27. COMMISSION DES ETOILES VARIABLES

Report of Meetings

PRESIDENT: P. Th. Oosterhoff.
SECRETARIES: R. Canavaggia, M. F. Walker.

Administrative meetings, 18 and 21 August 1961

According to the new rules the Commission had to propose names for an organizing committee. Following suggestions made by the President the meeting agreed to the proposal of the following names:

President: P. Th. Oosterhoff
Vice-President: G. H. Herbig
Members of the Organizing Committee: Mlle R. Canavaggia, L. Detre, C. Hoffmeister, P. N. Kholopov and M. F. Walker

Later the Nominating Committee and the Executive Committee approved these proposals.

At the time of the Berkeley meeting the Commission had 58 members, after the meeting this number has increased to 80.

It was decided at Berkeley to discontinue nearly all the Sub-Commissions and consequently the three Sub-Commissions of Commission 27 have been dissolved. As some of the work must be continued the meeting decided to set up two committees. They are:

Committee on Variable Stars in Clusters
President, Mrs Sawyer Hogg; Arp, Rosino and Wesselink

Committee on the Spectra of Variable Stars
President, Herbig; Bidelman and Kukarkin

Then the *Draft Report* was discussed and accepted. Shapley stressed the importance of investigating whether stars, thought to be constant such as photometric standards, are really constant. Van Hoof reported that α Lupi is definitely a β Canis Majoris variable.

The President made a financial recommendation, namely that $400 be granted for the publication of an English version of the remarks in the first supplement to the second edition of the General Catalogue of Variable Stars. The meeting approved. [This recommendation was approved by the Finance Committee, and incorporated in its report.]

Then followed the discussion of the recommendations and suggestions made by members. They were:

1. With the available Durchmusterung maps the positions for equinox 1900·0 in the *General Catalogue of Variable Stars* are not practical. The old equinoxes of 1855·0 and 1875·0 are to be preferred (Hoffmeister).

2. Galactic co-ordinates in the new IAU system (See *Information Bulletin No.* 1, June 1959) should be computed and published for all variables. (Mavridis).

3. The system of denomination and classification.

(*a*) Sometimes variable stars are denominated, for which only the mere fact of variability is known. On the other hand many old variables of which the variability is well established are still without final designation. It is suggested that we return to the old standards established by Prager, according to which a variable may be denominated only after some details

about type and other properties are known. (Hoffmeister). Hoffmeister also suggests that the old variables mentioned above be observed systematically to decide whether they may be named or not.

(*b*) It is proposed that a sub-committee of three or four persons reconsider the present system of classification (Plaut). As an example of some unsatisfactory aspects of the present classification Plaut mentions: that some variables classified as δ Sct-type probably are RR Lyrae-type variables; that no clear criteria exist for a distinction between δ Cep and W Vir stars; and that many variables, classified as semi-regular, belong to the long-period or *Mira*-type stars. (This last statement was independently made by Miss Harwood.) Further it has been suggested that systematic checks be made, on existing plate collections, of cataclysmic variables, the assignment of which depends on few and scattered observations. (Hoffleit).

(*c*) It is suggested that the Commission should study the question of denomination of variables in the Magellanic Clouds. (Wesselink). This question has been provisionally discussed by Sub-Commission 28*a* at its meeting in the Argentine in December 1960. Many of these variables carry a Harvard number, but in recent years many new variables have been discovered and it is to be expected that many more will be found in the next years to come. Some of the new variables have been denominated and are now given in the *General Catalogue*. It has been suggested that a special system for denomination or numbering be adopted for all the variables within certain regions around the two Clouds and that a special catalogue be prepared, similar to the list of variables in globular clusters, as prepared by Mrs Sawyer Hogg. Any positive decision on this problem will require a great deal of work for one or more persons.

4. Hertzsprung recommends that the coefficients of the rectangular co-ordinates of the Sun, X and Y, in the expression:

$$-X \cos \alpha \cos \delta - Y(\sin \alpha \cos \delta + 0{\cdot}4337 \sin \delta)$$

be given for all the variables for which the reduction to the Sun is significant.

5. The need for a photographic map of the sky north of $-20°$, from which fairly accurate co-ordinates can be derived quickly, has been expressed by Hoffmeister. As an example he mentions the Johannesburg maps for the southern sky.

6. It is recommended that a list be prepared of all the intrinsic variables which have been observed photo-electrically (Plaut).

7. Strohmeier would like to see quicker ways of communicating data on newly-discovered bright variables and of special phenomena. He suggests that the IAU *Circulars* be used for this purpose. Detre has similar complaints and suggests the establishment of a special publication of Commission 27 in the form of an international journal on variable stars, to be issued twice a year or so. If published in Hungary, the Konkoly Observatory could bear the cost of printing and a term of printing of 2-3 months could be guaranteed.

8. It is suggested that Commission 27 should indicate to the various Associations and Sections of Variable Star observers the most useful form in which observations should be published. (Bateson).

9. To further observation of variables for which sequences are not yet available, it is suggested that the amateur Associations have their most experienced observers select suitable stars for a sequence in each field and prepare charts from which they can be readily identified. (Bateson).

