27. COMMISSION DES ETOILES VARIABLES

Report of Meetings, 26 and 31 August 1964

PRESIDENT: P. Th. Oosterhoff.

SECRETARY: R. P. Kraft.

Business Meeting

I. FUTURE ORGANIZING COMMITTEE

The following officers and members were approved:

President: G. H. Herbig.
Vice-President: L. Detre.
Members: Arp, Walraven, Feast, Kholopov, Ledoux.

II. FINANCIAL RESOLUTIONS APPROVED

(1) Commission 27 requests of the Finance Committee of the IAU a grant of $700 for the publication of an English Version of the remarks in the Second Supplement to the 2nd Edition of the *General Catalogue of Variable Stars.*

(2) Commission 27 requests of the Finance Committee of the IAU a grant of $700 for the publication of an English Version of the 2nd Edition of the *Catalogue of Stars Suspected of Variability.*

(3) Commission 27 requests of the Finance Committee of the IAU a grant of $1000 for the publication of two sections of charts of variable stars south of declination $-30°$, which are being prepared by Mr Frank Bateson.

III. SCIENTIFIC RESOLUTIONS

(1) There should be a centre, perhaps with the AAVSO or with the RAS, for the safe-keeping of copies, preferably on microfilm, of photoelectric observations of variable stars, which cannot, for financial or other reasons, be published in the Journals.

(2) A continuation of the *Geschichte und Literatur* was deemed desirable with greater emphasis on the current literature. Astronomers are urged to send reprints of their work on variable stars to Dr Schneller in Potsdam.

(3) The co-operation of governments, universities, and plate manufacturers in providing adequate supplies of plates for astronomical work, and especially for sky patrols, was recommended.

(4) It was resolved that a Joint Symposium with Commission 42 be sponsored in Bamberg in 1965, with an Organizing Committee consisting of one member from each of the two Commissions, and with Dr Strohmeier accepting the responsibility as local host.

(5) Resolutions (1) through (5) on page lviii of the *Draft Report* were all adopted.

(6) It was resolved that two new constellations, the LMC and the SMC, be outlined strictly for the purpose of variable-star nomination. The exact boundaries and details of the numbering system are to be left to a subcommission of 27.

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IV. OTHER MATTERS

(1) A list together with maps of all novae of the past 30 years was requested by Mme Lortet-Zuckermann.

(2) The members of the Commission unanimously thanked Dr Plaut for his *Catalogue of Galactic Coordinates of Variable Stars.*

(3) Prof. Kukarkin sent a message that the 3rd Edition of the *Variable Star Catalogue* is expected to be ready in 1968.

(4) Dr Detre stated that the *Information Bulletin on Variable Stars* will be continued at least 3 years more.

V. SUBCOMMITTEE ON DESIGNATIONS OF VARIABLE STARS

At the Berkeley meeting a Subcommittee was established (Drs Haro, Herbig, and Kholopov) to study the classification of T Tau, UV Cet, and Ori-type variables. At Hamburg, Prof. Kukarkin submitted a proposal for an improved classification system for all variables. The most important proposed changes in the classification concerned those variables with which the Subcommittee itself had been working.

Commission 27 discussed Prof. Kukarkin's proposals and those of the Subcommittee, and approved them after making some minor modifications.

The new classification scheme is the following:

I. Eruptive Variable Stars

1. *Nebular and rapid irregular variables*

InT—T Tauri-type variables connected with diffuse nebulae. Brightness variations are irregular. They are characterized by F to M-type spectra with emission lines. The fluorescent emission lines of Fe I λλ4064, 4132, of [S II], λλ6717, 6731, of [O I] λλ6300, 6363, and emission lines of H, He I, Ca II, Fe II, Ti II together with the absorption lines Li I λ6707 are characteristic of the spectrum. A typical representative is T Tau.

IT—T Tauri-type variables not connected evidently with nebulosity. The same spectral characteristics. A typical representative is RW Aur.

Ine(a)—Orion variables of early spectral classes O to A. Irregular brightness variations. They are usually connected with diffuse nebulosities. In the spectra the signs of the presence of a shell or of P Cyg-type characteristics are often observed. Typical examples are T Ori and Z CMa. If only Hα-emission is known, the symbolical notation could be replaced by Inα (a)—a typical representative being BF Ori. Finally variables which show no emissions exist: In(a)—typical representatives are TY CrA and XY Per.

Ine(b)—Orion variables of intermediate and late spectral classes. Spectra Fe to Me. The spectral characteristics are the same as those of the previous type. A typical representative is SU Aur. If only Hα-emission is present the symbol could be replaced by Inα (b). A typical representative is SS Mon. In case of the absence of emission the symbol In(b) is used. A typical example is AH Ori.

