27. COMMISSION DES ETOILES VARIABLES

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MEMBRES: Ahnert, Ashbrook, Mme Balázs-Detre, Banerji, Bateson, Bertaud, Bhatnagar, Brun, Mlle Canavaggia, de Kock, Detre, Efremov, Eggen, Gadomski, Gaposchkin, Haro, Mlle Harwood, Hertzsprung, Mlle Hoffleit, Hoffmeister, Huffer, Huruhata, Istchenko, Kholopov, Kopal, Kordylewski, Kukarkin, Lacchini, Lindley, Mme Mayall, W. J. Miller, Nielsen, O'Connell, Odgers, Opolski, Parenago†, Piotrowski, Plaut, Rosino, Mme Sawyer Hogg, Schneller, H. Shapley, Soloviev†, Steavenson, Stibbs, Strohmeier, Svestka, Tempesti, Tsesevich, Vandekerkhove, van Hoof, Wachmann, Walker, Walraven, Wesselink, Zinner.

La Commission a trois Sous-Commissions: 27*a*, 27*b*, 27*c*.

INTRODUCTORY REMARKS

Commission 27 lost two of its members through the deaths of P. P. Parenago and of A. V. Soloviev. Both were active members of the Union since 1948. The Commission has also been deeply affected by the death of W. Baade, member of Sub-Commission 27*a*, whose work has often been of fundamental importance for variable-star astronomy. The results of their work will be quoted and used for many years to come.

With respect to the present report it should be emphasized that it is by no means complete, neither is the list of references given at the end. Several members of the Commission did not report to me on their work, while astronomers who are not members of the Commission may have done important work on variable stars which also has not been reported to me. Furthermore it is difficult for a single person to report with equal thoroughness on all the different aspects of variable-star astronomy.

In order to avoid duplication, investigations concerning variable stars in globular clusters and in galactic clusters are discussed in the report of Sub-Commission 27*b*, and the work done on the spectra of variables in the report of Sub-Commission 27*c*. No mention is made of investigations concerning eclipsing binaries which are dealt with by Commission 42. As a rule investigations on individual variables are not mentioned, unless special results have been derived.

CATALOGUES, SYMPOSIA, ETC.

The main event has been the appearance of the second edition of the *General Catalogue of Variable Stars*, published by the Academy of Sciences of the U.S.S.R. and edited by Kukarkin, Parenago, Efremov and Kholopov, of which the first copies were distributed during the General Assembly at Moscow. The catalogue contains information about 14 708 variable stars. The compilers of this catalogue should be congratulated on the completion of this enormous task. There is no doubt that the *General Catalogue* is indispensable to all workers on variable stars. In the report of Commission 27 for the tenth General Assembly B. V. Kukarkin has already given extensive information concerning the adopted system of classification. In the second volume of the new edition of the *General Catalogue* many new tables have been given which will prove useful for many investigations.

In 1959 the IAU published an English Version of the Remarks on individual variable stars, given on pages 615–68 of Volume I of the new edition of the *General Catalogue*.

The first supplement to this second edition of the *General Catalogue* is now ready for print. It will contain information about 796 variable stars which had not been named before and additional data for 1647 variables of the *General Catalogue*.

Late in 1960 Schneller published the first part of the fifth volume of the second edition of *Geschichte und Literatur des Lichtwechsels der veränderlichen Sterne*. This volume contains data and references for the variables in the constellations Andromeda-Cygnus, which were named between 1938 and 1958. Two more parts of Volume V are planned. When these will have been completed, all variables in the second edition of the *General Catalogue of Variable Stars*, will also occur in the volumes of *Geschichte und Literatur der veränderlichen Sterne*.

In 1958 P. Ledoux and Th. Walraven published a general article on variable stars in *Handbuch der Physik*, **51**, 353.

In 1960 a report was published on the Joint Discussion on the 'Luminosity of Cepheids' which was held at the tenth General Assembly (**1**).

