This chart together with its associated blueprint are reproduced as Figures 1 & 2 respectively.

Meanwhile over in America the Society for Practical Astronomy (SPA) was formed in 1909 with a clear objective to replicate in America the work of the BAA [7]. The SPA set up observing sections along BAA lines including a Variable Star Section initially led by W T Olcott (founder of the AAVSO) but replaced by Dr Edward Gray in 1913 [8]. The SPA was not sustained beyond 1917 and Gray only acted as SPA VSS Director for a year, but during that time he launched blueprint charts [9]. A few months earlier in 1912 Gray had also taken a leading role in the fledgling AAVSO adopting and distributing blueprint charts [10].

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Figure 1: Master chart of V Boo dating from October 1910 drawn by C L Brook. This master is based on a coated semitransparent paper that resembles modern tracing paper (click on chart for full size version)

Figure 2: Equivalent blueprint chart to figure 1. (click on chart for full size version)

The BAA VSS influence on blueprint charts was further extended in 1924 when the first southern hemisphere variable star group, the BAA New South Wales Branch VSS, was set up in Australia. A set of Brook's 1910 blueprint charts were issued to the NSW Branch VSS [11] and one of those charts (omicron Cet) was used by Frank Bateson to make his first variable star observation from Sydney in January 1926. When Frank retired in December 2004, I presented him with a picture frame based on the blueprint chart that he had used nearly 79 years earlier (Figure 3).



Figure 3: Picture frame presentation to Frank Bateson on 4th December 2004. The main content of the picture frame was the 1910 blueprint chart for omicron Cet.

Within the BAA VSS chart archive a few original master charts on coated semitransparent paper, drawing cloth and polyester have been retained. The changeover from paper to cloth was between 1935 & 1937 when Felix de Roy continued to use paper whilst W M Lindley had started to use cloth (in 1935 both materials were used for the charts of DQ Her). Cloth was used by R G Andrews until the mid-1960's. Figure 4 reproduces the master cloth chart for R And prepared in 1958 and Figure 5 is the equivalent blueprint copy.

Blueprints continued to be used for distributing charts until the mid-1960's at the end of R G Andrews' director term. At that time more economical methods of duplication started to become available. In 1967 J S Glasby wrote the following [12] to John Isles in relation to the chart for HR Del:

"You may notice the difference in the colour of the chart. This is because I have been unable to find any firm now doing the old-type blue-prints. Ozalid have this new method which produces a darker colour that does not fade. This difficulty in getting blue-prints has made it impossible for me to get out any further charts for another couple of months."





Figure 4: Master chart of R And dating from October 1958 drawn by R G Andrews. This master is based on drawing cloth that has a smooth wax texture on the reverse side. (click on chart for full size version)



From this point onwards new copies of charts were made in black on white format and the stock of blueprints gradually became exhausted. The last chart in white on blue format that exists in the chart archive (Figure 6) was drawn by Sir Patrick Moore in 1970 on behalf of the Binocular Sub-Group. Patrick's connections with publishers possibly helped at a time when conventional blueprints were effectively obsolete and commercial printing firms had discontinued their services.



Figure 6: The BAA VSS Binocular Sub-Group chart for U and EU Del drawn by Sir Patrick Moore in 1970. *(click on chart for full size version)*

References:

- 1. 2010J BAA, 120, 135
- 2. 2009 SCIAM, 301, 90
- 3. 1908 JBAA, 18, 26
- 4. 1908 JBAA, 18, 341
- 5. 1900 JBAA, 10, 386
- 6. 1910 JBAA, 21, 24
- 7. 1912 PA, 20, 524
- 8. 1913 PA, 21, 370
- 9. 2001 JAAVSO, 29, 140
- 10. 1912 PA, 20, 614
- 11. 1925 BAAVC, T, 22
- 12. Letter dated 10/10/1967 from J S Glasby to J E Isles retained in BAA VSS Chart Archive in HR Del folder

In summary blueprints were the principle means of copying and distributing BAA VSS charts from 1910 until the mid-1960's. They proved popular with observers because their appearance was akin to the night sky. Other variable star groups followed the BAA VSS lead by adopting blueprint charts and their general usage appears to have paralleled that of the engineering industry. One can speculate that Sir John Herschel would have been pleased at the ultimate success of his appeals to amateur astronomers to observe variable stars, his cyanotype invention and also the link between them.

Finally, the bulk of the current BAA VSS master charts are drawn on Melinex (legacy of my engineering draughtsman training back in 1978), so if for any reason in the future we wanted to produce a form of blueprint, we have the means to do so.