Infe—flare variables connected with diffuse nebulosities. They are characterized by irregular rapid flares, the duration of which lasts from some minutes to some dozens of minutes. Spectra Ke to Me. During flares continuous ultra-violet emission as well as line emission can be observed. A typical representative is V 389 Ori. Between the flares often only Hα-emission is observed (symbol Infα, a typical representative being V 390 Ori) or no emissions are observed at all (symbol Inf, a typical representative being FF Tau).

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UV—UV Ceti-type variables. Flare variables not connected with diffuse nebulae. They are photometrically similar to Infe variables and are characterized by irregular rapid flares with the duration of some minutes or some dozens of minutes. Spectra dMOe to dMGe. A typical representative is UV Cet.

Ise(a)—rapid irregular variables of early spectral classes not connected evidently with diffuse nebulae. They are characterized by irregular (sometimes rapid, sometimes slow) variations of brightness. Spectra Be to Ae. A typical representative is XX Oph. If only Hα-emission is present, the symbol Isα(a) is used: a typical representative is UX Ori. If no emission lines are observed we use symbol Is(a); a typical representative is BN Ori.

Ise(b)—rapid irregular variables of intermediate and late spectral classes not connected evidently with diffuse nebulosities. Spectra Fe to Me. If only Hα-emission is present the symbol Isα(b) is used; if no emission lines are in the spectrum—symbol Is(b). Typical representatives are PZ Mon, AQ Dra, BH Cep, V 338 Cas.

2. *Novae and novalike stars*

N—see GCVS 1958
Na— — „ —
Nb— — „ —
Nc— — „ —
Nr—instead of symbol Nd, symbol Nr is introduced for the recurrent Novae (see GCVS).
UG— (see GCVS).

Z Cam—this symbol is introduced instead of the symbol Z for the variables of the Z Camelopardalis type. (See GCVS). It was found that many stars of this and UG type are binary systems, often of very short period (down to 81^m). Probably the tendency to form close binary systems is a characteristic feature of these objects and may be a necessary condition for their eruptive activity. The stars of these types are connected also by a mean cycle—amplitude relation.

Z And—variables of the Z Andromedae type (symbiotic variables). The stars of this type were included in GCVS 1958 in the heterogeneous class of the novalike stars. The variables of this type usually have composite spectra.

Nl—this symbol is introduced instead of symbol Ne for the novalike stars. See GCVS 1958; a typical representative is P Cyg.

3. *The variables of R Coronae Borealis type*

RCB: see GCVS 1958.

4. *Supernovae*

We intend to give in the new edition of GCVS a detailed list of data about Supernovae, as it is given for variables of other types. Probably, it will be rational to use the subclassification of Supernovae into types, proposed by F. Zwicky.

II. Pulsating Variable Stars

L—irregular, slowly varying variable stars. Many stars are given this designation only because of poor information; in reality they are semiregular variables. It is possible to distinguish here two subtypes: L(a)—giants of spectral classes K,M,C, or S with small variations of brightness, and L(b)—supergiants of spectral class M.
M—Mira Ceti type stars (see GCVS)
SR—semiregular variables (see GCVS)
Cep—long period cepheids (see GCVS)

Cδ—(see GCVS)
CW—(see GCVS)
RR—shortperiod cepheids, or RR Lyrae type variables (see GCVS)
RRab—(see GCVS)
RRc—(see GCVS)
{RRs or δSc} ultra-short-periodic variables of RR Lyrae type (period from $0^d.05$ to $0^d.21$). It is quite probable that these stars belong to the disk population and their luminosities are below the luminosities of ordinary RR Lyrae type variables. This class includes the δ Scuti type variables.
RV—RV Tauri type variables (see GCVS)
RVa—(see GCVS)
RVb—(see GCVS)
βCMa—βCMa type variables (see GCVS)
αCV—α^2 Canum Venaticorum-type variables or magnetic variables (see GCVS).

III. Eclipsing Binaries

(See GCVS)

Of course, in some cases, the description of types given in the GCVS needs revision. We hope that such a revision will be a natural result of the forthcoming discussion of the proposed classification.