Other symposia, of interest to variable-star astronomy, which have now been published, are: 'Semaine d'Etude sur le Problème des Populations Stellaires' (**2**) and 'Second Conference on Co-ordination of Galactic Research' (**3**).

In 1959 the Remeis Observatory at Bamberg organized a colloquium on variable stars which was attended by 36 astronomers from six countries. The papers presented at this colloquium were published in 1960 (**4**). The Remeis Observatory intends to organize a second colloquium in 1962.

VISUAL OBSERVATIONS

At the Royal Cape Observatory R. P. de Kock continued his visual observations, at an average rate of 7000 estimates per annum. In 1958 his personal total passed the 100 000 mark.

The sections of variable-star observers have been active. Some new groups have been formed. The Swedish Astronomical Society has formed a Variable Star Section of which Gunnar Darsenius, Box 1523, Göteborg, is director. The observers in this group will pay special attention to U Gem stars and flare stars. The first circular of this section will be issued late in 1960. Very recently such a section was also formed in the Netherlands.

F. M. Bateson, the director of the Variable Star Section of the Royal New Zealand Astronomical Society, has published in 1958 a booklet of instructions: 'The Observation of Variable Stars', which was distributed free to all amateur observers and societies in the southern hemisphere and which has greatly stimulated interest in variable star observing. Together with A. F. Jones he published charts and sequences for many southern variables. They aim at ultimately providing uniform charts and sequences for all variables, south of declination $-30°$ and brighter than magnitude 13 (visual) at maximum. Variables of short period are not included in this programme. The headquarters of this section will be removed from the Cook Islands to New Zealand proper in 1961.

F. M. Bateson and Mrs M. W. Mayall, director of the American Association of Variable Star Observers, have come to an agreement about a better co-ordination of the programmes of their sections. They also agreed to a strictly comparable handling of the observations.

The President has drawn the attention of the AAVSO and other groups of variable star observers to the list of 51 red variables, published in *Trans. IAU* **10**, 413, 1960 which are studied spectroscopically by Nassau, Blanco and Cameron. As a result these variables were given priority on some of the observing programmes.

RR Lyrae stars are observed visually at Odessa (by Tsesevich, Lange, Grigorevsky and

Mandel) and at Rostov-Don (by Batyrev and Judkina). Visual observations of red semi-regular variables are conducted by the Kuibyshev Astronomical and Geodetical Society. Lavrov and others observe visually at the Engelhardt Observatory.

Lacchini, who was one of the founders of the AAVSO in 1911, still continues his observations of long-period variables at his home in Faenza.

PHOTOGRAPHIC OBSERVATIONS OF SPECIAL FIELDS

Many selected regions have been or are being searched for variable stars. The following investigations have been brought to my attention.

Van Hoof reports that nearly 1700 plates have been taken with the 10-inch Metcalfe of the Boyden Observatory of ten different fields. About fifty new variables have been discovered so far.

Wachmann and W. J. Miller co-operated in an investigation of the Cygnus cloud. Since 1958 results have been published on 34 variables (**5**). Wachmann nearly completed his work on the southern part of the Cygnus cloud. He investigated nearly 350 variables of which 43% are new. He continued his work on a Milky Way field in Monoceros ($6^h\ 50^m$, 0°).

Alexander and Eggen are studying blue and yellow plates, taken with the 74-inch Radcliffe reflector, of Baade's field in Sagittarius. They find that some of the previously assigned periods are definitely incorrect.

Nassau and Blanco (**10**) have made a search for M-type stars and red variables in the region around NGC 6522, covering practically Baade's field in Sagittarius.

Ponsen is continuing his work on two other selected fields in Sagittarius, the positions of which have already been given (**6**). In fields 1 and 2 the total numbers of variables found are 104 and 64 respectively, of which 44 and 29 respectively are cluster-type variables. As Ponsen found large systematic differences in mean apparent magnitude and in the mean colour for the RR Lyrae type variables in the two fields, he intends to check the results obtained by photo-electric measures.