10. Miss Hoffleit re-iterates the need for evaluating the completeness of discovery of variable stars of the various types to specific limiting magnitudes for different parts of the

sky. This type of information is important in discussions of the galactic distributions of these stars.

11. Miss Hoffleit also stresses the importance of 'normal colour indices' which would be of considerable value in parallax problems and for studying the relationship between some classes of variables and their association with gas and dust.

12. Bertaud recommends photo-electric observations of the stars with composite spectra: HD 4174 = BD + 39° 167 and BD + 67° 922 and also of the A-type stars with abnormal spectra: HD 43246, HD 30353 and HD 50169.

Recommendation 1 was dropped. The Yale and Naval Observatories are putting different catalogues, including the *General Catalogue of Variable Stars*, on IBM cards. Supplements will also be put on the cards. Other equinoxes could easily be computed and copies of cards made available at nominal cost.

Recommendation 2 was accepted. Kukarkin stated that the new l and b values will be given to one decimal in the third edition of the *General Catalogue of Variable Stars*.

Concerning recommendation 3, Kukarkin remarked that variables are named only when the type is known. Stars which are certainly variable, *e.g.* with a large amplitude, but of unknown type are not named, but they will be published in the *Catalogue of Stars Suspected of Variability*. The Commission strongly recommends that the stars in this catalogue be divided in two groups: (*a*) variability certain, but type unknown; and (*b*) suspected variables. The meeting also stressed the importance of an early supplement to the catalogue of suspected variables.

The problems connected with recommendation 3(*b*) are complicated. The meeting nominated a working group, consisting of Kukarkin, Oosterhoff, Payne Gaposchkin and Harlan Smith, which should report to the Commission in one or two years.

The meeting decided that recommendation 3(*c*) should also be studied by a working group. The following members were nominated: Arp, Buscombe, Payne Gaposchkin and Wesselink.

Recommendation 4. The meeting agreed that it would not be practicable to publish the co-efficients of X and Y for the individual variables in the *General Catalogue*, but that it would be better to produce a table of the coefficients as a function of α and δ. Walker, Irwin and some others were in favour of new and more accurate tables of the actual solar corrections. As Kukarkin was willing to publish tables of the coefficients to six decimals, the meeting gratefully accepted this.

Recommendation 5 was dropped. Transparent grids for the Palomar Sky Atlas can be obtained for $85 from the National Radio Astronomy Observatory, P.O. Box 2, Greenbank, West Virginia, U.S.A.

Recommendation 6. Hoffleit and Walker suggested that such information be included in the next edition of the *General Catalogue*. As Kukarkin remarked that it probably will be possible to follow this suggestion, although many complications are involved, the meeting strongly supported this idea.

Recommendation 7. After some discussion the meeting decided to establish an *Information Bulletin on Variable Stars*. This has become possible through the initiative of Professor Detre and the generosity of the Konkoly Observatory. The bulletin will *not* be a new journal for articles on variable stars, but its main purpose will be the rapid communication of discoveries, interesting observations, requests for photometric or spectroscopic observations, etc. Therefore speed will be essential. Texts in English or French should be forwarded direct to:

Professor L. Detre, Budapest XII, Postoffice 114, Box 67

One sheet of the bulletin (not more than two typewritten pages double-spaced) can probably be printed and mailed in about a week. Longer communications may take a month or six weeks after the typescript has been received. Drawings should be avoided, although it may be necessary to include finding charts. The bulletins will be air-mailed to all members of Commissions 27 and 42 and also to the observatories and institutes on the mailing list of the Konkoly Observatory.

Hoffmeister drew attention to the fact that longer articles or series of observations which do not need a very rapid publication can usually be published in the MVS (*Mitteilungen über veränderliche Sterne*). Such typescripts should be forwarded to his address.

The meeting agreed on the importance of the recommendations 8, 9, 10, 11 and 12, but decided not to take action in these matters.

At the request of the authors the President announced that: (*a*) Tsesevich has prepared finding charts for all the RR Lyrae type stars of the *General Catalogue*; these charts will be distributed to all observatories; and (*b*) van Herk has made a list of RR Lyrae variables to a certain limiting magnitude with indications of proper motion, radial velocity, magnitudes and colour, mean magnitudes and mean colour and Preston's value ΔS. This list makes it quite clear that our information on these stars is still very incomplete. Copies can be obtained from the author.

Scientific meeting, 16 August 1961

The topic of this meeting was:

Secondary Periods and Beat-Phenomena in Pulsating Variables

The first speaker was *A. van Hoof* on

THE MULTI-PERIODICITY OF THE β CMa STARS

Abstract. About half the number of variables in the β CMa group are known to have a secondary period. The speaker has suggested (*PASP*, 1957) that one of the periods is the free pulsation period in the fundamental mode while the other is a resonance period between the fundamental mode and an as yet undetected overtone whose period is about one half the fundamental period. Photo-electric observations of ν Eri, β Cru and θ Oph have proved that the idea is correct. The numerous light curves have indeed revealed the existence in each of these stars of *several* pulsations, which could be identified as the fundamental one, the successive overtones and those resonance (difference-) oscillations between them whose periods are close to the free periods. These oscillations have been traced in the radial velocity data, each showing maximum light at the descent of the velocity through the γ-value. In the case of ν Eri Walraven's S and M deformations are also present.