Scientific Meeting

1. RADIO EMISSION FROM FLARE STARS

Sir Bernard Lovell

Since 1958, over 3000 hours of observation of flare stars of the UV Ceti type have been carried out with the 250-ft radio telescope at Jodrell Bank. This has included 2500 hours of simultaneous observations of the stars with the Baker Nunn cameras of the Smithsonian Astrophysical Observatory's satellite tracking network and also combined observations with photoelectric recordings in the U.S.S.R. Radio emission associated with optical flares has now been observed on UV Ceti, Ross 882, EV Lac and V371 Orionis. In at least one case a frequency drift type of radio burst has been observed with the visual effect preceding the radio emission, and with a time delay between the high and low frequency radio emission as for the solar drift type bursts. In most cases however the radio and optical flares have a close temporal relationship. Calculations of the energies indicate that in both the optical and radio region the energies involved for small star flares of 1 m or less are at least 10 to 100 times greater than in the strongest solar flares ever recorded; and that the ratio of the energy in the radio and optical parts of the spectrum is much greater for the flare stars than for the Sun. The simultaneity of the radio and optical phenomena enables a new limit of a few parts in 10^7 to be set for the constancy of the velocity of light and radio waves in space.

2. A CALCULATION OF PULSATIONS IN RR-LYRAE MODELS

R. F. Christy
(CalTech)

A series of calculations of self-excited pulsations in RR Lyrae stars has recently been completed following methods already published (R. F. Christy, *Reviews of Modern Physics*, **36**, 1964). It has been possible to calculate not only the periods and the extent of the unstable region but also the shapes, phase relations, and amplitudes of the light and velocity curves which correspond closely with observation. A systematic study has been made of the influence of four physical parameters, namely mass, luminosity, hydrogen-helium ratio, and mean effective temperature.

It has been found that as the mean T_e increases, the shapes change from type b to a; with further increase, the first harmonic becomes unstable and type c results. However, the first harmonic instability exists only for a helium content exceeding 35% by mass. For less helium, only the fundamental is unstable. It has also been found that the region of instability shifts to higher mean T_e with increasing helium; the shift amounts to about 300°K for a He increase by 15% of the total mass. With decreasing mean T_e there is a progressive increase in the phase lag of the luminosity and a progressive decrease in the luminosity amplitude. Further correlations are being studied.

3. A SURVEY FOR RR LYRAE STARS IN THE FIELD MWF 361

T. D. Kinman
(Lick Observatory)

Ten fields (each 27 square degrees) are currently being surveyed for faint RR Lyrae stars with the blue lens of the 20-inch astrograph at Lick Observatory. The completeness from 6 triple image plates falls to 50% at $m_{pg} = 17{\cdot}6$ for variables with amplitudes greater than 0·75 mag. The magnitudes are calibrated from p.e. sequences in each field and extinctions are determined from the $B-V$ colours of the RR Lyrae stars at minimum. The first field (MWF 361) was reduced in collaboration with C. A. Wirtanan and K. A. Janes and yielded 77 variables; the majority were RR Lyrae stars. The periods of these stars were determined by an IBM 1620 computer using the criterion that the sum of the squares of the magnitude differences between observations of adjacent phase should be a minimum. Space densities (derived from variables of type ab with amplitudes greater than 0·75 mag) showed a maximum along the sight line at a distance of 5·4 kpc for $M_{pg} = +1{\cdot}0$. This gives an axial ratio (c/a) of 0·6 for a spheroidal distribution of these stars, if the solar galactocentric distance is 10 kpc. The period-amplitude relation suggests that the majority of variables in this field have a spectral class index $\Delta S > 4$ and a comparison with the variables in globular clusters indicates that M3 type variables predominate for heights above the plane of $1 < Z < 10$ kpc while the ω Cen type predominate for $Z > 10$ kpc. The proportion of low-amplitude variables (less than 0·75 mag) therefore probably increases with Z and this may lead to an underestimate of the space densities of RR Lyrae variables at large heights above the galactic plane.

4. ON THE SPECTROPHOTOMETRY OF RW AUR

E. K. Kharadze and *R. A. Bartaya*
(Abastumanii Observatory, U.S.S.R.)

From spectrophotometry based on 71 spectrograms of dispersion 166Å/mm, the authors conclude the following:

(1) The relative energy distribution curves show a surplus ultra-violet radiation.

(2) A pronounced correlation is detectable between the variations of the equivalent widths of emission lines and the continuous ultra-violet emission.

(3) There is no strict correlation between the continuous ultra-violet emission and the light variations of the star (in B or V light).

These results should mean that the release of energy carried out of the stars' interior by some mechanism almost always takes place mainly in the photosphere where it is transformed into thermal radiation. The other part is being released in the upper layers of the stellar atmosphere and with it continuous ultra-violet emission of nonthermal origin is connected. The visible effect of the latter reaches the observer sooner than the effect associated with the transformation into heat, since there is no correlation in time between light changes and ultra-violet emission.