Kaho has been working on nine selected regions (**7**).

Westerlund has made surveys in the infra-red in three regions, namely in Cygnus (**8**), in Aquila (**9**) and in the southern Coalsack. He has identified 140 new red variables and is following the magnitude and spectral variations of the variables in the Coalsack. The observations, which cover now about three years, are made with the 20/26-inch Schmidt of the Uppsala southern station at Mount Stromlo. He also kept a region in Carina under observation during this same period. The spectra are classified in the Case infra-red system, and the limiting infra-red magnitude is about $I = 13^m$.

At the Maria Mitchell Observatory Miss M. Harwood completed part of her investigation of the variable stars in the Scutum cloud. The article, to be published in the *Annals of the Leiden Observatory*, will contain information about 65 variables which have already been named in the *General Catalogue of Variable Stars* and about 354 new variable stars. She is continuing work on about 280 more new variables. At this observatory work is continued on the type and period of the variable stars in VSF 193 under the direction of Miss D. Hoffleit. Results will be published annually (**11**).

In the Soviet Union the systematic investigation of the plate collections at Kiev, Moscow, Lvov, Odessa. Stalinabad, Tartu and Vilnius is being continued. More than 200 variables have been investigated during the last three years. The results are published in 'Variable Stars,' in the 'Astronomical Circulars' and in the publications of the above-mentioned observatories.

At the Cape Observatory Stoy (**12**) and Cousins (**13**) discovered several new bright variables.

At the Sonneberg Observatory Jackish observed photo-electrically 156 bright stars of which 34 were found to be variable, with a mean range of $0^m.05$. He expects that 25–30% of all stars might be variable with ranges larger than $0^m.03$. Of the luminosity classes Ia, Ib and II more than 50% seem to be variable.

Romano has studied certain fields at low galactic latitude in the constellations Cepheus, Cassiopeia and Andromeda. The results of these investigations have mostly been published in *Coelum*.

At the Sonneberg Observatory many fields of the 'Felderplan' have been investigated for variable stars. From January 1958 to July 1960 7883 new Sky Patrol plates were taken, whereas at the Boyden Observatory 904 plates were obtained with the 10- and 8-inch telescopes. Hoffmeister derived types and periods of 145 variables in the Area 73 Herculis (**14**) and discovered 88 new variables in the northern (**15**) and 41 in the southern hemisphere (**16**). On the Boyden plates he discovered about 1000 new variables, many of them belonging to the galactic halo.

Richter investigated the areas γ Sagittae, ζ Hydrae and others. Together with Schaiffer and Wenzel he investigated 26 stars with spectral type later than M 4 in the area 23^h09^m, $+52°$ and proved the variability of 18 of them. Wenzel has been working on irregular variables of low luminosity, especially in the obscured regions in Aquila, Cepheus and Cygnus. Parts 10 and 11 of the Felderplan (Die veränderlichen Sterne der nördlichen Milchstrasse) and 124 issues of 'Mitteilungen über veränderliche Sterne' were published.

Also the work on variables at the Leiden Observatory has been continued. The following results have been published: Plaut 140 variables in a field around CPD $-31°$ 4931 (**17**), Kooreman 162 variables in fields around BD $-18°$ 5206, CPD $-37°$ 8446 and CPD $-58°$ 5038 (**18**), van Houten 32 variables in the Crux region (**19**) and Casparie 56 variables in regions around Boss 2581 and Boss 4599 (**20**). Another 100 variables are ready for publication. An investigation of a different character by Kwee should be mentioned here. The magnitudes derived by the Leiden observers from Franklin-Adams plates for the variables in the southern Milky Way fields are rough and by no means homogeneous. Kwee has tried to derive new magnitudes, at maximum and at minimum, on a well defined photometric system for all the variables in four fields surrounding the direction of the galactic centre, namely for the fields centred at: $18^h19^m.4$, $-31°49'$; $18^h54^m.3$, $-37°12'$; $19^h00^m.7$, $-27°49'$ and $19^h01^m.3$, $-18°53'$ (1900). He derived magnitudes for 901 variables, of which 444 are RR Lyr-, 35 Cepheid-, 166 Mira-, 97 semi-regular- and 108 eclipsing-type variables. The results of his work will be published in the *Leiden Annals*.

