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VARIABLE STAR SECTION

CIRCULAR 61

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ρ Cas

In a paper to be published in the AAVSO *Journal*, John Percy, Virginia Fabro and David Keith, discuss their examination of BAA and AAVSO visual observations of this very luminous yellow supergiant. Apart from an apparently unique 1-magnitude fade from 1945 August to 1947 June, the magnitude variations are small (about 0.2 mag, with a variation in the mean magnitude of also about 0.2 mag) and far from regular. The authors examined the observations by various methods, including one employing a correlogram, which appears to hold promise for the study of similar objects. They establish that the variations occur on a typical time-scale of 275 to 400 days. This is consistent with the pulsational time-scale for such a star, which shows some similarities with both Cepheid and R CrB objects. The authors conclude by saying that visual observations of ρ Cas should continue and that the analysis shows that as long as observations are made frequently, carefully and consistently, they can yield worthwhile information about such small-amplitude objects.

Charting Southern Hemisphere Binocular Variables: Part 1
- Colin Henshaw

Visiting the southern hemisphere is the ultimate objective of many amateur astronomers. An increasing number now are beginning to come south, but since they only come on holidays, their stays are unfortunately short. I've always felt that to appreciate the southern hemisphere full, from whatever aspect, a long-term stay is desirable.

It was a great opportunity for me, when I was appointed to teach for the Ministry of Education in Zimbabwe. I had the prospect of being in the southern hemisphere for a good number of years, and already I had a number of projects lined up.

One project was the charting of binocular variables in the southern hemisphere along the same lines as the Binocular Group's charts for the north. At first I concentrated on stars south of -40 , which I knew could never be seen from Britain, and then on selected variables between -20° and -40°, which in many cases could possibly be seen.

The task was not easy. I wrote around to numerous southern hemisphere astronomical societies, sending them a list of stars I wanted to observe with a pair of 12x 40 binoculars. What I got back was unbelievable (if I got anything at all!). Often I would receive charts for fifteenth magnitude dwarf novae, which would be difficult enough in a ten-inch, let alone binoculars!

Eventually, a few suitable charts filtered through, and I managed to start work. However, often they were inadequate. The charts would only show a small area of sky around the variable, and this made location difficult, since there was an absence of bright finder stars. Though sequences might have been reasonable

in many cases, I decided to re-draw these charts along the lines that we have been used to.

For the other objects I was interested in, it seem that charts simply did not exist. I decided then to produce my own.

In order that I could produce good binocular charts I needed a good atlas and a catalogue. Most Binocular Group charts are produced from the large Becvar atlases, *Borealis* and *Ecliptical is*, so I decided to obtain a copy of *Australis*, the southern counterpart to *Borealis*. For source magnitudes I opted for the Smithsonian Catalogue. These magnitudes are often considered a little ropey, but for the southern hemisphere I am told that they are better. If enough comparison stars have been selected, then those with discordant magnitudes can be rejected later. The *SAOC* is particularly convenient since its star positions are listed for Epoch 1950. This is a definite advantage when hundreds of comparison star positions have to be checked. Eventually I also managed to secure a copy of *Sky Catalogue 2000.0*, so I was able to derive photoelectric sequences for some of the brighter stars. On some occasions I was surprised to learn that after I had modified my original sequences from *Sky Catalogue 2000.0*, when it came to observing the star I preferred the original *SAOC* sequence. In these cases the original sequences were retained. New Zealand sequences were also retained where these were OK, since I felt it was preferable for only one sequence to exist for any particular star. (So far I have seen about half-a-dozen charts for η Carinae.)

Obtaining the *Atlas* and *Catalogues* was not easy. In Zimbabwe one cannot simply walk into the bank and demand a bank draft. I was told I had to apply to the Ministry of Trade and Commerce for an Import Licence, and when I did so they began to ask a load of silly questions. Eventually, after three months, the application was approved, and only then did the bank give me a draft. That process took about three months, and it took a further three months for the goods to arrive.

[To be continued]

Accuracies of magnitudes in *Sky Catalogue 2000.0* and *SAOC*

Commenting upon Colin Henshaw's finding mentioned above that the magnitudes in *Sky Catalogue 2000.0* are not necessarily better than those in the *SAOC*, John Isles points out that this is also true for the northern hemisphere. One problem is that many stars are wrongly listed with magnitudes to two decimal places (which should imply that they are photoelectric), the second decimal being a zero, but these magnitudes are simply rough visual estimates. Only when B-V is given to two decimals can one be sure that the V magnitude is really photoelectric. Also the photoelectric V magnitudes in *Sky Catalogue 2000.0* are not complete. Publ. USNO XXI (1968) gives photoelectric magnitudes for many bright stars for which *Sky Catalogue 2000.0* gives only a

rough visual extimate. The *Catalogue of Stellar Information* (CSI), compiled by the Centre des Donnees Stellaires at Strasbourg, includes many more photoelectric magnitudes than those in Publ. USNO XXI or *Sky Catalogue 2000.0*. But as it is compiled, in part, from the same database as *Sky Catalogue 2000.0*, CSI suffers from similar deficiencies.
[Both Guy Hurst and Andy Hollis, invited to comment on the accuracy of the CSI, report that it must be used with caution. Guy Hurst notes that it consists of a compilation of approximately 25 catalogues, most of which were not intended to be photometric, so the magnitudes are of varying degrees of accuracy. A source listing is given, however, so that with care reliable individual magnitudes may be chosen, if the original catalogue is known to be satisfactory. Guy Hurst hopes to be able to report on this subject at a later date. See also the review by John Isles of *Sky Catalogue 2000.0* beginning on page 6.]