CV & E News

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Recent activity in the CV & Eruptive programme stars DY Per, RZ Leo are discussed, along with new DNe discoveries MASTER OT J030227.28+191754.5 & TCP J07094936+1412280.

DY Per

Now finally classified as a type DYPer star in its own right and no longer type RCB(DY), DY Per is currently undergoing a moderately deep fade with the mean brightness at the time of writing (Feb 20) at magnitude 14.4 – the fade began in mid-October 2021 from a mean magnitude 11.0V. The rate of decline appears to be levelling off at this time. BAAVSS data shows the previous deep fade (to mag. 14.9V) occurring in October 2019 (Fig.1). DY Per can dip below magnitude 16.0 at times (2009 & 2013), but these deep fades seem to be the exception. The mean minimum brightness of the fades since 1992 when the star became popular with some observers, is 14.2.

The slow decline seen in Figure 1 below (currently 137d) is typical of DYPer stars in that the rate of decline is much slower than RCB stars. The recovery will be highly symmetrical to the decline rather than a slow, occasionally interrupted recovery generally seen in RCB type behaviour. Continuing with the RCB comparison, amplitude of fades are generally smaller. Observers are asked to continue to monitor DY Per for as long as possible into Spring, and to report your observations to the database as soon as possible after making them.

CCD+I photometry reveal DY Per to be a highly reddened object, with I magnitudes around 2.5 magnitudes brighter than V at maximum and minimum brightness. B measures are typically 2 magnitudes fainter. DY Per stars are all hydrogen deficient, normal C type stars which show Semi-Regular type behaviour at maximum. The period of DY Per itself has been measured at 792d.



Figure 1: The current fade of DY Per compared to the previous event in 2019. BAAVSS database. Observers: *Dryden, Joslin, Leyland, Pearce, Poyner, Vale & Withers.*

RZ Leo

The UGWZ star RZ Leo was detected in outburst on Jan 12.791UT at magnitude 13.6C by Tadashi Kojima (Gunma, Japan) with a 200mm lens on a Canon EOD 6D camera (<u>vsnet-alert 26522</u>). This is the first outburst detected since February 2016. By Jan 15 early superhumps of 0.09 mag amplitude

had been detected and reported to <u>vsnet-alert 26529</u>, with ordinary superhumps of amplitude 0.3 mag reported later on Jan 15, and reported on <u>vsnet-alert 26532</u>. By Jan 27 RZ Leo had faded to 15.5V then dropped a further two magnitudes in three days with the last positive observation made on Feb 14 at 18.03C - the outburst lasting 33 days. No rebrightenings were reported (unlike 2016), and sadly no t/s photometry was undertaken by BAAVSS observers.



RZ Leo on Jan 14.211 UT at magnitude 13.04C. Cropped 10' image from full frame taken by <u>COAST</u> (*G. Poyner*)

MASTER OT J030227.28+191754.5: - a new record for UGWZ systems

The discovery of a new transient object in Aries on 2021 November 26.825 UT was announced by K. Zhirkov et al. on <u>Atel 15067</u>. Discovery magnitude was 15.1C, but quickly brightened to 11.7 by Nov 27.704UT. Speculation at this time was that the object was a He Nova. Further spectroscopic observations and time series photometry carried out by K. Isogai et al and reported on <u>Atel 15074</u> however revealed characteristics of a dwarf nova of type UGWZ, and not a classical Nova. Further investigations into the brightness range reveal that MASTER OT J030227.28+191754.5 has the largest outburst amplitude yet detected in any UGWZ systems.

BAAVSS coverage was disappointingly sparse, with just 45 observations (both visual and CCD) reported from three observers (*D. Matthews, W Parkes and G. Poyner*) throughout the outburst



period. The light curve left from data by these observers reveals the path of the decline quite well, however. A slow steady decline set in from the first observation made on Nov 30.83 UT at magnitude 12.6C to 15.5C, 22d later on Jan 22.924UT. We then have a week's hiatus due to weather, where we can see that a sharp decline to magnitude 18.8C had occurred by Jan 29.908 UT. Fortunately, an inspection of the AAVSO data fills in this gap somewhat with

a V magnitude of 15.96V on Jan 23.9UT and 16.6C by Jan 24.79UT. Up to the time of writing (Feb 20), there have not been any rebrightenings observed.