The last report has mentioned already the work by Plaut at Groningen for a search of faint variables in four fields, observed with the Palomar 48-inch Schmidt telescope. Plaut reports that in the summer of 1959 new plates were taken especially for the study of the long-period variables. It is hoped that the work on field 2 will be completed in the course of 1961. At the Warner and Swasey Observatory Blanco is co-operating in determining the spectral types of the long-period variables.

An interesting experiment is being made by Walker at the Lick Observatory. In order to detect rapid variables, that is, stars which show appreciable changes in brightness in an interval of $6\frac{1}{2}$ hours or less, plates were taken with the 20-inch Carnegie Astrograph during the summer of 1959 of 12 fields at a galactic latitude of about 25°. Each plate carries a long series of 5-minute exposures, the plate being shifted $\frac{1}{2}$ mm between the exposures. Thus two plates were taken of a field each night and the total time that the area was monitored was about $6\frac{1}{2}$

hours. The limiting magnitude of each exposure is about $m_{pg} = 16$. The plates were taken on the following centres (1959):

	h	m	°	′		h	m	°
1.	17	22·0	+16	15	7.	18	16·0	+50 45
2.	17	32·0	+22	00	8.	18	24·0	+56 30
3.	17	42·0	+27	45	9.	18	38·0	+62 15
4.	17	51·0	+33	30	10.	21	52·0	+16 15
5.	18	00·0	+39	15	11.	22	20·0	+08 00
6.	18	08·0	+45	02	12.	22	46·0	00 00

Only about 10% of the plates have been examined to date and one variable has been found. From photo-electric observations obtained with the Crossley reflector it appears to be a short-period RR Lyr star having a steep rise and slow decline in a period of perhaps 4 hours.

Finally I want to mention in this section the work of Weber who has discovered several new variables on plates taken with his private cameras (**21**).

RR LYRAE-TYPE VARIABLES

Much fundamental work has been done on variables of this type. Proper motions will soon be published for 70 variables, derived by van Herk from Mount Wilson plates and from Carte du Ciel positions and new Leiden plates. It has been known for some time that these variables do not form a homogeneous group with respect to their kinematical properties. Kurochkin (**22**) has divided them into two sub-groups, one resembling the variables in the globular clusters, the other the intermediate galactic subsystems. That these stars do not form a homogeneous group spectroscopically was proved by Preston (**23**) who derived spectral types from the hydrogen lines and from the K line of Ca II. He showed that the spectral characteristics are correlated with the kinematical properties. An analysis of the spectral characteristics was also given by Alania (**24**) and Lange (**25**).

The question of the absolute median magnitude of these variables has not yet been definitely settled, but important contributions have been made through the study of variables in globular clusters and in the Magellanic Clouds. These investigations will be reported by the Presidents of Sub-Commissions 27*b* and 28*a*.

Kinman is preparing for print an account of his photometric and spectroscopic study of 22 southern RR Lyrae variables.

Systematic photo-electric observations in blue and yellow are being made by the astronomers of the Konkoly Observatory. Complete light-curves have been obtained for the variables: SW and XX And, RW Ari, RS, ST, SW, TV and YZ Boo, W and ST CVn, RZ Cep, S Com, UY and XX Cyg, SU and SW Dra, RR and SZ Gem, TW, VX and VZ Her, RR Leo, V LMi, TT Lyn, AV, BH, DH and DY Peg, AR Per, RU Psc and TU UMa by Balázs-Detre, Balázs, Lovas, Gefferth and Paál. Detre reports that the photo-electric observations show regularly a hump or standstill on the rising branch of the light curves and that there exists a correlation between the duration of this standstill and the amplitude of the light-curve.