From the run in the ratios, yellow/ultra-violet amplitudes, we can infer that the amplitudes of the oscillations increase faster and faster towards the stellar surface with increasing order of the overtone, as predicted by theory. We can further conclude that there exists a difference in spatial behaviour inside the star between the free oscillations and the resonance oscillations of comparable period.

From the ratios P_i/P_0 of the various overtone periods and their comparison with Schwarzschild's computations (*Ap. J.*, **94**, 245, 1941) it follows that these stars are built up as polytropes of index 3 and $\Gamma_1 = 1{\cdot}52$. When this model is admitted, Schwarzschild's computations can be used for the computation of the stellar radius. This yields plausible and consistent values for the different oscillations. Also the predicted temperature changes agree with the observations. Under certain assumptions the age of these stars is found to be of the order of 10^7 years.

We advance the following working hypothesis to explain the genesis of the oscillations: the fundamental pulsation is exicted by a central disturbance, and the overtones are excited far from the centre; if a reversible reaction, involving temperature changes, takes place in a thin shell that contains the nodal surface of a particular overtone, then that overtone will be excited and if more overtones are excited this way, they will in turn excite those difference oscillations that are sufficiently near resonance with a free lower mode. This hypothesis leaves open the possibility of a star pulsating only in one or more overtones. The *c*-type RR Lyrae stars and the δ Sct variables are believed to belong to this category.

The second speaker was *L. Detre* on

THE BLAZHKO-EFFECT IN RR LYRAE VARIABLES

Abstract. At the present time there are 20 RR Lyr variables with known secondary period, but the number of those which show light-curve variations is much greater. Photo-electric work disclosed some RR Lyrae stars with secondary variations of quite small amplitude, *e.g.* the RRc star TV Boo and the RRa star ST Leo. It is possible that secondary variations are a general phenomenon for RR Lyr stars.

RR Lyrae-stars with secondary periods

Star	P_0 d	P' d	P'/P_0	ΔS	R. V. km/sec	Reference
*TV Boo	0·3126	31·2	100	8	− 85	Budapest, unpub.
RS Boo	0·3773	537	1424	2	− 10	Oosterhoff, *B.A.N.* **10,** 101.
*SW And	0·4423	36·8	83	0	− 22	*Budapest Mitt*, 36.
*RW Dra	0·4429	41·7	94	3	−125	*Budapest Mitt*, 27.
RV Cap	0·4478	221·9:	494:	6	−110	*Sternb. Inst. Tru.* 23.
XZ Cyg	0·4666	57·3	123	6	−160	Muller, *B.A.N.* **12,** 11.
*RV UMa	0·4681	91·1	195	8:	−180	*Budapest Mitt*, 34.
*AR Her	0·4700	31·6†	67	6	−335	*Budapest Mitt*, 8.
*XZ Dra	0·4765	75·5	159	3	− 25	Bud. unp., *A.N.* **271.** 231.
*ST Leo	0·4780	30:	63:	7	+170	Budapest unpub.
X Ret	0·4920	45:	91:	—	—	Hoffmeister, *Sonn.* **5,** 3, 1.
V674 Cen	0·4939	29·5	60	—	—	Hoffmeister, *Sonn.* **5,** 3, 1.
*RZ Lyr	0·5112	122·1	239	9	−230	Budapest, unpub.
Y LMi	0·5245	33·4	64	—	—	*Budapest Mitt.* 39.
*AC And	0·5251	2·04	3·9	pec	− 70	Budapest unpub.
UV Oct	0·5426	80:	147:	—	—	Hoffmeister, *Sonn.* **5,** 3, 1.
*RW Cnc	0·5472	29·7†	55	—	—	*Budapest Mitt.* 23.
*RR Lyr	0·5668	40·8†	72	6	− 70	Walraven, *B.A.N.* **11,** 17.
DL Her	0·5916	49·2	83	—	—	Tsesevich, *Odessa Izv.* LII
150·1936 Her	0·6131	40·6	66	—	—	Tsesevich, *A.Zh.* **38,** 293.

The stars are arranged according to the length of the fundamental period, P_0. Stars preceded by an asterisk (*) are those observed photo-electrically at the Budapest observatory. P' denotes the length of the secondary period; a dagger (†) refers to variations of P' with a longer cycle. ΔS is Preston's spectral-index.