TCP J07094936+1412280:

A new transient in Gemini was discovered by Tadashi Kojima, Tsumagoi, Gunma-ken Japan on Dec 28.532 UT at magnitude 13.6C from three 5s frames using a Canon EOS 6d and 200mm lens. Early superhump data was reported to <u>vsnet-alert 26497</u> on Dec 30, from where the classification of UGWZ is taken from. The outburst peaked on Dec 29.0 at 12.15C.



BAAVSS data is again surprisingly sparse, with only twenty nine observations reported to the database by two observers – *M. Phillips and G. Poyner.*

The light curve (*left*) from BAAVSS data shows a slow decline from magnitude 12.15C on Dec 29.037 UT to 15.48C by Jan 30.058. Following this a rapid fade set

in over the next week, with the next observation made on Feb 7.843 UT with the object fainter than 17.6C. A visual inspection of the AAVSO light curve also reveals a break in observations for this period.



TCP J07094936+1412280 at maximum brightness on Dec 29.04 UT 2021 at magnitude 12.15C. Cropped image from a full 43'x43' field. SLOOH C2. *G Poyner* It's getting extremely difficult these days to keep up with new discoveries of variable stars by the various surveys now in operation, and it's thanks to observers, both professional and amateur, around the world who report their discoveries or news of discoveries to mailing lists which allow observers to gather valuable data on these new objects. BAAVSS observers are encouraged to monitor the various mailing lists which are available, and to observe these new targets as often as possible and report their data to the VSS. Many of these new objects won't necessarily end up on the BAAVSS observing programmes (which would result in a very large programme indeed), but they should still be monitored as closely as possible at every opportunity.

RS Cancri

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Observations of RS Cancri submitted to the BAAVSS in the period 1970-2022 show a main period of 239.3 days, slightly lower than that quoted in the VSX of 242.2 days. There are tentative suggestions for a secondary period in the range of 122-144 days, which agrees with quoted secondary periods of 122 and 130 days.

RS Cancri is a bright semi regular variable, which is ideal for observers using binoculars. The <u>VSX</u> lists the star as being a SRb star with a range of 5.33-6.94V, period 242.2d and a M6S spectra which is rich in oxygen. A secondary period of 134.6d (Otero) is noted, along with a note from the GCVS Team of P2=1700d and comment of Tc (Technetium) being present in the spectrum.

RS Cnc is a fascinating star to study and has been the subject of several professional papers. A 2010 study by Libert [1], found that RS Cnc started mass loss some 20,000 to 30,000 years ago, during which time it has experienced approximately 20 thermal pulses, 10 of which included dredge up. They suggest that the initial mass of the star was 1.5 solar masses, which has now reduced to 1.2 solar masses. They also mapped the star in $H_1(21cm)$ and found that the star displayed a gas trail in the opposite direction to the stars proper motion. Fig 1 is an H_1 map for RS Cnc from Hoag [2]. Only X Her and Mira are currently also known to display such a trail, [3].



Figure 1: H1 total intensity map, derived from data with 6 kl tapering. Contour levels are $(1,2,3...9) \times 6.6$ Jy beam⁻¹ ms⁻¹. This image was derived by summing the emission over the velocity range from 2.6kms⁻¹ to 11.6kms⁻¹; to minimize the noise contribution to the map, data that did not exceed a 2σ threshold after smoothing the data spatially and spectrally by a factor of 3 were blanked. The star symbol marks the stellar position of RS Cnc.

Currently there are three known occurrences where material from deeper layers within a star are dredged up into the surface layers.

The first dredge-up occurs when a star leaves the main sequence and enters the red-giant branch of the Hertzsprung-Russell diagram. This appears in a depletion of ¹²C in favour of the CN-cycle products ¹³C and ¹⁴N.

The second dredge-up occurs only in stars in the range of 4 and 8 Solar masses. When helium fusion ends at the core, convection mixes all the products of the CNO cycle. This results in an increase in ⁴He and ¹⁴N, in the surface abundances and decrease in ¹²C and ¹⁶O.

The third dredge-up occurs when a star enters the asymptotic giant branch, after a flash in the helium burning shell. This brings helium, carbon and s-process products to the surface. In some larger stars this process turns the star into a carbon star. The s-process produces many heavier elements including Ba, Sr and Pb. Of note however is Tc, which has a short half-life, ⁹⁹Tc with a half-life of 2.1x10⁵ years at low temperatures. At higher temperatures, for example 3.5x10⁸ ⁰K, which is characteristic of the temperatures of a helium flash, this reduces to about 12 years. Technetium is apparently able to survive the hot environments of the helium flashes and not significantly decay before it is dredged to the surface. Presence of the element indicates that the synthesis in nuclear reactions are recent phenomena, Deupree and Wallace (1987) [4].

