29. COMMISSION DES SPECTRES STELLAIRES

Report of Meetings

PRESIDENT: L. H. Aller.
VICE-PRESIDENT: Anne B. Underhill.
SECRETARY: Margherita Hack.

Business meeting, 17 August 1961

The President, L. H. Aller, announced the names of the Commission executives. These are: Vice-President, A. B. Underhill; Secretary, M. Hack; Organizing Committee, M. W. Feast, Y. Fujita, H. Kienle, A. Melnikov and J. Sahade. It was suggested that V. Bappu, W. Iwanowska, and A. Slettebak act as alternates should any of the above be unable to serve.

The *Draft Report* was adopted with minor corrections.

Following this the question of reprinting the Henry Draper Catalogue was discussed. A motion, moved by A. B. Underhill and seconded by J. Sahade, that a working group be established to evaluate the need for reprinting the Henry Draper Catalogue, to estimate the cost of such a project, and to investigate the possible methods of proceeding was passed. C. H. Gaposchkin was appointed chairman of this working group.

Greenstein reported on a proposal by R. Griffen to produce an intensity-tracing atlas of the spectrum of α Bootis from Mount Palomar spectrograms. The spectrograms have a resolution of at least 100 000 and the linear dispersion is 1·1 Å/mm in the range λ3600 to λ5500 and 1·6 Å/mm in the range λ5300 to λ6800. Samples were shown of the intensity tracings that it is proposed to reproduce. The scale is closely similar to that of the Utrecht Solar Atlas. Greenstein requested that comments regarding the desirability of the undertaking be addressed to him. It appears that such an Atlas would be a valuable teaching aid as well as a source of useful information for research purposes.

The future organization of Commission 29 was discussed and it was decided to make no major change at present. There will be three Committees and one Working Group.

1. Committee on Line Intensity Standards—Chairman, K. O. Wright.
2. Committee on Spectral Classification—Chairman, W. P. Bidelman.
3. Committee on Spectrophotometry—Chairman, J. B. Oke.
4. Working Group on Question of Reprinting H. D. Catalogue—Chairman, C. H. Gaposchkin.

Slettebak reported that he and Iwanowska had concluded that the best way to effect the exchange and loan of high-disperson spectroscopic material was through personal contact between the interested parties and that attempts to establish a central clearing office were undesirable at present.

The value of and need for concentrated, high-dispersion observing of selected objects with spectra that may vary rapidly, for example, W. Serpentis, was emphasized by M. Hack. Observations of W Serpentis are urgently needed at phases between 13·2 and 13·7 days at a dispersion close to 10 Å/mm.

Working group on Be stars

After the formal business meeting had adjourned, a working group on Be stars was organized with Mme R. Herman as chairman and D. B. McLaughlin and A. A. Bojartchuk to represent

the Northern Hemisphere and J. Sahade and A. D. Thackeray to represent the Southern Hemisphere.

Joint meeting with Commission 25, 18 *August* 1961

A joint session of Commission 29 was held with Commission 25 at 7 p.m. on Friday, 18 August, to discuss the setting up of color and energy-distribution standards in a zone between declinations $+15°$ and $-15°$ so these stars could be used as standards by observers in both hemispheres. A committee consisting of G. E. Kron and J. B. Oke was appointed to co-ordinate activities of observers interested in this problem.

Joint meeting with Commission 9, 21 *August* 1961

A joint session was held at 9 a.m. on Monday, 21 August, with Commission 9, to discuss practical problems that arise in coudé spectroscopy.