IQ Per - Dr Richard Miles

I observed this eclipsing binary on the night of 1985 Feb.15/16 using my home-built photometer and a 28-cm aperture telescope. This star is fairly bright and is included in the Eclipsing Binary Programme of the VSS. Details given in the 1974 GCVS are as follows:

Epoch of Minimum:	JD 2 440 222.5974
Period:	1.7435673 days
Range (V mag.):	7.72 - 8.27
Eclipse duration:	5.0 hours
Duration of constant phase:	0.02 P (about 50 minutes)

The variable has a companion (mag. 9.3) situated 39 arcsec distant. I therefore employed an aperture with a diameter of 140 arcsec in the photometer head, so as to include the light from both the variable and the companion star. In this way it is possible to avoid using a very small aperture that would otherwise be needed to isolate the variable star only, and telescope guidance becomes a relatively simple task.

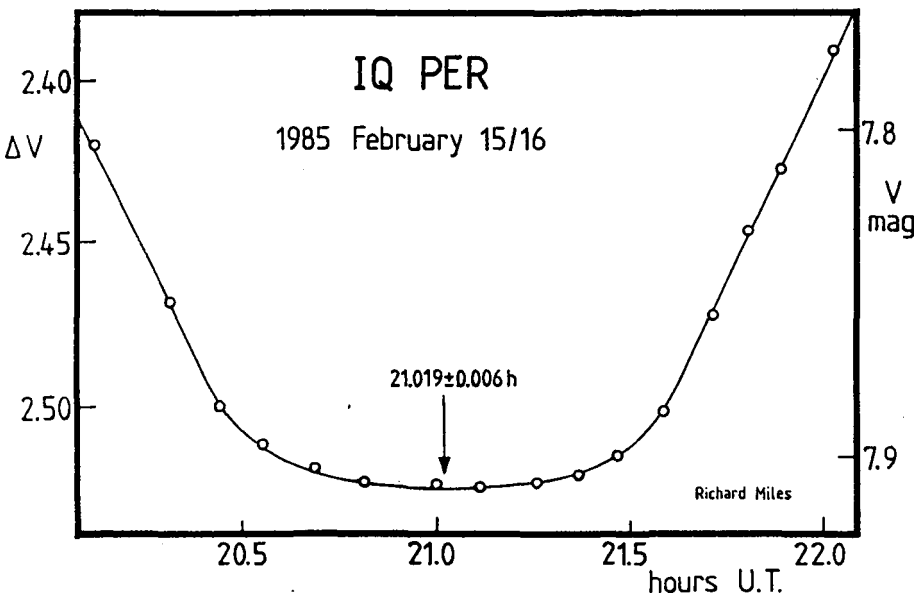
I monitored the variable for one hour either side of the primary minimum and obtained the light-curve shown in the Figure (overleaf). Observing conditions were very good with no evidence of obscuration by clouds or haze. Each point shown plotted is derived from the average value of eight 10-second integrations of the variable (+ companion). The standard deviation of each plotted value from the mean (symmetric) light-curve is a mere 0.002 magnitudes. At minimum, IQ Per + companion registered a combined V magnitude of 7.91, equivalent to V = 8.26 for IQ Per only, in good agreement with the value given in the GCVS. The duration of the phase of constant light at primary eclipse was measured as 58 minutes or 0.023 P, again in agreement with the GCVS. The value for the (O - C) time of minimum adjusted for the

light-time correction was estimated to be +0.0090 days ±0.0003 days).

I hope that this short note illustrates the capability of the technique of photoelectric photometry in the field of variable star observation. Members of the VSS who may be interested in furthering the use of photoelectric methods of observation should contact me at the following address:

Fernbank Farm, Sugar Lane, Manley, Cheshire WA6 9DZ

[O - C values for IQ Per, derived from visual results, are reported in VSSCs 58 - 60. John Isles remarks that this system's secondary minima, which are only 0.07 mag deep according to the catalogue, do not come midway between primary minima but about 1.8 hours later. The orbit is elliptical, and according to IBVS 1815 the system may show apsidal motion. Despite their greater difficulty, photoelectric observers are urged to time secondary minima too.]



Erratum - VSSC 60

Due to a printing error the photograph on page 4 was not centred on the Nova. It is actually the bright object 98 mm from the top and 34 mm from the right-hand edge.

Eta Geminorum - request for observations

Observations of this semiregular and eclipsing variable from 1964 to 1984 are being collated for analysis in the *Journal*. Members who have unreported observations are invited to send them in. Data are required for all years but particularly 1969 (to check a possible deep minimum reported by a single observer), 1977-78 (for which so far we have no observations at all) and 1980 (the last eclipse). Observers should write to John Isles, who will advise what, if any, observations of theirs are already held.

1984 Light-curves

Enclosed with this issue is a separate booklet containing 1984 light-curves for various Main Programme stars. These should be regarded as preliminary, as not all observations were submitted in time to be included in the computer files that were used, and also as the observations have not been examined in detail. Negative estimates have been removed when positive observations were recorded on the same date and multiple negative estimates have been reduced to a single (lowest) magnitude. Erroneous observations have not been removed or corrected.

The information available on these particular computer files did not allow the behaviour of some of the eruptive stars - in particular the 2 novae - to be shown in detail. We expect to improve the time resolution in future and make other changes to assist in the reproduction of the light-curves.

[For those interested in such matters, the hard work was done by Greg Coady, who entered the data on a BBC microcomputer. The disk files were transferred via another BBC machine (belonging to Don Miles) and an RS 423 - RS 232 link to Storm Dunlop's Epson QX-10 machine, and after some further manipulation, plotted on an Epson HI-80 plotter.]

Binocular Chart Booklet

Copies of the 32-page booklet *Binocular Variable Star Charts*, Vol.1, containing 24 charts and covering 41 stars on the Binocular Programme, are now available. The first printing of this booklet, made available at BAA meetings, sold out rapidly. This second printing contains the same charts, but incorporates some corrections, additional material in the explanatory text and some alterations to the layout. Although reduced to approximately A5 size from our normal larger format, the charts remain fully legible and are convenient to use. Copies of the booklets are available, price £1.00, post free, inland and foreign surface mail (foreign air mail £1.50), from Storm Dunlop, and will also be obtainable from the BAA Office and at BAA meetings. This booklet has met with much interest, and we hope to publish other items of this sort in the near future.