Mrs Balázs-Detre is studying the Blazhko-effect. She published a list of the variables showing this effect (**26**). She obtained a large number of photo-electric measures of AC And, RV, RW and XZ Dra, AR Her, RR Lyr and RV UMa. The discussion has been completed for RR Lyr and RW Dra by herself and for AR Her by Almár. She finds that the changes of the two periods are correlated for each variable, but that this correlation is not the same for different stars. Changes of period are always accompanied by changes of the amplitude of the Blazhko-effect.

For some variables, like RR Gem and SW And, the effect can temporarily cease to exist. As the cause of the light-variation she adopts zonal eruptions, presumably symmetrical to the magnetic field of the star. Form and amplitude of the light-curve will then strongly depend on the orientation of the axis of rotation. The Blazhko-effect can then be explained by the fact that the axis of the magnetic field does not coincide with the axis of rotation.

Most other authors, however, maintain the model of a pulsating star to explain the observed phenomena. From three-colour observations, like those by Spinrad of AN Ser (**27**), it is clear that there exist observational differences between RR Lyrae-type stars and Cepheids. Abt (**28**) has shown that a shock-wave model can successfully account for the observed hump at mid-rising light, for the ultra-violet excess, the hydrogen emission lines, the double absorption lines and for the difficulties with the Baade-Wesselink method.

Kordylewski at Cracow and Tsesevich at Odessa have been studying the long-period and secular changes in the periods of these variables. They published linear ephemerides for the years 1960 and 1961 (**29**). In accordance with resolution 2, approved by Commission 27 at the Moscow general assembly, Tsesevich has organized a campaign for the systematic observation of RR Lyrae-type stars. From August 1958 until September 1960 232 variables were observed from 579 of the programme. The following institutions have taken part in this work: Budapest, Sonneberg, Skalnaté Pleso, Cluj, Rostow and Odessa. For some of these variables Blazhko-effect could be established.

Some rather bright ultra-short-period variables have been discovered. Eggen found that V 703 Sco, listed as a RRc-type variable, probably is a δ Scuti-type variable. Independently Ponsen proved that this star of magnitude 7·8 resembles AI Vel very closely. He derived the periods $P_0 = 0^d{\cdot}115218$ and $P_1 = 0^d{\cdot}093545$ with a beat period $P_b = 0^d{\cdot}49730$. The $(U-B)$ colour curve is the reflected image of the light curve. A similar result was found by Hardi for CY Aqr, while for DY Peg (**30**) and DY Her (**31**) he found a very small range for the $(U-B)$ variation relative to the variation in $(B-V)$. Churms discovered that HD 199 757 is a dwarf Cepheid with a period of about 97 minutes.

Bojartchuk at the Crimean Observatory is studying the chemical composition of variables of the δ Scuti type.

CEPHEIDS

A large amount of observational material has become available for the Cepheids. Photo-electric two-colour observations have been made by Bahner and Mavridis (**4**, pages 18–19) of 18 Cepheids in the northern sky. Walraven, Muller and Oosterhoff observed 184 southern Cepheids in blue and yellow (**32**). Irwin observed 145 Cepheids in three colours, V and $(B-V)$ in the Johnson-Morgan system and $(U-B)$ in the Cape system. His work covers most of the Cepheids south of $-20°$ and brighter than 13th photographic magnitude at minimum and those Cepheids between $+20°$ and $-20°$ and brighter than the 10th photographic magnitude at minimum. Prokofieva made three-colour observations (effective wavelengths 4800, 7700 and 9200 Å) at the Crimean Observatory of RT Aur, RX Cam, SU Cas, X Oph, S Sge, α UMi and T Vul. She found that RT Aur, SU Cas, S Sge and T Vul do not show black-body radiation (**33**). Oosterhoff published three-colour photometry in the U, B, V system of 51 northern Cepheids, which had not been observed photo-electrically before (**34**). A similar programme has been carried out at the Lowell Observatory by observers from Berkeley. McCarthy made U, B, V observations of V, X, Z and RR Lac, first at Lick and later at the Vatican Observatory. Finally the six-colour work of 24 Cepheids by Kron and Svolopoulos (**35**) and also the six-colour work by Mianes at the St Michel Observatory should be mentioned. The latter applies Canavaggia's method (**36**) to derive colour-excesses and intrinsic colours.