Turning to analysis of the light curve for RS Cnc, the BAAVSS have received 5,536 observations between 1970 and 31/01/2022. A plot of all observations is shown below. This gives an extreme range of approx., 5.0-7.0, which is in line with VSX. It should be noted that due to the star's location close to the ecliptic it is not visible from more northerly latitudes during the period from early June to late August.



Light Curve for RS CNC

Contributors: S W Albrighton, C M Allen, J M F Andujar, M Barrett, J W Barry, M Beach, B J Beesley, M R Bell, G C Blair, N M Bone, R Braga, T Breistaff, C Brookman, R S Byrne, R H Chambers, A Chapman, E H Collinson, P Craven, B S Crawford, R W Cripps, M Currie, J S Day, G C Dobie, H G Duncan, D 2 Ells, J W LElls, S J Evans, M Fadda, J Farrer, R W Fleet, G Floming, G R Floodgate, R B J Fraser, A Gardner, D Gavine, M Gill, A D Godden, T Gough, L Green, M A Hather, S R Heathcote, C Henshaw, D Herbert, T L Heywood, J R Higgs, M S Hoenig, K Holland, P W Hornby, E H Horsley, A Horton, J J Howarth, D Hufton, R K Hunt, G M Hurst, A Hutchings, J E Isles, R D Januszewski, B Jobson, S Johnston, B J Keenan, N S Kleman, G J Kinby, R Livingstone, D K Lloyd, D Loughney, B MacDonald, B MacDonald, C Mann, T Markham, R A Marriott, L R Matthews, L McCalman, R H Mcnaught, J Meacham, I A Middlemist, I Millier, R Minty, B R M Nunden, I P Nartowicz, M J Nicholis, R Pearce, R D Pickard, G Pointer, G J Privett, G Ramsay, D H Roberts, K Robers, K Rohter, I W Saunders, T G Savine, P A Saven, A B Scott, J D Shanklin, J Simpson, A Smeaton, H W S Smith, J S Smith, E Spooner, R M Steele, R Steer, G Stefanopoulos, D M Swain, T Tanti, M D Taylor, J Thorpe, J Toone, , E J W West, D Young, D L Young, E Yusuf

Analysis using the AAVSO, VStar program [5], gives two dominant periods of 239.3d and 234.1d, with semi amplitudes of 0.14 and 0.11 mags, respectively. These two periods are probably manifestations of the same period. This is not surprising as by their very nature SRb stars display only poorly defined periodicity. It is also possible that the star can flip between one period or another, or indeed show gradual change. Whilst this result is close to the VSX period of 242.2d, it is however shorter. In a recent study Roberts [6], AAVSO results yielded strongest periods of 239.2 and 240.6d, which again is slightly shorter than the VSX.

In the 2010 report by Libert [1], periods of 130d and 250d were found, whilst Adelman (2005) [7], found 122 and 248d. Checking our data reveals three weak possible periods of 123,136 and 144d, all with semi amplitudes of 0.08 mag. This hints at a possible shorter period but remains uncertain. There is no evidence for the longer 1,700d period noted by GCVS.

Interestingly, looking specifically at the period 2012-2022 (see plot below), we find fewer observers, but more consistent results. A dominant period of 238.9d is found with semi-amplitude of 0.32 mag. A longer period of 705d is also found (0.22 mag), together with two shorter periods of 129.9 and 115.7d (0.16 and 0.15 mag). The 705d period however is not hinted at in the longer time frame. It will be interesting to see if continued monitoring of the star confirms any of these additional periods.



Symbol Key: Crosses = Negative observation, Triangle = Brighter than, Otherwise: Circle = Visual, Diamond = CCD/CMOS, Plus = Everything else Contributors: SW Albrighton, M Barrett, G Fleming, R B I Fraser, D Gavine, T L Heywood, B MacDonald, C Mann, T Markham, R Pearce, M D Taylor, J Toone

Observers with binoculars are encouraged to add RS Cancri to their programme, not only is the star fascinating from an astrophysical point of view, but it also shows significant variation. Early morning estimates during autumn and early winter are especially needed. Care should be taken when making estimates as due to its orange colour, there is the possibility of observations being influenced by the Purkinje Effect. This effect means that staring at a red/orange star causes the star to appear brighter. Observers should therefore avoid where possible, using larger binoculars (colour will be more obvious) and observe the star with short glances. Some observers use the extra-focal method, whereby the stars are defocused, thereby reducing the colour. Finally, for those who make estimates using DSLR cameras, RS Cnc would be an ideal addition to your programme.