In the $U-B$ vs. $B-V$ diagram the star RW Aurigae takes its place to the right of the main sequence—along the so-called T-stripe. The star has not yet reached the main sequence.

The study of RW Aur or of the stars of its type requires simultaneous and continuous three-colour photometry and spectrophotometry from the ultra-violet up to the yellow-red or even near the infra-red region. Co-operative observations between observers at several observatories may prove to be very desirable.

5. SOME COMMENTS ON THE SPECTRUM OF RW AUR

G. H. Herbig
(Lick Observatory)

The excess energy in the ultra-violet of RW Aur is due to a smooth continuum that obliterates all the lines of the underlying G-type star between λ3250 and λ5000, and has nothing to do with the Balmer continuum. On 16 Å/mm coudé plates, taken near maximum light, there are a number of narrow absorption lines below λ3600 that at first glance match those in the spectrum of a G-type dwarf. On closer inspection these are due not to a normal star but to a peculiar low-excitation absorption shell, which presumably lies above the level where the continuous emission originates.

6. THE SPECTRUM OF NOVA HER (1963)

J. Alania
(Abastumanii Observatory)

Sixty spectrograms of N Her 1963 were obtained at Abastumanii Observatory. The interstellar absorption lines of ionized calcium (H,K) were distinctly visible in 1963 March. On 1963 April 26, the Nova was in the state of the nitrogen flash.

The spectrophotometric gradient involved a very high colour temperature. The average velocity of expansion determined with the hydrogen emission lines is evaluated as being about 1200 km/sec.

7. THE FIRST PHOTOGRAPHIC NOVA IN A GLOBULAR CLUSTER

H. Sawyer Hogg and *A. Wehlau*
(David Dunlap Observatory and University of Western Ontario)

The discovery of this Nova in Messier 14, NGC 6402 at RA $17^h35\cdot0$, Dec. $-03° 15'$ (1950) by Dr A. Wehlau has been reported in the Draft Report; we wish to add now some subsequent details.

First we repeat briefly the pertinent information. Dr Wehlau found this Nova last autumn on David Dunlap Observatory 74-inch reflector plates taken by Dr Hogg in 1938. The Nova appeared just after Dr Hogg finished a 5-year hunt for variables in the cluster, and hence escaped detection for a long while. It was at magnitude 16·0 for one week in 1938 June, (absolute magnitude about $-1\cdot5$).

Since the IAU Draft Report went to press, Dr Hogg has visited the Harvard Observatory and investigated all possible plates between August 1937 and July 1938 on which the star might appear. No conclusive result was obtained, but an RB plate on April 30—May 1 shows the cluster nucleus as suspiciously heavy.

Identification photographs of the Nova have now been published in the March issue of *Sky and Telescope*, the August issue of the *Journal of the Royal Astronomical Society of Canada*, and will also appear soon in a David Dunlap Observatory Communication. We request that all astronomers who may have access to plates of this cluster taken at the strategic time please to examine them.

8. ON THE PERIOD CHANGES OF VARIABLE STARS

K. Kordylewski

K. Kordylewski announces two new effects concerning the period changes of variable stars which are obtained from the quasi-radial accelerations:

$$a = c\frac{d^2(O-C)}{dt^2} \approx \left(\frac{dV_r}{dt} + \epsilon\right) \text{km s}^{-1}\text{ yr}^{-1}$$

as defined by Zb. Kordylewski (at Wroclaw Observatory), where c is the velocity of light and where ϵ is a term which is caused by reasons other than the radial acceleration of the star with respect to the Sun. Statistical investigations of these a-values for 154 periodic variables of different types show a dependence on the galactic latitude b. This effect enters all (O − C) − curves with the value,

$$\Delta(\text{O} - \text{C})^d = -5{\cdot}4 \times 10^{-2}\, T^2 \sin b,\ T = \frac{(t-t_0)^d}{10^4}$$

and was confirmed by R. Szafraniec on the basis of the data for 91 stars which were not used by Zb. Kordylewski. It can be recognized also in the differences between two catalogues of radial velocities by Moore and Wilson.

I have found a second effect for the variables in the globular clusters ω Cen, M3, M4, M5, and M15. The quasi-radial accelerations of the single stars reveal a relation with the apparent distance to the cluster centre. They are zero at the outer border of the cluster and in the centre the α-values scatter around zero up to $\pm 0{\cdot}3$ km s^{-1} yr^{-1}.

A simple physical interpretation of both effects could be discussed as gravitational; however, the effects have to be tested first with additional investigations.