Of the work on individual Cepheids may be mentioned the result derived by the group of Chalonge for δ Cephei, namely that the luminosity class changes from II to Ib, when the brightness changes from maximum to minimum; photo-electric observations of TU Cas by Balázs-Detre and of κ Pavonis by Cousins (37); the variation in the period and perhaps also in the shape of the radial velocity curve of l Car, as found by Kucewicz and C. Jaschek (38), and the notes by Fernie on the intrinsic colour of this interesting variable (39).

Much work has been done on Cepheids in galactic clusters and also on Cepheids in the Magellanic Clouds. These articles will be discussed in the reports of Sub-Commissions 27*b* and 28*a*. In combination with modern theories about stellar evolution, the Cepheids in galactic clusters contribute important information concerning the period-luminosity relation and the intrinsic colours of Cepheids.

From the many new observations it has become clear that our knowledge concerning the relations between period, amplitude and shape of the light curve is still rather confused, even for the Cepheids of population I. The quite generally adopted distinction between type A and type B Cepheids probably needs a revision. The situation with respect to the intrinsic colours has become more satisfactory. Thanks to the investigations of Kraft (40, 41) and of Arp, Sandage and others on Cepheids in galactic clusters and in the Magellanic Clouds, it now seems that the intrinsic colour of Cepheids of a certain period in our own Galaxy and in the Magellanic Clouds is the same. From a spectroscopic study Feast, Thackeray and Wesselink (42) also concluded that no differences are observed between galactic and Cloud Cepheids.

Melnikov (43) calculated the luminosities of Cepheids for different values of the constant Q in the period-density relation. Investigations concerning the values of Q and the intrinsic dispersion of the period-luminosity relation were published by Sandage (44), Reddish (45) and Canavaggia (46). C. Jaschek and Ringuelet (47) studied the evolution of the Cepheids.

A study of the galactic orbits of Cepheids was made by Janák (48). Petit investigated the criteria by which Cepheids of population types I and II can be distinguished (49) and for both population types separately he studied the spatial distribution in our Galaxy (50). He concludes that Cepheids with short periods are most often found in the external regions of the Galaxy and those with long periods in the central region. Further he finds that the Cepheids of population II are relatively rare in the outer regions of the Galaxy, while near the centre a much larger fraction of all Cepheids belongs to this population. Badalian at the Burakan Observatory finds that in our Galaxy, in M 31 and in the Magellanic Clouds the space distribution of the Cepheids is closely related with that of neutral hydrogen.

LONG-PERIOD VARIABLES AND RED VARIABLES

Many of the observations of Mira-type, semi-regular and irregular variables have been referred to in the sections on visual and photographic observations. The work by Osvalds and Risley on the space velocities and dispersions of more than 300 Mira variables has been completed and will be published in detail in *Publications of McCormick Observatory* Vol. XI (51). O'Connell reports that McCarthy is studying the space distribution of M-, S- and C-type stars in a region in Cygnus ($21^h\,04^m$, $+46°$). He suspects variations in several of these late-type stars which will be further investigated photometrically and spectroscopically. Eggen completed three-colour photometry of L_2 Pup, T Cen, S Car and TY Vir. Feast at Radcliffe is continuing his spectroscopic work on M variables in the southern hemisphere. Grigorian and Vardanian at Burakan made photo-electric observations and polarization measures of μ Cep, RW and ST Cep. At the Stalinabad Observatory red semi-regular variables are observed systematically. At Abastumani the red super-giants RW Cyg, UX Dra and SU Per are being

observed. Matveev at Kuibyshev investigated the space distribution of red irregular and semi-regular variables. Real space-groups of this type of variables were discovered.

