29. COMMISSION DES SPECTRES STELLAIRES

PRÉSIDENT: M. H. N. RUSSELL, *Director of the Princeton University Observatory, Princeton, N.J., U.S.A.*

MEMBRES: MM. W. S. Adams, Beals, Mlle Cannon, MM. Cecchini, Chalonge, Colacevich, Mme Payne Gaposchkin, MM. Gerasimovich, Joy, A. Kohlschütter, Lindblad, Merrill, Milne, W. W. Morgan, H. H. Plaskett, J. S. Plaskett, Redman, Stratton, Struve, Swings, W. H. Wright.

Two-thirds of the members of the Commission have replied to the request of the chairman for an expression of their opinion. Most of them are in general well satisfied with the existing system of classification and nomenclature. Lindblad reports on successful work upon the determination of absolute magnitudes of faint stars, in many ways. Adams writes: "I might suggest that attention be called in the report to the fact that the ultra-violet spectra, even of stars like β Orionis, show large numbers of lines. As you probably remember, the spectrum of Sirius resembles, at first sight, the solar spectrum. If all observatories had the facilities for getting spectra in the far ultra-violet, this region would probably furnish the best criteria for spectral type." Merrill suggests: "The nomenclature which, upon the basis of atomic transition, assigns the adjective 'nebular' to lines which may not occur in nebulae, and 'auroral' to lines which may not occur in the aurora, is surely not an ideal one. Nevertheless the suggestion by Boyce *et al.* that leads to this circumstance seems to fill a need and is quite often used. I believe the simple modification of substituting 'nebular type' for nebular, and 'auroral type' for auroral, will do away with the ambiguity (which may be serious) and retain the advantages. Would the Commission consider recommending this usage for adoption?" Struve recommends: "Astronomers interested in the problem of stellar rotation keenly feel the need for a larger amount of observational data concerning the components in the line of sight of the rotational velocities. Heretofore only short lists of such velocities have been published, and many of them are based upon single-prism spectrograms which can be relied upon for very large velocities exceeding about 50 km./sec. It is recommended that observatories possessing large collections of spectrograms publish an estimate of the rotational velocity together with the data on radial velocity, spectral type or spectroscopic parallax. It should be sufficient to calibrate a small number of spectrograms by means of accurate line contours, evaluated either by the method of Carroll or by that of Struve and Elvey. The rotational velocities for other stars may then be estimated from visual comparisons with the calibrated plates."

REPORT OF SUB-COMMITTEE ON NOVAE

The appointment of a sub-committee on the spectra of Novae arose in part from the steps taken by the Editors of *The Astrophysical Journal* to collect information as to the complete spectroscopic material secured at many observatories for Nova Herculis 1934. The first steps taken by the sub-committee were to complete the work for Nova Herculis 1934 and at the same time to collect similar information as to the scattered material available for earlier bright novae. For each of these novae the information asked for was the number of plates secured, the range of dates covered and the range of spectrum. It was also ascertained whether the material had been or was being measured and prepared for publication and whether the observatories concerned would lend original plates or copies to investigators

desirous of working up a particular nova as a whole or of studying some particular point. The information readily supplied by directors of observatories has been collected and filed by the Chairman of the sub-committee and it is suggested that individuals needing information about available plates of earlier novae should apply in the first instance to the Director of the Solar Physics Observatory, Cambridge, England.

The examination of the material for Nova Herculis made two facts abundantly clear. There had been a great deal of overlapping of observations and there was plenty of material available for a daily atlas of the spectrum of Nova Herculis, for the first four months after its outburst, the completion of which had been suggested in *The Astrophysical Journal*. This work was delayed until a number of the separate observatories had completed the study of their material in the hope that original plates could then be more freely lent to the observatory where the atlas would be compiled. Preliminary work in combining material from instruments of different dispersion (both total and differential) has been carried out successfully and the Solar Physics Observatory, Cambridge, has undertaken to make the atlas if sufficient support is forthcoming from subscribers to meet the cost of publication.

The excessive multiplication of certain observations for Nova Herculis 1934—3200 spectrograms were obtained in the first 110 days after discovery—led to the revival of a scheme for co-operative observations of novae drawn up originally by Dr W. H. Wright. Information was sought as to the type of instruments likely to be readily available for the study of bright novae in the future. The summarized replies are given below—the numbers in brackets refer to special preferences:

	No. of Observatories
(i) Slit spectrograph:	
(*a*) "Ultra-violet" region (3000 A. to K)	4
(*b*) Ordinary "photographic" region (K to Hβ):	
High dispersion (3-prisms or equivalent)	10 (2)
Medium dispersion (2-prisms or equivalent)	4
Low dispersion (1-prism or equivalent)	12 (5)
(*c*) "Visual" region (Hβ to Hα, or beyond):	
High dispersion (3-prisms or equivalent)	4 (1)
Medium dispersion (2-prisms or equivalent)	2
Low dispersion (1-prism or equivalent)	9 (3)
(ii) Prismatic camera or slitless spectrograph	15
(iii) Diaphragms, crossed grating, or other means of making spectrophotometric comparisons	14

It is clear that high and low dispersion slit spectrograms in the photographic region and low dispersion in the visual region are well provided for, as also slitless spectrograms, and it has been suggested that observatories which have the necessary equipment and are so placed as to be able to use it in the case of a bright nova should concentrate on *uv* slit spectra, medium dispersion in the photographic region and high or medium dispersion in the visual region. No details are available about observations being made in the extreme infra-red, a field which at present seems unprovided for.