There are two different types of this Blazhko effect: (*a*) When P' is relatively short (*e.g.* RR Lyr, RW Cnc; see Fig. 1), the lower portions of the rising branch of the light-curve appear to be substantially constant in time and phase at different phases of P'. The light-curves

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figure 1

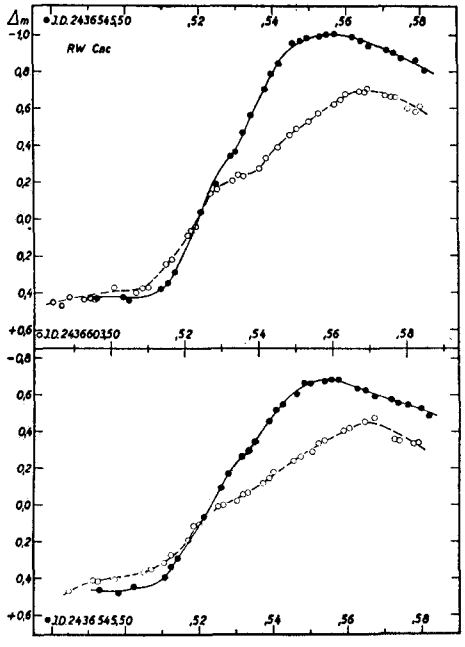

figure 2

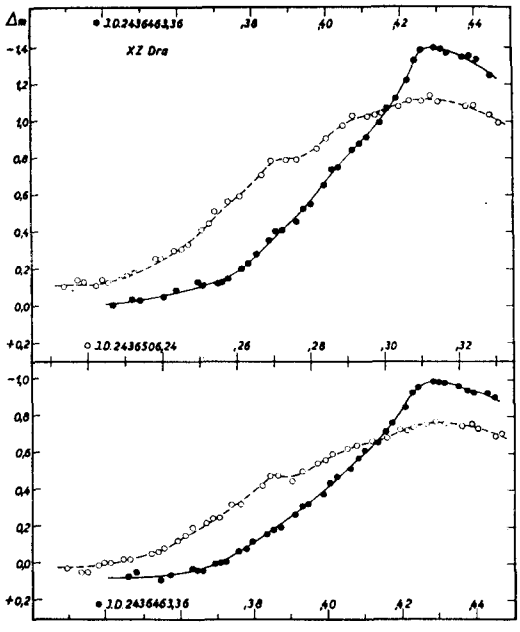

figure 3

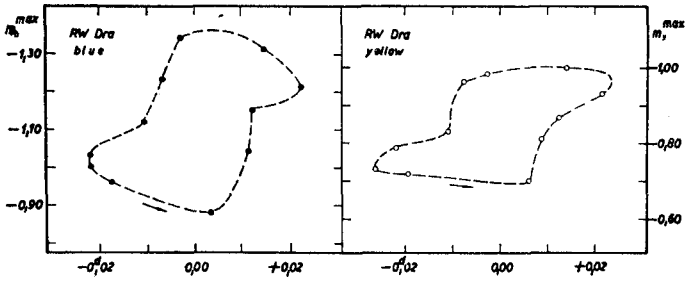

figure 4

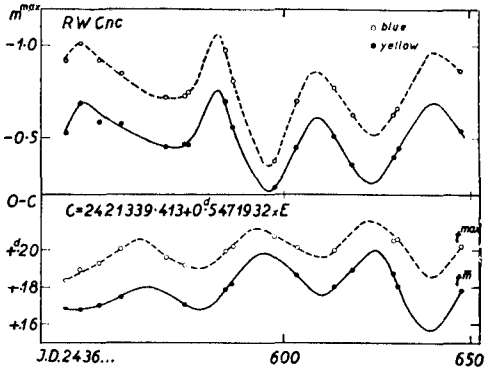

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figure 5

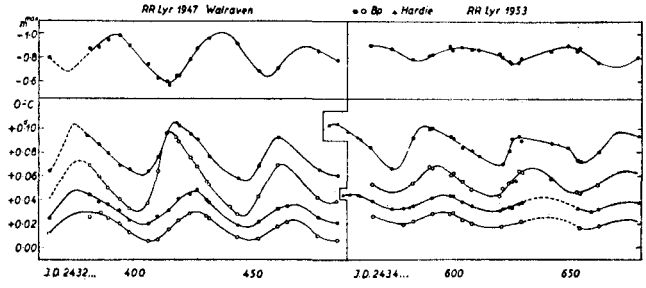

figure 6

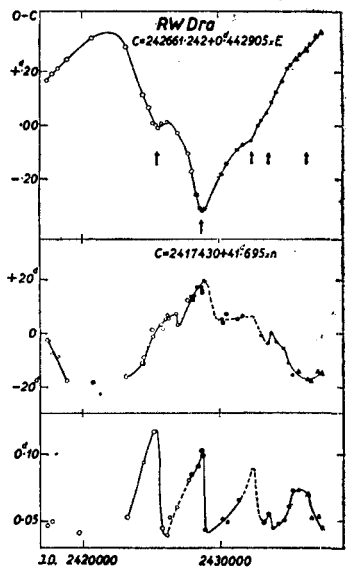

figure 7

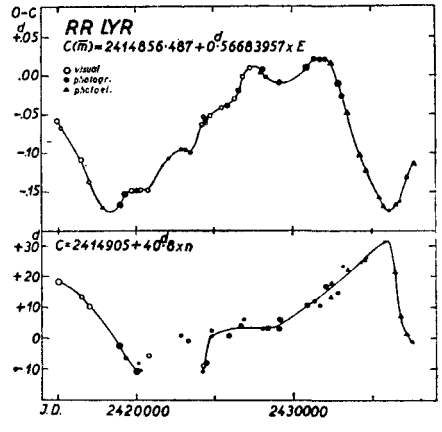

figure 8

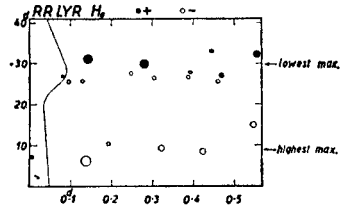

Fig. 1. Two extreme maxima of RW Cnc. Photo-electric observations at Budapest. Above in blue, below in yellow light.