Review:

Sky Catalogue 2000.0, Volume 2: Double Stars, Variable Stars and Nonstellar Objects. Alan Hirshfeld and Roger W. Sinnott (eds). Cambridge Universtiy Press, 1985. Dimensions: 23 cm x 30 cm. Pp. lvii + 385, pbk, £17.50.

Like Volume 1 (*see* the excellent review in the *Journal*, 92 (6), 283, 1983 Oct.), this is an invaluable companion volume to Tirion's *Sky Atlas 2000.0*. It collects together an enormous mass of information from specialist publications not readily available to the amateur.

The introduction (30 pp.) gives a brief account of the history of observation of each class of object and their physical nature, and describes the sources of each part of the catalogue. Included are 24 photographs and diagrams, and tables of OB associations, the Messier catalogue, the Local Group, and clusters of galaxies. The updated classification of variable stars used in the 1985 GCVS is described in detail, and an algorithm for light-time corrections is given; unlike some in the literature this actually gives correct results. A list of references follows (5 pp.).

Perhaps the most fascinating section is the glossary of selected astronomical names (6 pp.) If you want to identify Baxendell's wisp, or Struve's lost nebula, they are all here, along with Branchett's object, Gyulbudaghian's nebula, Przybylski's star, Wischnjewski's supernova, and Eggen's nearby star ("CoD -31 622, briefly thought to be near the solar system but later found not to be").

The index to letter names of variable stars (7 pp.) provides an alternative route to entries in the main list (which is in RA order) for objects with variable star designations, plus Roman letter designations such as P Cyg and g Her - but curiously not those with Greek letter designations.

The main lists follow:

Double and multiple stars (160 pp.): all 8,315 known systems down to 8.0 m, for the 1976 magnetic tape version of the IDS.

Visual binary stars (40 pp.): orbits for 518 pairs with a primary 8.7 m or brighter, mainly from a 1982 tape compiled by Couteua and Fulconis. An ephemeris is also given for five points in time, ranging from 1985.00-1985.08 (Capella, already out of date) to 1940-2020, depending on the orbital period.

Spectroscopic binary stars (20 pp.); 485 systems brighter than 6.3, plus selected fainter ones, from the 1978 catalogue by Batten *et al.*

Variable stars (40 pp.): 2427 objects, mainly from a tape of the 1969 GCVS and supplements, updated for constellations And-Cru from a tape of date from the 1985 GCVS. Stars are included if they are 9.0 or brighter at maximum, or 9.5 if they are plotted in the *AAVSO Variable Star Atlas*, or if they are in the *Yale Bright Star Catalogue*.

Suspected variable stars (12 pp.): 706 objects from the 1982

NSV, brighter than 10.3 at maximum and having an amplitude of 0.5 m or more (plus a few others). Suspects indicated in NSV as doubtful appear to have been excluded even if they meet these criteria.

70 percent of the catalogue thus deals purely with stars. There follow open clusters (17 pp. including a cross-index of designations); globulars (4 pp.); bright (6 pp.), dark (4 pp.) and planetary (10 pp.) nebulae; galaxies (48 pp.); QSOs (6 pp.); radio (12 pp.) and X-ray (5 pp.) sources. These lists will no doubt be considered elsewhere by competent reviewers.

Several of the lists are followed by notes (very concise) which include some information added by the editors from other sources.

To illustrate the wealth of data available, consider the star η Gem. Vol. 1 (p.141) has already told us that this is Propus = 7 Gem = HD 42995 = SAO 78135 = ADS 4841, a multiple and variable star as well as a spectroscopic binary at (2000.0) $06^h\ 14^m\ 52\overset{s}{.}6$, $+22^o\ 30'\ 24''$, with annual proper motion -0.004^s in RA and $-0.01''$ in Dec. Its V magnitude is 3.28, B - V = +1.60, absolute magnitude -.5, spectrum M3III, radial velocity +19 km sec^{-1}, distance 57 pc. Vol. 2 adds the following information (exact repetitions of data are not mentioned):

As a double star (p.40), it is also known as Burnham 1008 (1882: 301^o, $1.0''$; 1958: 266^o, $1.4''$). Magnitudes 3.3 and 8.8, spectrum M, and an orbit has been computed. Component A is variable.

As a visual binary (p.173), its parallax is $0.013''$ (implying a distance of 77 pc). Orbital elements by Baize (1980) are quoted, and the ephemeris is for 1940-2020.

As a spectroscopic binary (p.208), its orbit is quoted from McLaughlin (1944). The period is 2983 days.

As a variable star (p.230), its type is SRb(E), visual range 3.2-3.9, period 232.9d, duration of eclipse 0.05 of period. The date of an eclipse in 1962 is given, with a note that η is a spectroscopic binary with a period of 2984 days.

It will be noted that there are some inconsistencies between the sections, reflecting differences in the sources. This is fine; far better than imposing a cosmetic uniformity, which leaves one even more uncertain what the source is for a particular item of information. The editors have however, forced the magnitudes of double star components to agree with the magnitudes given in Vol. 1. This is a pity, as the latter are mostly not photoelectric and may not be more accurate. The USNO photoelectric catalogue, indirect source (via Strasbourg) of many of the Vol. 1 mags, usually indicates which components of a double are said by the observer to be included in a magnitude; but the present editors have simply programmed the computer to force to the Vol. 1 magnitude either the combined magnitude of the components, or the magnitude of the primary, whichever

results in the smaller adjustment.

How accurately have the data been transcribed? I have checked the known and suspected eclipsing binaries against my card index and found no discrepancies with the GCVS and NSV except that:

(a) The notes of the 1985 GCVS were evidently not available to the editors. Thus, for example, the V range for WW Aur is taken from the 1985 GCVS, but the mag of Min II is taken from the 1969 edition and is actually photographic.

(b) For some systems (but not all those possible), different elements appear to have been taken from the Cracow yearbook.

(c) κ Draconis, not in the GCVS, is listed as EB?, 3.5 - 3.9, 30d:, presumably from the Bright Star Catalogue.