References:

- 1: Libert, Y., Winters, J., Le Berte, T., Gerard, E., Matthews, L. (2010), A&A, 351, A112
- 2: Hoai, D. et al, (2018). <u>The Multi-scale Environment of RS Cnc from CO and H₁ Observations</u>. A&A manuscript no. rscnc, October 30, 2018.
- 3: Diep, P et al (2015) <u>CO and H1 Emission from Circumstellar Envelopes of Some Evolved Stars</u>. October 30 2015.
- 4: Deupree, R.G and Wallace, R.K. <u>The Core Helium Flash and Surface Abundance Anomolies</u>. Astrophysics T. 317, 724 (1987).
- 5: AAVSO <u>V Star Program</u>.
- 6: Robert, R. <u>LPV of the Month</u> Jan 2020 RS Cnc.
- 7: Adelman, S. Dennis, J. (2005). <u>The S-Type AGB Stars RS Cnc, ST Her, OP Her & HR Peg</u>. Baltic Astronomy, Vol 14, pg. 41-50.

BH Crucis and Dual Maxima Miras

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The Mira star BH Crucis has undergone a variety of changes in behaviour since its discovery in 1969. These are summarised and compared to stars exhibiting some of these features. Of particular interest is its change from a double maximum Mira to a somewhat brighter but cooler single maxima Mira with a pronounced hump on the rise. The recent suggestion by Tracie Heywood that T Cephii could be changing from a Mira with a pronounced hump to a dual maxima Mira suggests it may be in an earlier stage of evolution and may add an important part to the overall picture.

Introduction:

Dual maxima Miras (D M Miras) seem almost entirely confined to the southern hemisphere, but this doesn't fit our ideas about stellar evolution. More likely this feature is a very short part of the lifetime of a long period variable star such as a Mira and due to a statistical anomaly, the dozen or so stars showing this feature at this time are largely in the south.

One of the most interesting of these is BH Crucis. For a star which has a range of about 2-3 magnitudes and reaching ~6.5 at maximum it should have been discovered long before 1969. Since its discovery by Ron Welch in Auckland that year it has performed in quite an unexpected but interesting manner.

Some stars just shine in the sky and do nothing. But BH Crucis does a little bit of everything that Miras are noted for:

- It shows a major period change.
- It also is probably subject to period alternations.
- It had dual maxima for a period.
- It changed from a dual maxima Mira to a Mira with a strong hump.
- It brightened by 0.7 magnitudes
- Its spectrum changed from SC to CS
- It appeared to cool as it brightened, indicating a major change in radius.

What will it do next?

History from 1969 to 2021:

When discovered the period was ~421 days and the amplitude made its classification as a Mira marginal, being almost exactly 2.5 magnitudes. For a detailed summary of this see Walker, 2009.

By the late 1970s it was clear that the period was becoming longer and over the 24 year interval from 1974 to 1998 it had increased by 109 days or ~25%. The only other star with a similar period change is LX Cygni. Since 2008 its period seems to have decreased slightly to ~505 days.



Figure 1: This periodogram covers a half century of measures of BH Crucis. The vertical scale is days, the horizontal one is JDH - 2400000. During the first two decades its period increased by 109 days, or a little over 25%, before becoming relatively stable at 530 days. But is the period now decreasing?

Apart from these two there are less than a dozen Mira stars with true period changes. These are attributed to helium flash events but in all cases the change is very slow, lasting centuries. R Hydrae's period was ~520 days in 1666 decreasing to 490 days by ~1790 and appeared to have stabilised at 388 days by ~1950 but more recently has shown a continued reduction in the period. So, it's doubtful that we have seen even one completed helium flash induced period change in any of these other stars.



Figure 2: This periodogram shows changes in period of almost 300 cycles of R Hydrae over more than three centuries. The vertical scale is days, the horizontal one is cycles. The green diamonds are individual periods, the red circles are means of 5. In the mid-20th century, the period seemed to have stabilised at 388 days but over the last two decades has now begun to decrease again. Period alternations are also clearly visible during the last century. The more recent cycles have been determined by measuring minimum then adjusting to the date of maximum as the maxima have not been completely observable.