Fig. 2. Two extreme maxima of XZ Dra. Photo-electric observations at Budapest. Above in blue, below in yellow light.

Fig. 3. Variations of brightness and phase of maximum light of RW Dra. Photo-electric observations Budapest, 1958.

Fig. 4. Successive cycles of the Blazhko effect for RW Dra. Photo-electric observations Budapest. Above, variations of maximum in blue and yellow; below, phase variations of maximum and of median brightness on the rising branch of light-curve.

Fig. 5. The Blazhko effect of RR Lyr in 1947 and 1953. Above, variations of maximum brightness; below, black dots and triangles denote phase variations of maximum and median brightness, circles the phase variations of the upper and lower parts of the ascending branch.

Fig. 6. RW Dra. Above, O − C diagram for P_0; in the middle, O − C diagram for P'; below, total amplitude of phase-variation of maximum brightness.

Fig. 7. RR Lyr. Above, O − C diagram for P_0; below, O − C diagram for P'.

Fig. 8. Effective magnetic field intensity of RR Lyr arranged according to phases of P_0 and P'.

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depart then from a common rising branch at the phase of P_0 where the UV-excess has its greatest value (1). It is at this same phase that the remarkable changes occur in the hydrogen-line structure, observed by Sanford (2) and Struve (3). The phase-variation is greatest at maximum light, and diminishes towards minimum. The lowest maximum comes latest. (*b*) When P' is long (*e.g.* XZ Dra; Fig. 2; RV UMa, RS Boo), the phase-variation of maximum light is small, but the phase-variation of the lower part of the rising branch has a great amplitude. When the rising branch begins early, its slope is small and the range of the light-variation is a minimum. When on the other hand the rising branch comes late, it is steep and the light-range is largest. The highest maximum comes latest.

Fig. 3 shows for RW Dra that the amplitude of the variation of m_{max} is greater in blue than in yellow light, but the reverse is true for the amplitude of the phase-variation.

Different cycles of the Blazhko effect may differ in length and amplitude as was first shown by Walraven for RR Lyr (4). Especially large are the differences between successive cycles for RW Cnc (Fig. 4). To represent these variations by longer periods may be successful for a short time-interval, but long series of observations show that the variations are not periodic. Sometimes the Blazhko effect may undergo considerable changes: *e.g.* for RR Lyr its amplitude was much smaller than in 1947 (see Fig. 5). For some RR Lyr stars, like RR Gem and SW And, the effect can temporarily cease to exist.

The changes of the Blazhko effect seem to be connected with the variations of the fundamental period P_0. This is evident for RW Dra, (Fig. 6) where every sudden increase in P_0 is accompanied by a drop of the amplitude effect, sometimes to a third of its previous value. For this star the O−C diagram for the secondary period, P', has a trend opposite to that for P_0. This is only partly valid for RR Lyr (Fig. 7). But it is a general rule that the amplitude of the Blazhko effect is small while the run of the O−C diagram is smooth. RRc stars showing light-curve changes have generally very complicated O−C diagrams.

In Fig. 8 we have arranged Babcock's measures of the magnetic field intensity of RR Lyr (5) according to the phases of P_0 and P'. There is no correlation with P_0, but a separation of positive and negative values is apparent in the course of the 41^d secondary period. Brightest maxima coincide with largest negative, lowest maxima with largest positive values of the field intensity. As the number of the magnetic observations is small, the correlation is not yet definitive. But if real, it may be of fundamental importance in understanding the nature of the Blazhko effect (6).

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The third speaker was *Th. Walraven* on "The short-period variables of the AI Vel type and on multicolour observations of V 703 Sco and other similar variables." No report.

Finally *P. Th. Oosterhoff* reported on work by Jansen on the Cepheid U TrA, which proved to be very similar to TU Cas, the ratio P_1/P_0 being identical for both Cepheids and equal to 0·710.