A few specific errors have been noted:

ZZ Boo: The type, range and spectrum are all wrong.

i Boo: The elements are taken from the 1976 Supplement (or Cracow); the revised ones in the 1985 GCVS are ignored.

AH Vir: Data are taken from the 1971 Supplement. The V range given in the 1974 Supplement is ignored.

Among possible criticisms, it is a pity the editors did not ensure that the binary section contained an orbit for every pair for which PA and distance were omitten from the doubles section on the grounds that an orbit existed (e.g. Struvbe 3062). Many more recent orbits in the 1983 catalogue of Worley and Heintz are not used; the editors say that have used these only if they appeared to be significantly better, comparing them with published measures. the BAA Handbook for 1986 will use the 1983 catalogue, and there are some large discrepancies with the ephemerides given here. The ephemeris interval depends only on the orbital period and not one the current rate of motion. For example, ψ Sgr (period 19 years) is predicted annually, its PA changing $4\overset{\circ}{.}25$ per year, but γ CrA(120 years), whose annual PA change currently averages $4\overset{\circ}{.}55$, is predicted at 10-year intervals.

The list of variables excludes some bright red objects such as RV Cyg for which the GCVS gives a photographic range. The lsit of suspects would have been more useful had it been complete to a (perhaps brighter) magnitude limit, rather than covering only objects for which the NSV happens to mention a range of 0.5 m or more. Suspects which have received final designations since 1978 have not been eliminated; thus for example NSV 1063 appears elsewhere in the volume as V 623 Cas.

In fairness to the editors it should be mentioned that they recognize some of these limitations; one wonders though why in that case they didn't do something about them.

These are real criticisms, but minor ones when one considers that there is no publication like this. The only alternative is to buy all the source catalogues on which it is based. For the stellar observer for whom this is out of the question, *Sky Catalogue 2000.0: 2* is an essential purchase.

John Isles

Observations of some Suspected Variables - T. Markham

Over 28 000 stars are known to be variable and nearly 15 000 are suspected of variation. The problem is to distinguish between true variation and the inevitable scatter that occurs in visual observations.

The following table gives a summary of my observations with 10x 50 binoculars, carried out between 1980 and 1984, of some suspected variables. Only class I estimates are included. Except for BS 551 And, RX Cyg and ε Peg the comparisons used were from available BAA charts. The 'Range' column indicates the extremes of the estimates, and should not taken to imply that the stars actually varied to such an extent. The headings for the last three columns are abbreviated, 'SD' indicating Standard Deviation, and '2000' and 'Coe.' the magnitude given in *Sky Catalogue 2000.0* and *Atlas Coeli Catalogue*, respectively.

Star	Other name	Obs.	Range	Mean	SD	2000	Coe.
BS 551 And	SAO 37607	92	6.0-6.7	6.38	0.18	6.24	
NSV 02537	+31 1048 Aur	98	5.7-6.6	6.26	0.15	6.04	5.96
+49 2165 CVn		55	6.5-6.8	6.66	0.06	6.51	
α Cas		114	2.2-2.4	2.32	0.05	2.23	2.47
τ Cas		112	4.8-5.2	5.03	0.08	4.87	5.09
V Cep		21	6.4-6.7	6.62	0.07	6.4	6.6
SAO 19521 Cep		70	6.5-6.8	6.68	0.08	7.5	
RX Cyg		38	7.7-8.2	7.98	0.11		8.0
V 1624 Cyg	28 Cyg	81	4.6-5.1	4.84	0.10	4.93	4.82
NSV 12247	CSV 8232 Cyg	43	7.2-7.7	7.49	0.11	7.5	
NSV 12439	CSV 8307 Cyg	26	7.6-8.2	7.85	0.14	7.6	
NSV 13784	CSV 103049 Cyg	29	6.5-7.3	6.94	0.18	6.25	
NSV 13150	+19 4450 Del	12	7.6-7.8	7.66	0.07	7.5	
NSV 14213	CSV 8775 Lac	37	5.9-6.4	6.23	0.10	5.71	5.80
NSV 14260	CSV 102195 Lac	37	5.3-5.8	5.59	0.13		
θ Lyr		95	4.3-4.8	4.48	0.12	5.50	5.47
ε Peg		49	2.4-2.8	2.55	0.15	2.38	2.54
70 UMa		96	5.6-6.1	5.90	0.15	5.55	5.72

I have yet to be convinced that any of these stars are actually variable. In some cases it may well be that the star is not variable but that the catalogue magnitude is incorrect. In many cases the size of the observed range may well be an indicator of the quality of the sequence.

For most of the above stars there has been little or no detectable pattern in the observations. There are, however, five possible exceptions:

BS 551 And: Generally 6.3/6.4, but 6.1/6.2 in mid-1980 and 6.6/6.7 in late 1980

NSV 02537: Generally 6.2/6.3/6.4 but 5.8/6.0 in 1980 Feb.

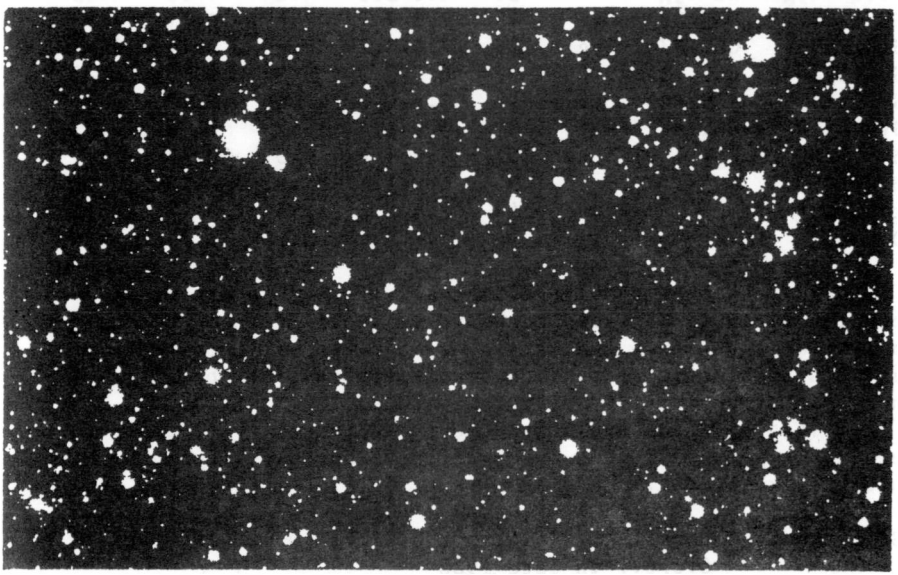
NSV 13784: Fade from 6.8/6.9 in 1982 to 7.1/7.2 in late 1984
ε Peg: Fade from 2.4/2.5 in 1980 to 2.7/2.8 in 1984
70 UMa: Generally 5.8/5.9, but 6.0/6.1 in 1980 Jan.-Feb., also 1980 Nov.-1981 Feb. and most of 1984.