9. OBJECTIVE PRISM SPECTRA OF NOVA HER 1963

Waltraut Carola Seitter

Objective prism spectra of Nova Herculis 1963 were taken from 1963 February to November with the Schmidt camera of the Hoher Lüst Observatory of the Sternwarte Bonn using dispersions 240, 645 and 1280 Å/mm at Hγ and 1700 to 6300 Å/mm at λ8000.

Radial velocity measurements yielded velocities of 1120 and 1520 km s^{-1} for the two major hydrogen absorption lines in good agreement with other observers. An increase in radial velocity with time seems indicated for the mean of all other absorption lines.

Continuum measurements between λ3500 and λ8000 were compared with the emission of a hydrogen nebula according to a model by Seaton and showed excellent agreement with the emission expected from a nebula with T_e = 20 000°K and $N_e = 5{\cdot}10^4$ cm^{-3}.

Changes of absorption line intensities were followed until the end of March. A general decrease in the hydrogen absorptions was found while several N V, N II, and O II lines showed broad maxima.

The changes of emission line strength observed until May were much like those found by Meinel for the same lines in Nova Herculis 1960.

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An attempt to determine the Balmer decrement failed to show changes with time, probably due to the over exposure of Hα and Hγ on almost all plates; however, an approximate mean value similar to that derived for other novae could be determined.

10. ON THE PERIOD CHANGES OF CEPHEIDS

R. Kippenhahn

I would like to draw your attention to a possibility where variable star observers can test the theory of stellar evolution. In their calculations of stellar evolution, Hoffmeister, Kippenhahn and Weigert predicted period changes of classical cepheids due to evolution (*Z. Astrophys.* 1964). They get increasing and decreasing periods and the order of magnitude of their period changes is not in disagreement with the data collected by Kraft (1960) from the general catalogue of variable stars. But the data available in the literature are not sufficient and therefore new (photoelectric) observations are needed. With these new observations it may be possible to work out a test for the present ideas on stellar evolution. The observations needed can be carried out with relatively small telescopes.

11. SOME RESULTS CONCERNING RW AUR STARS

C. Hoffmeister

Continuous light curves of the 4 variables T Cha, RU and RY Lup, AK Sco were obtained by the author in South Africa (Boyden Observatory) in 1959 by collaboration with 7 observers in New Zealand (main contributor A. F. Jones) and could be compared with curves from 1952–53 in order to find out whether the behaviour of the stars has changed. Generally no changes in principle were found.

T Cha shows changes in that way that the minima are more conspicuous in 1959 than in 1952–53, when the maxima predominated.

Special attention was paid to the quasi-periodic variations. It seems that each of these stars has a characteristic period.

T. Cha: 1952–53; main period $3^{d}.2323$ (26 epochs, 200 days); other periods $3^{d}.4375$ (31^{d}) and $4^{d}.1800$ (21^{d}), (temporary values).

Main period 1959: $3^{d}.2436$ (20 epochs, 126^{d})

Characteristic periods of 4 stars:

T Cha	$3^{d}.2436$
RY Lup	3·7609
RU Lup	3·8375 (?)
AK Sco	5·1480(?)

The question marks mean that these periods are not yet confirmed by observations in different years. They were active without doubt, but one cannot decide whether they are chacteristic or temporary values.

Rotation of the star in connection with temporary non-uniform distribution of surface brightness may be regarded as the probable cause of the phenomenon.

Temporary periods may be due to shifts of bright and less bright areas on the surface of the star, or, perhaps more probably, to a dependency of the rotation period from astrographic latitude.

12. VARIABLES IN NGC 188

C. Hoffmeister

Four variables have been found in the old galactic cluster NGC 188 on plates taken with the Schmidt Camera 135/200/400 cm of Karl Schwarzschild Observatory. The stars S 8279 and S 8280 had been noticed by Dr Richter first and have been recovered independently by the author. Three of the new variables proved to be pulsating stars with ultra-short periods.

	1855·0				
S 8278 Cep	$0^h33^m.9$	$+84°28'$	$17^m.0 - 17^m.5$	M = 243 8331·492 + 0·74055·E	Ecl
S 8279 Cep	$0^h36^m.0$	$+84°26'$	$16^m.2 - 16^m.9$	M = 243 8246·381 + 0·143829·E	RRs
S 8280 Cep	$0^h36^m.1$	$+84°27'$	$16^m.2 - 16^m.8$	M = 243 8246·383 + 0·1503085·E	RRs
S 8474 Cep	$0^h33^m.3$	$+84°33'$	$17^m.0 - 17^m.5$	M = 243 8246·454 + 0·126246·E	RRs

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