Scientific meeting, 22 August 1961

The topic of this meeting was:

Atmospheres of RR Lyrae variables

The first speaker was *J. B. Oke* (also on behalf of *L. T. Searle*) on:

ATMOSPHERIC CONDITIONS IN RR LYRAE STARS

Abstract. The observation of RR Lyrae stars with photo-electric spectrum scanners has now made it possible to study the atmospheres of these stars in considerable detail. From these scans the absolute energy in the spectrum is obtained at each phase. A comparison of this with model atmospheres determines the effective temperature T_e and the effective gravity g_{eff}. An analysis of SU Dra ($P = 0^{d}{\cdot}66$) yields effective temperatures ranging from 6000 to 7500 °K. The effective gravity varies from 20 to 100 cm/sec² except during the phases of rising light when it reaches a value of 2000 cm/sec². These very large gravities on the ascending branch of the light-curve make the Balmer discontinuities abnormally small and consequently produce the well-known loop in the usual 2-colour diagram. Using the monochromatic light-curves and model atmospheres one can solve for the relative radius $R/R_{\min}$ at each phase. The amplitude of the radius variation is 10%. This photometric displacement curve represents the motion of a layer which is always near $\tau = 0{\cdot}6$.

Spectra with a dispersion of 18 Å/mm have also been obtained for SU Dra. The metal lines give a velocity-curve which is continuous and nearly identical with that of RR Lyrae (Sanford, 1949). The Hα curve has a larger amplitude and is discontinuous, the hydrogen lines being double near maximum light. Since these velocity-curves are different, each layer in the atmosphere must be moving with its own characteristic velocity. Since the opacity is changing with phase the metal velocity-curve does not represent the motion of a particular layer of the star, and integration of this curve does not give a displacement-curve which can be compared with that from the photometric data. Fortunately between phases 0·4 and 0·8, the temperature, the pressure, and consequently the opacity remain effectively constant. Hence one can integrate this portion of the velocity-curve and compare the resulting displacement which refers to a fixed layer in the atmosphere with the photometric displacement-curve. This comparison yields an absolute radius for SU Dra which varies from 34×10^5 to 37×10^5 km.

The layer where the metal lines form moves $3{\cdot}2 \times 10^5$ km while the layer where the hydrogen cores are formed moves $6{\cdot}4 \times 10^5$ km. This implies that the scale-height of the atmosphere changes by a factor 17 between minimum and maximum distention. The scale-heights computed from the model-atmosphere data are in approximate agreement with this.

From the absolute radius and temperature at maximum radius, one finds an absolute visual magnitude at phase 0·40 of + 0·8. The total range in magnitude is from + 0·2 to + 1·2. This agrees with the recent determinations made by fitting colour-magnitude diagrams of globular clusters to the main sequence.

The period-density relation gives a pulsation constant of 0·06 if the mass in solar units of SU Dra is 1·0. Masses of 0·5 and 0·25 yield pulsation constants of 0·04 and 0·03 respectively. Since theoretical values are approximately in the range 0·03 to 0·04 days, it appears likely that the mass is considerably smaller than one solar mass. Using a mass of 0·5 and the radius obtained above one obtains an acceleration of gravity of 500 cm/sec². Combining this with the mechanical accelerations derivable from the radial-velocity curve suggests an effective gravity of about 300 cm/sec². This is considerably larger than that observed. It should be pointed out that the effective gravities inferred from the Balmer discontinuities may be in considerable

error because, (*a*) the absolute calibration of α Lyrae is uncertain in this wave-length region and, (*b*) the constant involved in the negative-hydrogen ion is somewhat uncertain.

One must be very cautious in applying static models to moving atmospheres as has been done in the above work. It can be shown readily that radiative equilibrium is always established. It can also be shown that unless accelerations are very large, even in a moving atmosphere static models are satisfactory approximations. It should be recalled that Babcock has observed a large magnetic field in RR Lyrae on several occasions. Such fields, if they exist generally, must play an important role in the interpretation of atmospheres of RR Lyrae stars.

The second speaker was *Hazelhurst* on: Shock wave phenomena in the atmospheres of RR Lyrae stars. An abstract follows.

SHOCK WAVES IN RR LYRAE VARIABLES

The good overall agreement found by Oke and Bonsack (*Ap.J.*, **132**, 417, 1961) in RR Lyrae and by Oke (see above) in SU Draconis between the kinematic and model-atmosphere effective gravities is here ascribed to the existence of radiative equilibrium in the atmosphere at almost all phases. The sharp increase in g_{eff} just after light minimum and the doubling of the hydrogen lines are attributed to the formation of a collision layer generated by the meeting of the infalling and rising gases.

It is suggested that there is a temporary breakdown of radiative equilibrium along the path of this collision layer and that the subsequent diffusion of the excess radiation is responsible for the observed temperature variation. The decay time of the temperature curve indicates the presence of Mach 2 shock within the collision layer. It is emphasized that line doubling could occur even in the absence of a shock within the layer.

The incorporation of the observed value of the temperature peak within the shock propagation calculations permits an estimate of the atmospheric density. This is in good agreement with that obtained by the usual (indirect) methods.