[Data from the NSV and the 1985 GCVS for some of the stars discussed above may be of interest. These are as follows:

NSV 02537: Range 4.0-6.07; Sp = B7; flares (1-2m)
α Cas: Class = 'Cst:'; range 2.20-2.27 V
V Cep: Class = 'Cst:'; mag. 6.56
NSV 12247: Range 8.6-9.1 pg; Lb; Sp = M4
NSV 12439: Range 7.3-8.2 V; SR; Sp = K5
NSV 13150: Range 7.0-8.2 V; Sp = M7
NSV 13784: Range 6.20-6.26 V; Sp = K4 Ib
NSV 14213: Range 5.6-6.8 V; L; Sp = G8
NSV 14260: Mag. 5.09; amplitude 0.09 mag. in V; Sp = M4; ADS 16140 A]

HT Cassiopeiae

Further to the note in VSSC 60 (page 5), we include here a chart for this object (prepared by Guy Hurst for *The Astronomer*), and a photograph obtained by Harold Ridley (1985 Jan 23/24, 23.16 - 00.16 UT, 103aF, f/6.3 lens, 500 mm focal length). Please note that the photograph has a slightly different orientation to that of the chart and a smaller scale.

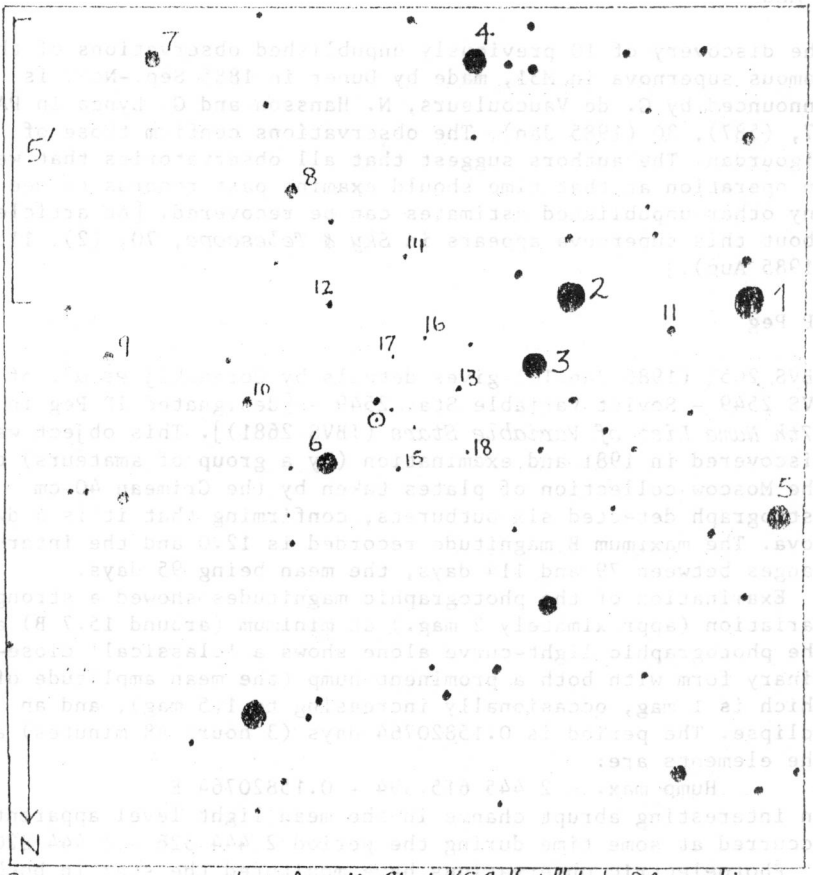


(C) 010359 HT CASSIOPEIAE

RA $01^h07^m.0$ DEC $+59°48'$ (1950)

Magn: 11.9 – C16 v

UG Star ?



Sequence: measures by W Pennell. Chart V.S.C. 16 + Photo by D. Buczynski.

1	9.5	5	11.3	9	12.7	13	14.7	17	16.3
2	10.1	6	Var?	10	13.4	14	15.1	18	16.6
3	10.4	7	11.5	11	13.6	15	15.5		
4	10.6	8	12.4	12	14.3	16	15.9		

GM HURST 85.01.20

(D) THE ASTRONOMER

Notes from other publications

International Bulletin on Variable Stars (IBVS)
Monthly Notices of the RAS (MN) and *Publications of the Astronomical Society of the Pacific* (PASP)
(From 1984 January MN have been issued twice monthly. The references below are to date and page.)

S And

The discovery of 10 previously unpublished observations of this famous supernova in M31, made by Duner in 1885 Sep.-Nov. is announced by G. de Vaucouleurs, N. Hansson and G. Lynga in PASP, 97, (587), 30 (1985 Jan). The observations confirm those of Bigourdan. The authors suggest that all observatories that were in operation at that time should examine past records to see if any other unpublished estimates can be recovered. [An article about this supernova appears in *Sky & Telescope*, 70, (2), 115 (1985 Aug).]