Another line of work in which co-operation between observers is desirable is the study of short-period magnitude oscillations in a nova's brightness. These have been

clearly indicated in the case of Nova Herculis, but they are not so certain as they might be owing to the incomplete way in which observations of magnitude have been published. The help of Commission 27 would be invaluable if it could give clear instructions to the various national bodies of variable star observers as to the best methods of measuring and reporting on magnitude fluctuations of short-lived variable stars appearing suddenly without warning.

Another great service would be rendered by variable star observers if a scheme could be drawn up and carried out which would lead to the discovery of bright novae at some longer time before their principal maximum. Drs Baade and Zwicky at Mount Wilson Observatory have discovered a number of super-novae in distant extra-galactic nebulae by systematic photographic search in a number of selected regions, such as the Virgo cluster. What is needed is some such scheme of co-operation by which a number of selected areas should be kept under systematic observation, as continuously as is possible, by means of short-focus photographic cameras, the plates secured being examined without delay. The plates would no doubt furnish valuable data about other variable stars in the region under examination. Probably the ninth magnitude would be a useful enough limit for photographic work along these lines, but other valuable results might be secured by observers who took the trouble to learn all the naked-eye stars and to scan the sky with care on every fine night. The A.A.V.S.O. has already a nova programme in hand with twenty observers who examined thirty-one different regions covering 3100 square degrees of sky during July and August 1937. Their work might be extended to other countries. The importance of an early pre-maximum observation of a nova's spectrum was emphasized in the case of Nova Herculis 1934, where the spectrum changed to a later type between the early morning and evening of the day of discovery.

The study of pre-maximum changes in the spectrum of a nova is perhaps the chief need at the moment. This may help more to the understanding of the nature of a nova outburst than anything else, though the subsequent stages of a nova development still leave many problems unsolved. A few of these may be mentioned. The connection between the expanding photosphere required by considerations of temperature and brightness and the expanding shell suggested by the displaced absorption lines and broad emission bands requires elucidation. The alternative explanations in terms of expanding shells, jets, and continuous ejection of matter have to be examined further both theoretically and spectroscopically. The differences between the pre-maximum and post-maximum stages and between successive absorption spectra with successively greater velocity displacements need explanation, as also the connections of magnitude and spectroscopic fluctuations and the departures from a black body distribution of continuous radiation. All these problems require careful spectrophotometric treatment, both for the continuous spectrum, so difficult to examine with any certainty, and for the absorption and emission spectrum. For some of the changes round maximum it would be very interesting to have observations made with a stellar interferometer, if one were available at the time.

Another class of problem still unsolved is to be found in the variation of radial velocity with wave-length, with element and with ionization potential. While most of the absorption lines found in nova spectra are readily grouped into lines of a regular spectral type sharing a common velocity displacement, there is a residual of narrow absorption lines frequently reported and not yet identified; these lines are not the same for different stars. The relation of the absorption spectra to maxima

in the bright bands appearing at a later stage is unknown as yet, as also the connection between these maxima and the condensations or nuclei observed as the nova grows into a measurable disk or breaks into several nuclei.

A further line of study well worth following out at this stage would be an intercomparison of the various stages of development of different novae, such as the one that Dr McLaughlin has recently published on their rates of development. This is becoming increasingly possible with the wider publication of the observations of earlier novae.

The ultimate fate of novae and their links, if any, with white dwarfs and planetary nebulae have yet to be established. Differences between novae and super-novae need to be explored; they are almost certain to exist in other matters than the scale of the outburst. It cannot be said that any link between novae (or even super-novae) with cosmic rays has yet been established, and the committee feel that the subject of cosmic rays—perhaps now ripe for study by the methods of astronomy—should be placed under the care of some other committee.

F. J. M. STRATTON
Chairman

REPORT OF SUB-COMMITTEE ON THE CLASSIFICATION OF WOLF-RAYET STARS

The Sub-Committee repeats its recommendations of 1935 (see pp. 184–87 of *Transactions of the International Astronomical Union*, **5**, 1935). Mrs Gaposchkin, who at that time submitted a minority report, now expresses the opinion that: "It will be well to adopt the classification that he [Dr Beals] has proposed"; so that this recommendation may now be regarded as unanimous.

The following report has been submitted by Dr C. S. Beals:

INTRODUCTION

At the 1935 meeting of the International Astronomical Union a tentative report was presented which dealt with the general problem of the classification of Wolf-Rayet stars. The division of Wolf-Rayet stars into parallel sequences was demonstrated and criteria of classification were suggested which made it possible to include all Wolf-Rayet stars whose spectra had been adequately investigated. At that time it was not found possible to secure unanimous agreement in all points relating to the classification, and it was deemed best to postpone official action until certain additional observations could be made and until the question of nomenclature and notation could receive further consideration.

Since that time the observational basis of the classification has been strengthened, particularly in the visible region, where some of the most important criteria of classification are to be found. The accompanying illustration shows that the gap in the series of spectra accompanying the 1935 report has been filled by a grating spectrogram of the star HD 151932 in the visible region. The new observations have amply confirmed the soundness of the original criteria of classification and there now seems no reason why the adoption of this system of classification should be further postponed. The report which follows is closely similar to that presented in 1935. The principal difference concerns the matter of notation, where a more detailed discussion is presented and where a somewhat different approach to the question is advocated.