Combined scientific meeting of Commissions 27, 27*b* and 37, 19 August 1961

Variable Stars in Clusters

First speaker, *R. P. Kraft* on

CLASSICAL CEPHEIDS IN GALACTIC CLUSTERS

Abstract. The most reliable data on Cepheids in galactic clusters have been collected in the following table:

Star	log P	$E(B-V)$	$<(B-V)^\circ>$	$<M_V^\circ>$
EV Sct	0·490	0·58	+0·57	−2·62
CF Cas	0·687	0·555	+0·655	−3·45
U Sgr	0·628	0·55	+0·605	−3·92
DL Cas	0·908	0·50	+0·72	−3·84
S Nor	0·989	0·205	+0·78	−3·96

From these data we find the relation between intrinsic colour and period:

$$<(B-V)^\circ> = -0{\cdot}101\,(\log P)^2 + 0{\cdot}538\,(\log P) + 0{\cdot}264$$

and the zero-point of the period – luminosity relation:

$$<B^\circ> = -1{\cdot}33 - 2{\cdot}25 \log P$$

in which the coefficient of log P follows from a study of the Small Magellanic Cloud. On the basis of these relations one can find

(*a*) spiral structure from Cepheids brighter than $<M^\circ> = -4{\cdot}5$;

(*b*) Oort's constant $A = 15$ km/sec/kpc.

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It seems that there may be classical Cepheids at large distance in the northern Milky Way having low metal abundance.

Second speaker, *A. D. Thackeray* on

RR LYRAE VARIABLES IN CLUSTERS IN THE MAGELLANIC CLOUDS

Abstract. Searches for RR Lyr variables in the following globular clusters have been successful: NGC 121 (SMC), and NGC 1466, 2257 (LMC), probably also in NGC 1978. Three-day Cepheids have been found in NGC 1866, confirming Shapley's findings.

A few pairs of Radcliffe plates of a number of other clusters in both Clouds have also been searched for variables without success. Details will be communicated on request. The difficulty of finding variables at 19th magnitude naturally increases greatly for clusters in rich regions. For this reason it is not surprising that searches were quickly successful in outlying clusters like NGC 121, 1466 and 2257; the latter is so far out that it lies outside Kerr's 21 cm isophotes. These regional successes do *not* prove that Cloud clusters containing RR Lyrae variables are only to be found in the outer regions, although this possibility cannot be excluded.

Third speaker, *G. H. Herbig* on

IRREGULAR VARIABLES IN YOUNG CLUSTERS AND ASSOCIATIONS

Abstract: There are a number of questions concerning the irregular variables in young clusters and associations that are particularly pertinent at the present time, and that should be brought to the attention of members of these Commissions.

1. A very thorough study of the light-curves of a representative group of T Tauri stars, extending over several seasons and including a search for new variables, is long overdue. The region of the Tau-Aur dark clouds ($3^h\,40^m < \alpha < 5^h\,00^m$, $+15° < \delta < +30°$) is recommended. There are about 55 known T Tauri stars in this area brighter than $m_{pg} = 17{\cdot}5$, and probably many more variables remain undiscovered. The plates should be inspected not long after exposure in order that interesting changes can be promptly brought to the attention of spectroscopists.

2. An especially careful watch, by either photographic or visual observers, should be kept on "nova-like" T Tauri stars such as UZ Tau, VY Tau, and EX Lup, so that quick announcement can be made of any flare-up.

3. It is very desirable that a photo-electric check be made of the bright B- and A-type variables in the Orion Nebula, to see if they are truly variable, or whether their apparent changes were simply the result of background difficulties. No such variables have been found in other similar associations, and few modern photo-electric observations have not shown any variation.

4. Photometric study of the bright variables of later type found in nebulae is desirable; here, however, the variation is unquestioned. Examples are FU Ori, BF Ori, and VY CMa.

5. A search is recommended of a number of nearer clusters and associations for the flash-variable population that has been found in Orion, NGC 2264, and the Tau-Aur clouds by Haro and Rosino.

Fourth speaker, *J. Sahade on*

W UMa VARIABLES IN GALACTIC CLUSTERS

Abstract: Sahade and Frieboes published the results of a preliminary search for these variables in galactic clusters. Three or four are now known to be certain cluster members,

including TX Cnc in Praesepe, RZ Com in the Coma Berenice cluster and IR Car in NGC 3532. Sahade and Frieboes also noted that these variables appeared in clusters with ages near 10^8 years. This fact was further discussed by Eggen for the three stars mentioned above, all of which have periods near $0^d.36$ and lie approximately one magnitude above the main sequences of the clusters concerned. It is very important to attempt the discovery of additional variables of this type in other clusters to ascertain whether or not (*a*) they occur in clusters of all ages and (*b*) a correlation exists between the period of the variable and the age of the cluster.

Sahade and Béron Dávila are now completing a more extensive catalogue of eclipsing variables of all types in galactic clusters which will greatly extend and revise previous catalogues of this kind by Kholopov and by Kraft and Landholt. Accurate photometry is obviously desirable for all these variables.

Fifth speaker, *B. V. Kukarkin* on

VARIABLE STARS IN WIDE AREAS AROUND GLOBULAR CLUSTERS

Abstract: Kurochkin and Kukarkin started a search for variable stars in very wide areas around globular clusters. Preliminary conclusions are: (*a*) RR Lyrae type variables exist at very great distances from the globular clusters, up to 2 kpc. According to the values of $(m - M)$ the majority of them belong to the clusters. The estimated number of field RR Lyrae variables is several times smaller than the number of variables actually discovered. (*b*) One can estimate that one third of all RR Lyrae stars, not connected now with globular clusters, have originated from such clusters.