IP Peg

IBVS 2653 (1985 Jan.10) gives details by Goranskij *et al.* of SVS 2549 - Soviet Variable Star 2549 - [designated IP Peg in the *67th Name List of Variable Stars* (IBVS 2681)]. This object was discovered in 1981 and examination (by a group of amateurs) of the Moscow collection of plates taken by the Crimean 40-cm astrograph detected six outbursts, confirming that it is a dwarf nova. The maximum B magnitude recorded is 12.0 and the interval ranges between 79 and 114 days, the mean being 95 days.

Examination of the photographic magnitudes showed a strong variation (approximately 2 mag.) at minimum (around 15.7 B) and the photographic light-curve alone shows a 'classical' close-binary form with both a prominent hump (the mean amplitude of which is 1 mag, occasionally increasing to 1.5 mag), and an eclipse. The period is 0.15820764 days (3 hours 48 minutes) and the elements are:

Hump max. = 2 445 615.394 + 0.15820764 E

An interesting abrupt change in the mean light level apparently occurred at some time during the period 2 444 526 - 2 444 820.

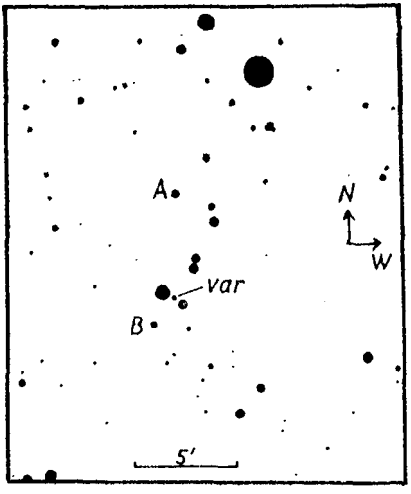
Photoelectric observations have monitored the star in both high and low states. The authors describe how, when they were monitoring the star on JD 2 445 909.519, the brightness suddenly fell by 2 mag in 2 minutes. Not expecting such behaviour, they used the comparison star to check sky conditions and the performance of the equipment, only to find that they had missed eclipse minimum. Subsequent photoelectric observations have established that the eclipse has an even larger amplitude (about 3 mag.), that it is total, and is also strongly asymmetric. The overall duration of the eclipse (D) is 42 minutes and the total phase (d) lasts for just 5.5 minutes.

The object appears to be a dwarf eclipsing system with low-luminosity components and an edge-on a ccretion disk. This is why the hot spot makes such a large contribution to the total luminosity of the system. The authors suggest that it should be monitored by amateurs if possible. The precise position of this object is:

$23^h20^m39^s.47 \quad +18^o08'42.0 \quad (1950)$

The field is shown in the small chart, which has been recopied from the published version. Photoelectric (V) magnitudes for the two comparison stars shown are:

A = 13.62 B = 13.80



β Per (Algol)

Observations of the HeI line at 5875 A are reported in PASP, 97, (587), 51 (1985 Jan) by J. Tomkin and T. Huisons. These confirm that the rotation of the primary is synchronous with the orbital period.

TW Vir

Infra-red observations of this object with the IRFT instrument on Mauna Kea are described by M. Mateo, P. Szkody and M. Bolte in PASP, 97, (587), 45-50 (1985 Jan), in the first of a series of papers on cataclysmic variables.

Examination of the observations revealed the presence of a period of 131.52 minutes. This is exactly half that of the orbital period and is therefore interpreted as being ellipsoidal variation from the tidally distorted M3 secondary.

Minima of Eclipsing Binaries, 1984 - John Isles

The Section's visual and photoelectric timings of minima of eclipsing binaries in the year 1984 are given in the accompanying table. Photoelectric determinations are distinguished by '(PEP)' following the observer abbreviation. Unless otherwise stated, O - C values are against the linear elements of the 1969 GCVS. The 1985 GCVS will become the datum for O - C when all relevant volumes have been published. For further explanation of the table, *see* VSSC 58. [New members may obtain copies of this *Circular* (and others) from Storm Dunlop at the address given inside the front cover.]

The total numbers of observations received (including estimates reserved for separate discussion, e.g. ε Aur) are summarised below.

	Observations	Timings
Photoelectric:		
J. Ells (EJ)	395	7
A. Hollis (HO)	244	6
M. Peel (PB)	-	1
R. Pickard (PI)	136	4
Total	775	18
Visual:		
J. Agar	46	-
N. Bone	18	-
T. Brelstaff (BS)	1741	126
H. Duncan (DH)	123	1
C. Henshaw (HC)	387	6
A. Horton	11	-
S. Jenner	20	-
S. McRoyall	29	-
G. Maris	2	-
T. Markham	6	-
P. Moore	16	-
G. Pointer	3	-
M. Savage	10	-
M. Taylor (TY)	58	4
P. Wheeler (WH)	130	7
W. Williams	5	-
Composite timings	-	2
Total	2605	146
Grand Total	3380	164

An asterisk draws attention to further information in the following notes:

V 523 Cas. Not listed in the 1969 GCVS. The O - C is against the elements of the 1976 Supplement.

β Lyr. Observers were BS, DH, Agar, Jenner, McRoyall, Markham, Pointer and Savage.

IQ Per. No period is given in the 1969 GCVS, so the O - C is against the elements of the 1974 Supplement.

LS Per. The period given in the 1969 GCVS is wrong, so the O - C is against the elements of the 1971 Supplement.

RV Psc. The period given in the 1969 GCVS and repeated in the 1971 Supplement is wrong The O - C is against the revised elements (Brelstaff and Isles, JBAA, in press):

Min = 2445053.31 + 0.93047 E

Approximate times of pre-1984 minima, derived from single estimates when the variable was seen faint, are also given. These replace the data given in VSSC 60.

GR Tau. The period given in the 1969 GCVS is wrong. The O - C is against the revised elements (Brelstaff and Isles, JBAA, in press):

Min = 244982.334 + 0.429853 E

For the following stars, all observations made in the calendar year were folded onto a single cycle and used to derive the times of the minima nearest to the median date of the observations: UW CMa, β Lyr, V Pup, V 450 Sco.