T TAURI VARIABLES

Little need be said here about these variables as Herbig will prepare a report, which will form a supplement to the report of Sub-Commission 27*b*. Hoffmeister reports that he is investigating an obscured region near ϵ Cha with more than 20 variables of the RW Aur type, while Götz is working on Hα stars in the Orion and Taurus region. The latter finds that the intensity of the Hα emission increases with the photographic absorption of the cloud. Wenzel investigates obscured regions in Aquila, Cepheus and Cygnus for variable stars. Tchugainov at the Crimean Observatory is making photo-electric three-colour observations of variables of this type. Dolidze at the Abastumani Observatory has started a systematic search for stars with Hα emission. Artiukhina at the Sternberg Astronomical Institute has derived the proper motions for 40 variables of this type (**52**). Finally Kholopov investigated the H-R diagrams of T-associations (**53**), and he prepared a critically revised list of such associations and gave a discussion of their main properties (**54**). Varsavsky found that the intrinsic colours are often much more blue than would be expected from the spectral type (**55**).

THE β CANIS MAJORIS VARIABLES

Van Hoof and Blaauw studied θ Oph (**56**), van Hoof and Haffner β Cru (**57**), which is also investigated photometrically and spectroscopically by Milone at Bosque Alegre, and further van Hoof made an extensive study of ν Eri (**58, 4**). For the first star an amplitude of $0^m{\cdot}06$ (UV) and a period of $3^h\,22^m$ were derived, for the second a range of $0^m{\cdot}02$—$0^m{\cdot}05$ (UV) and a period of $5^h\,41^m$. Besides the main period β Cru shows some shorter periods. The same is true for ν Eri, while for θ Oph the situation is less clear. According to van Hoof the light variation cannot be explained by adopting two nearly equal periods, as has often been done. Magalashvili and Kumsishvili at Abastumani observed γ Peg (**59**) and δ Cet. Popov at Pulkovo studied the continuous emission of six variables of this type (**60**). From an analysis of the radial velocities he derived a K-effect of $+2{\cdot}7$ km/sec. Kopylov at the Crimean Observatory studied the period-luminosity and period-spectrum relations of 14 β CMa-type stars. He found that these stars form a sequence with insignificant dispersion parallel to the main sequence. He estimates the total number of these variables in our Galaxy at 8×10^3, and the duration of their variability at 2×10^5 to 10^6 years (**61**). A theoretical paper on the lifetime of these variables was published by Reddish and Sweet (**62**).

NOVAE AND SUPERNOVAE

Tsê-Tsung published a 'New Catalogue of Ancient Novae' (**63**).

Bertaud publishes annually an article with catalogues about historical novae, recent novae and supernovae in *l'Annuaire Astronomique Flammarion*. Every fourth year he publishes a more detailed article on novae in *l'Annuaire du Bureau des Longitudes*. The next issue will appear in 1961.

Walker continued his observations of DQ Her. From photo-electric observations with the Crossley reflector he concludes that the period of $0^d{\cdot}19$, discovered in 1954, is probably increasing, presumably as a result of continuing loss of mass by the system. Accurate times of minimum over the next few years will be sufficient to confirm this variation. He derived definite elements for the 70-second period. The best elements are:

$$\text{max.} = \text{J.D. Hel. } 2\,434\,954{\cdot}78537 + 0{\cdot}00082\,25207\,2\,E$$

No evidence was found of a variation in this period since 1954. Walker suggests that this

phenomenon is a deep-seated one and that it probably is the fundamental period of pulsation of the old nova. Even though mass loss is probably going on, the nova is adjusting itself in such a way that the mean density of the configuration remains accurately the same. Spectra of this nova were investigated by Mustel and Bojartchuk (**64, 65**), from which they derived the chemical composition.