With more material we may be able to evaluate: the number of stars leaving a cluster, the velocity of escape, the masses of the clusters, the time during which a star remains in the RR Lyrae stage and the direction of evolution for these variables.

Two recommendations: (*a*) Some W UMa stars are sub-dwarfs and quite a few could be expected in globular clusters. Therefore it is important to search for new variables which are 3 - 5 magnitudes fainter than the RR Lyrae stars. (*b*) Many of the red giants, 2 - 4 magnitudes brighter than the RR Lyrae stars, may be variable. Plates with long time-intervals should be used for their discovery.

Sixth speaker, *Tifft* on

THE CLUSTER NGC 121 IN THE SMALL MAGELLANIC CLOUD

Abstract. NGC 121 appears to have a colour-magnitude diagram fairly closely like galactic globular clusters. The red-giant variables lie on the extension of the giant branch, and the cluster-type variables lie at the blue end of a red-populated horizontal branch. For the red variables $\langle V \rangle = 16.4$ and $\langle B \rangle - \langle V \rangle = 1.9$. Cluster-type variables in the field have $\langle V \rangle = 19.6$ and $\langle B \rangle - \langle V \rangle = 0.25$. These variables are slightly brighter in the cluster than in the field, but this is possibly due to background enhancement.

Last speaker, *L. Rosino* on

WORK BEING CARRIED OUT AT THE ASIAGO OBSERVATORY

Abstract: A systematic survey has been made in 1959–61 in the regions of the Trapezium and the Horsehead Nebula (ζ Orionis) with the 50–40 cm Schmidt and with the 122 cm reflector. Light-curves of many irregular variables have been derived and 97 new variable stars were discovered around the Trapezium, NGC 1977 and NGC 1999. Many new variables were also discovered near ζ Orionis. Some of the new variables show flares. Variables have been found in NGC 7023 (Rosino and Romano); M 8 (Rosino); M 17 and M 20 (Maffei).

Photographs of some loose and distant clusters have been taken with the Asiago reflector and with the Lick 120-inch, by Kinman and Rosino. In particular the following clusters are now under investigation for variables as well as for distance and colour-magnitude diagram: Abell 1, 2, 4, 5, 10, 11, 12, 13, IC 1276 (Abell 7) and the Shakhbazian cluster. The last is probably not a physical association of stars, but simply an assembly of some extremely distant galaxies and some foreground stars. Clusters Nos. 2 and 10 are deeply reddened, they are scarcely seen on the blue Asiago plates, but they appear fairly rich in yellow and deep red. Nos. 4, 5 and 13 have been the object of preliminary study by Rosino; work is continued on the luminosity function, the HR diagram and the periods of variables. No variable stars have been found in Abell 11, but this search is not complete. Five were found in Abell 7, one of which has a large amplitude and a period greater than 30 days. Several suspected variables are present in Abell 12. Finally Zwicky's cluster at $16^h\ 57^m$, $-0°\ 28'$ (1950) has been observed and several suspected variables identified.

27*b*. SOUS-COMMISSION DES ETOILES VARIABLES DANS LES AMAS

Report of Meeting, 22 August 1961

PRESIDENT: Mrs H. Sawyer Hogg.
SECRETARY: L. Rosino.

DRAFT REPORT AND BUSINESS

The meeting opened at 11^h. The *Draft Report* was approved and discussion proceeded on the proposals in Section 4 of the report.

1. Detre emphasized the importance of having photographs of globular clusters taken at different observatories made available to interested observers for the study of variable stars. It was noted that Sandage is preparing to publish a detailed study of the *U,B,V* light-curves of the variables in Messier 15, a cluster for which periods have been published without observations. Oosterhoff supported the request of Detre. The Sub-Commission was in favour of the proposal.

2. Detre proposed further that new plates be made in order to study the secondary changes of periods of variable stars in ω Centauri. Schwarzschild stressed the importance of such a search in this important cluster. Oosterhoff noted that, with the period already known with high accuracy, only a small number of plates is sufficient for the study of secular variations. The Sub-Commission was in favour of the proposal.

3. The President noted that, at the meeting of Commission 27, the Sub-Commission had been transformed to a Committee consisting of H. Arp, L. Rosino, A. J. Wesselink, with H. Sawyer Hogg as chairman.

4. With the business of the Sub-Commission thus concluded, the President invited scientific discussion on results of researches obtained since the *Draft Report* went to press.

SCIENTIFIC REPORTS AND DISCUSSION

Rosino spoke of the recent photographic researches made with the 120-inch telescope of the Lick Observatory by Kinman and himself, on some loose inter-galactic clusters, like Abell 1, 5, 11 and 13, the Shakhbazian cluster, and IC 1276. An RR Lyrae star and two variables with periods greater than 100 days and large amplitude have been found in IC 1276 (No. 1 by H. Sawyer Hogg, Nos. 2 and 3 by Rosino and Kinman).