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

Star	Date	No.	Other Dates
KO Aql	5931	11	5334
AN Cam	5821	6	5925-6052
TW Cnc	5794	3	5795
SW Cyg	5814	12	5832
	5942	7	5593
RR Del	5923	8	5932-83
RW Gem	5814	3	5768-6066
LS Per	6066	5	5976
β Per	6031	18	5704-6034
SY Sge	5976	3	6001
GP Vul	6061	7	5942-6001

STAR	EPOCH	HELIO JD 244...	O - C	No	OBSERVER	
WZ AND	15670	5976.347	-0.018	9	BS	
AB AND	29575.5	5925.454	+0.027	7	BS	
	29593.5	5931.436	+0.035	9	BS	
	29804	6001.301	+0.036	4	BS	
	29979	6059.367	+0.022	6	BS	
	29985	6061.362	+0.026	8	BS	
AD AND	7026	5931.420	-0.043	11	BS	
	7027	5932.421	-0.028	9	BS	
	7071.5	5976.312?	-0.023?	7	BS	
DS AND	9807	6052.563	+0.111	9	BS	
KO AQL	4205	5931.523	+0.230	27	BS	*
OO AQL	23548.5	5859.532	-0.074	7	WH	
	23678.5	5925.428	-0.062	7	BS	
	23690.5	5931.498	-0.073	10	BS	
	23712	5942.405	-0.063	8	BS	
	23775	5974.330	-0.066	8	BS	
V346 AQL	13201	5934.481	-0.016	12	BS	
	13237	5974.307	-0.019	7	BS	
SS ARI	36412	5731.314	-0.104	12	BS	
	37077.5	6001.307	-0.094	5	BS	
	37220.5	6059.365	-0.093	7	BS	
SX AUR	16793	6066.3144	+0.0292	55	EJ (PEP)	
AR AUR	4589.5	5718.4706	+0.0119	19	HO (PEP)	
HL AUR	32488	5812.396	+0.001	8	BS	
	32888	6061.393	-0.004	8	BS	
TY BOO	35743.5	5816.432	+0.063	10	BS	
	36115.5	5934.402	+0.054	8	BS	
TZ BOO	44134.5	5816.460	+0.068	9	BS	
	44531.5	5934.413	+0.049	10	BS	
AC BOO	22838	5813.469	+0.012	18	BS	
	22843.5	5815.426	+0.031	10	BS	
	22846.5	5816.485	+0.032	11	BS	
44i BOO	31521	5804.4405	+0.0515	53	HO (PEP)	
	31532	5807.3860	+0.0510	37	HO (PEP)	
	31569.5	5817.4306	+0.0526	34	HO (PEP)	
SV CAM	20156	5731.368	-0.012	9	BS	
	20296	5814.395	-0.015	13	BS	
AL CAM	14607	5814.473	-0.016	10	BS	
AN CAM	944	5821.20	-4.95	8	BS	*
AZ CAM	14811	5932.405	-0.001	9	BS	

STAR	EPOCH	HELIO JD 244...	O - C	No	OBSERVER	
TW CNC	197	5794.647	+0.167	5	BS	*
UW CMA	4427	5776.31	-0.08	45	HC	*
	4426.5	5773.91	-0.28	42	HC	*
RZ CAS	7229	5784.426	-0.005	9	WH	
TV CAS	14196	5849.533	-0.028	8	WH	
AB CAS	9011	5933.456	+0.005	12	BS	
V523 CAS	19303.5	5731.354	+0.006	10	BS	*
	19337.5	5739.298	+0.005	9	BS	*
	20134	5925.442	+0.014	6	BS	*
	20160	5931.513	+0.008	11	BS	*
VW CEP	46078.5	5988.2889	-0.1415	14	PI	(PEP)
	46079	5988.4250	-0.1445	30	PI	(PEP)
	46100.5	5994.4082	-0.1452	21	PI	(PEP)
	46136	6004.2906	-0.1430	33	EJ	(PEP)
	46150.5	6008.3234	-0.1459	14	PI	(PEP)
	46226	6029.3414	-0.1409	33	EJ	(PEP)
	46230	6030.4545	-0.1410	75	EJ	(PEP)
EG CEP	34523	5731.410	+0.029	10	BS	
	34894	5933.463	+0.027	9	BS	
RW COM	53816	5813.420	-0.055	11	BS	
RZ COM	32425	5813.472	-0.006	11	BS	
	32431	5815.508	-0.002	11	BS	
SS COM	50415.5	5813.559	-0.061	15	BS	
	50420	5815.421	-0.057	10	BS	
	50422.5	5816.450	-0.060	12	BS	
CC COM	28457	5813.433	-0.041	9	BS	
	28461.5	5814.417	-0.050	10	BS	
	28466	5815.423	-0.037	9	BS	
	28466.5	5815.537	-0.034	9	BS	
U CRB	8466	5974.331	+0.007	8	BS	
SW CYG	1577	5814.401	-0.004	25	BS	*
	1605	5942.447	-0.005	12	BS	*
WZ CYG	29388	5925.546	+0.031	13	BS	
	29475	5976.394	+0.031	9	BS	
V466 CYG	12246	5815.510	0.000	11	BS	
	12325	5925.449	+0.005	8	BS	
	12331.5	5934.500	+0.011	11	BS	
V1143 CYG	2661	5834.481	+0.052	12	BS	
W DEL	5802	5933.434	+0.153	13	BS	