BH Crucis has also changed in other ways: it has become brighter, and the shape of its light curve has changed from a double maximum to a bright single maximum with a pause on the rise, joining the ranks of the 'hump' Miras. The phase of this hump is very close to that of the initial first maximum. Colour photometry through B-V filters shows a slightly redder and cooler star. All of these can only be explained by a substantial increase in radius.

The importance of all of this is that it shows that these long period variables are capable of changing their behaviour in a variety of ways which may provide a better understanding of their evolution. Tracie Heywood's <u>recent article</u> about T Cepheii is important in that the future behaviour of that star may confirm that a strong hump evolves into a D M Mira.

The Colours at Maximum:

At the Auckland Observatory we made many UBV measures of both BH Crucis and R Centauri. The latter is also another Mira undergoing a period change - in this case rather similar to that of R Hydrae but it's only in the early stages, having begun about 1923.

These two stars show a marked contrast. BH Crucis now exhibits a hump on the rise as do many other Miras. Of the two maxima in the 1970s the second was the bluer and hotter. In the case of R Centauri, the reverse is the case and its behaviour over the last few decades has shown that the second maximum is the less stable.

A good project would be for someone to obtain B-V colour measures of the separate maxima of the other dual maxima Miras to show which of these two stars they resemble. Useful candidates are R Nor, V415 Vel, TT Car, BX Car, KS Pup and BN Sco which last has a regular hump of 50% in magnitude.

In making such measures the transformation and atmospheric corrections need to be accurate. I have tried using published measures of B and V from the International Database maintained by the AAVSO but without success. Many of these use single filter transformations which do not allow for what Hardie, 1962, defines as the scale factor or correction for the divergence of the effective filter wavelengths from those defined by H L Johnson in the 1950s. Johnson selected B and V to be useful as a quick indicator of temperature and it is probably still the best filter system for doing that

The observation that the two maxima of R Centauri in the past had slightly different colours but the same brightness presented us with the question - what is happening to the radius? The Stefan-Boltzman law indicates that luminosity = radius^2 x temperature^4. I have been working with a colleague to obtain radial velocity curves but to date this has not produced any useful results.

The Hump Stars - How do they relate to the Dual Maxima Stars?

I was interested in S Orionis as it lies close to the celestial equator and has been measured from both hemispheres. Giorgio di Scala of New South Wales measured this star through a few cycles. These are shown in Figure 3. The curves of most interest are V and B-V, but V-R and V-I have been included for completeness. This graph is unusual in that whilst the horizontal scale is phase there are two vertical scales - magnitudes on the left and intensity at the lower right.



Figure 3: S Orionis phased to the ephemeris JD 2453600 + 429. This places the maximum at phase 0.50 which is convenient to study the shape of the curves. The left vertical scale is in magnitudes, the scale at the lower right is in intensities with an arbitrary minimum of 1.

If we are examining S Orionis from an astrophysical viewpoint we need to work with real proportions and relationships. Thus, while the hump looks to be around half the amplitude on the magnitude scale it is only about 10% of the intensity. S Ori has one of the more prominent humps so that many of the other hump stars are much weaker.

The B-V curve clearly follows the changing spectrum and temperature whereas the V-R and V-I are clearly affected by the overall variability and are not of much interest in a normal analysis. There are also many measures of this star by other northern observers, but these could not be used as they used different comparison star values and transformations. A discussion of this problem can be seen in <u>Variable Stars South</u>, <u>Newsletter 2020/1</u>, page 31.

A star very similar to S Orionis in the scale of the hump is R Telescopii but neither of these stars can compete with T Cep or BH Cru. An interesting feature is that these four stars are rather low amplitude Miras - 5.0, 5.3, 4.0, 3.0 magnitudes respectively in recent times. Is this important?

Conclusion:

Miras evolve very slowly, and professionals are rarely first to see changes - it is the large network of amateur observers who do this and provide the background behaviour against which more powerful methods of study such as spectroscopy and even colour photometry can be fitted. Projects such as ASAS3, TESS and Hipparcos may last for a time and produce more accurate measures while they are in action - but then the funds run out or they disappear for other reasons. So, the visual measures are important and tend to be the only long term historical record.

I have recently been collaborating on a project to study aspects of the superoutbursts on VW Hydri, the most widely studied CV in the southern sky. But it is alarming to see the drop in the numbers of visual observations being made. Perhaps the International Astronomical Union is also concerned about this as they have recently set up a ProAm group to work more closely with we amateurs. Hopefully this will devote strong attention to the need to encourage more visual observers.