The light curve of Nova Her 1960 was determined by Bertaud and will be published in the *Journal des Observateurs*. This nova was observed in the *U*, *B*, *V* system by Tchugainov at the Crimea, at wave-lengths 7700 and 9200 Å, by Prokofieva at the Crimea and in the blue by Albo at Tartu. Efimov at the Crimea observed photo-electrically the changes in the Hα intensity. Spectra were obtained by Bertaud and by Kopylov, Galkin and Kumaigorodskaya at the Crimea and by Savelieva and Shakhovskoy at the Sternberg Institute in the Crimea.

A systematic search for super-novae was started in 1957 with the Palomar Schmidt telescope. Co-operating in this search are the Steward Observatory at Tucson and the Bern Observatory in Switzerland. Altogether 16 super-novae have been discovered. Photometric and spectroscopic observations have been collected by many observers from the Mount Wilson and Palomar Observatories. A spectrophotometric study of the super-nova 1960 in NGC 4496 was also made by Saveljeva at the Sternberg Astronomical Institute.

The spectroscopic studies of novae and super-novae will be discussed in the report of Sub-Commission 27*c*.

Theoretical studies concerning super-novae were made by Gordon at Kharkov on those of type I (**66**) and by Shklovsky (**67**). The latter concludes that the type I super-novae, the radiation of which is of a non-thermal nature, occur in the early stages of the galaxies and are the only source of the heavy elements, while those of type II, with thermal radiation, are the product of O- and B-type stars with a high abundance of heavy elements.

OTHER VARIABLES AND MISCELLANEOUS INVESTIGATIONS

In 1958 Babcock discussed eight magnetic variables (**68, 72**). Later he published a note (**69**) emphasizing the importance of photometric observations. Several magnetic variables have now been observed photometrically. Jarzebowski (**70**) observed: α^2 CVn, 53 Cam and HD 71 866, 98 088, 125 248, 153 882 and 188 041. Hardie studied HD 124 224 (**71**).

Based on information from Babcock, A. J. Deutsch and Hoffleit, the President of Commission 27 prepared a circular letter for the members of the commission with a list of magnetic stars, wide-line silicon stars and peculiar A-type stars for which photometric observations would be important. Copies are still available.

Miss Zuckermann at the Institut d'Astrophysique in Paris is studying SS Cyg. She hopes to organize a concentrated international campaign on this variable in 1962. Nielsen is working on the photometric observations of this star in order to derive a continuous light-curve. Photo-electric observations in *U*, *B*, *V* were made at the Crimea by Tchuvaev, who found rapid variations up to half a magnitude during minimum light.

In a series of papers Zhevakin (**73, 74**) and Aleshin (**75**) have been studying the problems of variability due to pulsation and they developed a theory for the transformation of radiation flux into mechanical energy. According to them the required mechanism is found in giants and super-giants within a narrow zone in the envelope of these stars. Kukarkin is continuing his studies of the morphological properties of variable stars in the galactic field and in globular clusters.

P. TH. OOSTERHOFF
President of the Commission

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27*a*. SOUS-COMMISSION DE CO-ORDINATION DES RECHERCHES GALACTIQUES (ETOILES VARIABLES)

MEMBRES: Baade†, Blaauw, Kukarkin, Oosterhoff.

Sub-Commission *27a*, like Sub-Commission *33a*, is primarily concerned with special problems. It has not had occasion to meet and has nothing to report. Adequate reference to work done in the field of variable stars in Galactic Research is made in the report of the main Commission.

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

PRÉSIDENT: Mrs Dr. H. B. Sawyer Hogg, David Dunlap Observatory, Richmond Hill, Ontario, Canada.

MEMBRES: Arp, Detre, Kholopov, Rosino, Wesselink.

INTRODUCTION

In this, the second report of this Sub-Commission, the researches now in progress or published since the 1958 meeting will be considered under the following sections: 1. Variables in globular clusters. 2. Variables in galactic clusters and associations. 3. Variables in star clusters of external galaxies. 4. Proposals.