STAR	EPOCH	HELIO JD 244...	O - C	No	OBSERVER	
RR DEL	6031	5923.407	+0.189	10	BS	*
Z DRA	9424	6061.247	+0.024	7	BS	
AI DRA	5639	5817.5303	+0.0085	0	PB (PEP)	
	5774	5979.377	+0.016	9	TY	
BH DRA	11119	5980.352	+0.069	5	TY	
RW GEM	9601	5814.305?	+0.013?	7	BS	*
V450 HER	22182	5933.475?	-0.244?	3	BS	
	22183	5934.412	-0.221	11	BS	
SW LAC	26043.5	5925.454	0.000	7	BS	
	26068.5	5933.459	-0.014	12	BS	
	26280	6001.300	-0.007	5	BS	
	26461	6059.347	-0.011	7	BS	
	26467	6061.271	-0.013	8	BS	
AW LAC	16791.5	5814.470	+0.086	10	BS	
	16896.5	5934.443	+0.060	13	BS	
	16955	6001.316?	+0.075?	5	BS	
CM LAC	11783	5934.397	0.000	10	BS	
	11788	5942.420	0.000	8	BS	
	11813.5	5983.336	-0.004	6	TY	
UV LEO	12256	5795.362	-0.014	9	BS	
	12289.5	5815.488	+0.009	10	BS	
AM LEO	27952	5818.4832	-0.0506	34	HO (PEP)	
AP LEO	45032	5794.382	-0.024	8	BS	
TT LYR	2910	5925.515	+0.014	13	BS	
TZ LYR	47547	5813.504	+0.038	11	BS	
	47770	5931.438	+0.045	11	BS	
UZ LYR	11451	5925.434	+0.032	8	BS	
BETA LYR	3664.5	5943.90	+51.49	80	8	*
	3665	5950.44	+51.58	93	8	*
V839 OPH	23383.5	5925.435	-0.022	8	BS	
	23400.5	5932.434	+0.024	11	BS	
	23403	5933.459	+0.027	14	BS	
ER ORI	22557	6059.409	-0.031	8	BS	
V640 ORI	8493	6059.463	-0.023	8	BS	
	8494	6061.485	-0.021	12	BS	
U PEG	25320.5	6001.305	-0.029	4	BS	
	25475.5	6059.382	-0.044	7	BS	
	25480.5	6061.268	-0.031	8	BS	

STAR	EPOCH	HELIO JD 244...	O - C	No	OBSERVER	
BX PEG	31024	5925.444	-0.004	7	BS	
	31049	5932.441	-0.017	11	BS	
	31052.5	5933.428	-0.011	10	BS	
	31084.5	5942.407	-0.007	10	BS	
ST PER	2631	6059.486	-0.038	12	BS	
IQ PER	3304	5983.359	+0.015	6	TY	*
IU PER	13807	5731.427	+0.079	15	BS	
	14195.5	6064.379	+0.078	11	BS	
LS PER	2288	6066.410?	-0.215?	11	BS	*
BETA PER	2285	6031.484	-0.150	25	DH	*
RV PSC	38905	5934.507	-0.011	11	BS	*
	38977	5974.384	-0.021	6	BS	*
	38980	5976.337	-0.006	7	BS	*
UV PSC	20929	6059.412	+0.026	6	BS	
V PUP	11790	5796.704	-0.010	42	HC	*
	11790.5	5797.392	-0.050	44	HC	*
V SGE	15639	5931.418	+0.007	15	BS	
	15641	5932.443	+0.003	15	BS	
SY SGE	3655	5976.424	+0.188	12	BS	*
V453 SCO	1456.5	5916.38	+2.45	52	HC	*
	1457	5922.22	+2.30	46	HC	*
RW TAU	10305	5731.289	-0.082	12	BS	
	10421	6052.457	-0.100	9	BS	
	10426	6066.310	-0.092	6	BS	
BV TAU	0	5053.316?	+0.006?	1	BS	*
	28	5079.373?	+0.010?	1	BS	*
	388	5414.323?	-0.009?	1	BS	*
	416	5440.368?	-0.018?	1	BS	*
	819	5815.392?	+0.027?	1	BS	*
	1074	6052.633	-0.002	12	BS	*
CF TAU	5591	6059.360	-0.051	15	BS	
GR TAU	2505.5	6059.338	+0.007	8	BS	*
	2506	6059.548	+0.002	11	BS	*
X TRI	8736	6059.509	-0.048	14	BS	
	8738	6061.458	-0.042	12	BS	
W UMA	20947	5781.435	-0.174	5	WH	
	20956	5784.430	-0.182	10	WH	
	20962	5786.431	-0.183	11	WH	
	20980	5792.4293	-0.1898	36	HO	(PEP)
	21055	5817.457	-0.186	9	WH	
	21729	6042.3207?	-0.1998?	28	EJ	(PEP)

STAR	EPOCH	HELIO JD 244...	O - C	No	OBSERVER	
W UMA	21738	6045.3259	-0.1974	40	EJ (PEP)	
	21738.5	6045.4942	-0.1959	43	EJ (PEP)	
ZZ UMA	4397	6061.330	0.000	9	BS	
RS UMI	3060	5731.340	+0.034	7	BS	
RT UMI	10415	5815.482	-0.083	18	BS	
	10478	5931.514	-0.097	20	BS	
RU UMI	37205	5986.319	+0.015	7	BS	
	37344	6059.258	-0.011	8	BS	
BP VUL	4377	5931.461	+0.020	16	BS	
GP VUL	11099	6061.216	-0.031	13	BS	*

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R. Miles - Fernbank Farm, Sugar Lane, Marley, Cheshire WA6 9DZ

P.J. Wheeler - The Old School, Brushford, Dulverton, Somerset
TA22 9AP

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SECTION OFFICERS:

Director	D.R.B. Saw, 'Upanova', 18 Dollicott, Haddenham, Aylesbury, Bucks. HP17 8JG Tel: Haddenham (0844) 292065
Assistant Director	S.R. Dunlop, 140 Stocks Lane, East Wittering, nr Chichester, West Sussex PO20 8NT Tel: Bracklesham Bay (0243) 670354

Programme Secretaries:

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Assistant Secretary Telescopic	G.A.V. Coady, 1 Mossop Drive, Longtoft, Peterborough Tel: Market Deeping (0778) 345396
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Nova/Supernova Search Secretary	G.M Hurst, 16 Westminster Close, Kempshott Rise, Basingstoke, Hants. RG22 4PP Tel: Basingstoke (0256) 471074
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