Tracie should be commended for drawing attention to an aspect of Mira evolution - if the dual hump phenomenon is a normal but short-lived part of the evolutionary process then we should see its onset. We have seen the end of this phase with BH Crucis - her question is, and it is very interesting and important, are we seeing the beginning of the phase with T Cephei?

References:

| Hardie, R H | 1962 | Stars and Stellar Systems II, Astronomical Techniques |
|-------------------|---------|-------------------------------------------------------|
| Heywood, Tracie L | 2021 | BAA VSS December, Circular 190,8 |
| Walker, WSG 2009 | Journal | AAVSO |
| Walker, Stan | 2020 | Newsletter, Variable Stars South 2020/1 |

Eclipsing Binary News

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Eclipsing Binary Animation

This animation of an EA system by the European Southern Observatory might be useful for presentations. (*Click on image*)



Note the comment: "By studying how the light changes, and other properties of the system, astronomers can measure the distances to eclipsing binaries very accurately. A long series of observations of very rare cool eclipsing binaries has now led to the most accurate determination so far of the distance to the Large Magellanic Cloud, a neighboring galaxy to the Milky Way and crucial step in the determination of distances across the Universe".

Castor - the six-star system

Castor is the second brightest star in the constellation Gemini and is 48.9 light-years away from Earth. William Herschel was the first astronomer to describe Castor A and Castor B as a true binary system in 1803.

Castor AB and Castor C are currently separated by over 1100 AU (16 days and 9 light-hours). Even though it is fainter than Gemini's "beta" star, Pollux, Castor has the Bayer designation "alpha."

The time that Castor AB and Castor C take to orbit each other is currently unknown, but it is probably more than 10000 years. The Castor AB system has an estimated orbital period of 467 years. The diagram is courtesy of NASA /JPL - Caltech.



Castor C is also known by the variable star designation YY Gem and is an EA system.

zeta Aurigae - notice of eclipse July 2022

This system has an eclipse about every three years (972 days). The midpoint of the next eclipse is predicted to be 13/7/22. This not a favorable opportunity from the UK but I am sure useful measurements can be made elsewhere of ingress and egress, The eclipse lasts about 37 days. For some information on the eclipse referring to the last eclipse see <u>VSSC 178</u>.

LY Aurigae - an approaching opportunity for measurements/ observations



This system is on our priority list for observing. It is a bright EB/SD system that varies between about 16.6V and 7.35V. As it has a period of nearly an even day the period is currently 4.002494 days - the predicted mid-time of primary/ secondary eclipses only changes by 3 minutes from one primary eclipse to the next. There can be long periods when, from the UK, the mid eclipses occur in daylight. At the time of writing the eclipses are around 18.30 and are slowly but steadily getting later. Eclipses will quite soon be taking place, for about a year, between 18.00 and midnight. Thus, the system will be

favorable for observing. Of course, as an EB system eclipses are continuous and useful measurements/ observations can be made at any time.

The light curve above is taken from a paper ' The O type eclipsing contact binary LY Aurigae - member of a quadruple system': P Mayer et al <u>AA Vol 559, November 2013</u>.

More recently obtained times of minima and light curves of some Eclipsing Binaries

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This article includes times of minima of the following eclipsing binaries; DO Cas, TT Aur, GW Gem and IY Aur, and light curves and phase diagrams of DO Cas, HD 227877 (= V2896 Cyg), HD 332629 and V698 Cyg.

The following eclipsing binary minima were observed from Somerby Observatory using the '2 Inch Titan'. Photometry was with AIP4WIN and the HJD of the minima were obtained using Peranso.

| Star | HJD of Minimum | Error | Type of Minimum |
|--------|----------------|----------|-----------------|
| DO Cas | 2459583.348422 | 0.000052 | Secondary |
| DO Cas | 2459584.320888 | 0.000015 | Primary |
| TT Aur | 2459600.353042 | 0.000049 | Secondary |
| GW Gem | 2459601.376766 | 0.000302 | Secondary |
| IY Aur | 2459615.533222 | 0.000251 | Secondary |

Some light curves and phase diagrams

DO Cas

A primary minimum of this EB type eclipsing binary was observed from Somerby on 2022 January 4, and a secondary minimum was observed on 2022 January 5. These are shown in the following light curve and phase diagram.





The following two sets of diagrams are of eclipsing binaries discovered in 2016. The data is from photometry of images taken by the Open University COAST telescope. (Prior to mid July 2021, COAST consisted of a C14 (14 inch/35cm) Schmidt-Cassegrain, it was then changed to a CDK17 (17 inch/42cm) corrected Dall-Kirkham.

HD 227877 (recently added to the GCVS as V2896 Cyg)

Photometry from 193 V filtered images taken between 2017 July 6 and 2021 December 31.



HD 332629

Photometry from 191 V filtered images taken between 2017 June 17 and 2021 December 29. There is some suggestion that the secondary minimum doesn't quite occur at phase 0.5 but is slightly later at about phase 0.52



The following light curve and phase diagram are of the EA type eclipsing binary V698 Cygni. At more than 97 days, this has a much longer period than the above systems, and long term observing programs using online instruments cover the whole of the phases, not just the minima. Again, photometry is of images taken with the COAST system.

V698 Cyg

Photometry from 171 V filtered images taken between 2017 July 10 and 2022 January 2.



More details about these observations, and others, can be found on my website at https://davidsconner.weebly.com/

Recent minima of various Eclipsing Binary Stars

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This report lists recent timings of minima of various eclipsing binaries. The observations from which the timings were obtained have all been posted to the BAAVSS photometric database. For stars which were included in Christopher Lloyd's recent series of articles, updated O-C diagrams, including the observations listed here, are shown below.

Timings:

| <u>Star</u> | <u>HJD of Min</u> | <u>Filter</u> | <u>Error</u> | <u>Type of</u> <u>Minimum</u> |
|-------------|-------------------|---------------|--------------|----------------------------------|
| V704 Cyg | 2459378.51556 | TG | 0.00125 | Primary |
| BS Vul | 2459416.49200 | TG | 0.00035 | Primary |
| VX Lac | 2459450.47489 | TG | 0.00053 | Primary |
| WZ Cep | 2459453.42961 | TG | 0.00035 | Primary |
| WZ Cep | 2459453.63575 | TG | 0.00064 | Secondary |
| AD And | 2459464.46368 | TG | 0.00043 | Secondary |
| WW Cyg | 2459478.44368 | TG | 0.00073 | Primary |
| TW Cas | 2459507.52984 | TG | 0.00233 | Secondary |
| ZZ Cyg | 2459509.36972 | TG | 0.00025 | Primary |
| EG Cep | 2459511.43123 | TG | 0.00012 | Primary |
| TW Cas | 2459525.37899 | TG | 0.00024 | Primary |
| SV Cam | 2459550.54617 | TG | 0.00025 | Primary |
| CW Cas | 2459516.33008 | TG | 0.00039 | Secondary |
| AD And | 2459584.28322 | V | 0.00039 | Primary |
| Z Dra | 2459593.50180 | V | 0.00062 | Primary |
| V375 Cas | 2459594.33100 | V | 0.00067 | Primary |

The observations from which these timings were obtained were made from June 2021 to January 2022 using a 102mm refractor and an ASI 183MM-Pro cooled mono CMOS camera. The timings were extracted using Bob Nelson's Minima software. Due to difficulties obtaining a V Band filter, all but the last three observations were made with the green filter from an LRGB filter set and are listed as "TG".

AD And, Z Dra and EG Cep featured in Christopher Lloyd's series of articles published in the Circulars between 2018 and 2020 (AD And & EG Cep in <u>VSSC 176</u> and Z Dra in <u>VSSC 182</u>). For these stars, the most recently available O-C diagrams from the O-C gateway of the Czech astronomical Society are shown below. I have also added the timings listed above to those diagrams

and they are shown in red. The AD And O-C diagram includes both observations above and also the DSLR observation which was published in the June 2021 Journal . The sinusoidal curve suggests the presence of a third component which is causing a variation in distance from us to the eclipsing pair of ± 0.02 light days or about ± 3.5 AU with a period of about 12 years. The O-C diagram suggests that the pair are now near their closest to us and should soon start receding. The EG Cep O-C diagram also shows a sinusoidal variation but shallower and with a longer period of about 50 years. Z Dra has shown a number of period changes and the observation included above suggests another one might be underway. As with AD And, more observations over the coming months should reveal more.

O-C diagrams:

AD And



EG Cep







visual

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Charts for all stars on the BAAVSS observing programmes are freely available to download from the VSS Website <u>www.britastro.org/vss</u>

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Deadlines for contributions are the 15th of the month preceding the month of publication. Contributions received after this date may be held over for future circulars. Circulars will be available for download from the BAA and BAAVSS web pages on the 1st day of March, June, September and December.

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