Scientific meeting, 18 August 1961

The scientific program consisted of the following papers:
Summarizing Reports—

H. Kienle, Absolute Stellar Energy Distributions

J. L. Greenstein, Spectra of Faint Stars

H. W. Babcock, Properties of Magnetic Stars

Short Papers—

C. and M. Jaschek, Spectroscopic Work at La Plata

L. Frederick, Some Image Tube Results of Spectroscopic Interest

N. Roman, Rocket Observations of Stellar Spectra

A. Thackeray, Comments on η Carinae

ABSOLUTE STELLAR ENERGY DISTRIBUTIONS

H. Kienle

H. Kienle briefly summarized some of the calibration work described in the *Draft Report* and mentioned recent results on carbon arcs and ultra-violet standards that are suitable down to 2000 Å. Bahner's very preliminary results of work done at the McDonald Observatory with photo-electric scanning seems to show that: (1) the spectrum of α Lyrae may be represented precisely by a Planckian curve for 14 000 °K. from λ4000 to λ6800 to within 0·01 in the logarithm of the flux; (2) there is no discontinuity larger than 0·01 in log F near λ4800 in the spectra of the B stars; (3) the apparent excess of radiation near λ4800 found when B stars are compared with F stars disappears if the measurements are corrected for unresolved lines; it seems to be caused by a minimum of line concentration in this part of the F spectrum.

Discussion of Kienle's paper. Greenstein remarks that the lines are very important in the determination of stellar gradients. It would be desirable to derive gradients both with and without lines.

Kienle replied that his group is doing this, in fact. They use both a wide slit (35 Å resolution) and a narrow slit (0·5 Å) in their spectrum scans.

SPECTRA OF FAINT STARS

J. L. Greenstein

Spectroscopic studies of faint blue stars to about magnitude 16·5 have become attractive both because of the instrumental possibilities of the 200-inch prime-focus spectrograph and

the discovery of large numbers of faint blue stars at the galactic poles. From a survey carried out mostly at 180 Å/mm, Greenstein finds that approximately one third of the stars bluer than $-0{\cdot}1$ ($B - V$), are white dwarfs, and one third are very hot sub-dwarfs with He II strong in the sdO type and He I surprisingly weak, but pressure-broadened. In another group, the so-called 'horizontal branch' stars, the hydrogen lines are surprisingly sharp (lines up to $n = 15$ are visible) as if the stars were super-giants. These stars probably have shells as a result of their evolutionary development.

Among 15th magnitude stars thus selected by their colors, about one third have a mean luminosity fainter than $+9$, one third about $+3$, and the balance near zero.

The nuclei of faint planetary nebulae range in luminosity from about -1 to about $+8$, i.e., the fainter ones are nearly as dim as the white dwarfs. Four of these are extremely hot (possibly they are among the hottest stars known) and show O VI emission as the strongest emission lines. Several of these old novae are white dwarfs, and at least two (possible recurrent novae) are probable binaries like DQ Herculis.

Parallaxes should be measurable for the white dwarfs. Accurate absolute proper motions are badly needed for the hot sub-dwarfs, and first-epoch plates should be obtained. A fifteenth magnitude star of the solar luminosity should have a parallax of only $0''{\cdot}00$ but if it has a space velocity appropriate to that of a halo star, the annual proper motion should be $0''{\cdot}030$.

In the following discussion the importance of the 60-inch astrometric telescope projected by Strand was emphasized. Aller (*Ap. J.*, **108**, 462, 1948) remarked that the nucleus of the planetary nebula NGC 246 was a relatively bright star of the high-excitation type here described.

PROPERTIES OF MAGNETIC STARS

H. W. Babcock

H. W. Babcock, using a dispersion of 4·5 Å/mm and a magnetic analyzer, has recently studied the three magnetic stars 53 Camelopardalis, HD 187 474 and HD 215 441.

53 Cam is the best example of a magnetic star with periodical changes; the magnetic field varies from $+3400$ to -5000 gauss in a period of eight days. The spectrum is variable; the Mg II λ 4481 line has a peculiar behavior; it is faint and becomes unusually wide when the field is zero.

HD 187 474 is remarkable for the slowness of the magnetic change. It appears to have a regular variation from about -2000 to about $+2000$ gauss in a period of about seven years, which is by far the slowest rate of change among magnetic stars. Up until now the slowest known magnetic variable was HD 188 041 which had a period of 226 days. The spectrum of HD 187 474 is variable and the lines are sharp.

HD 215 441 always seems to show the same polarity. Its field, 35 600 gauss, is so strong that the three Zeeman components of a line are completely resolved. The magnetic fluctuations are irregular. The spectrum of this star is peculiar but the intensities of its lines are not particularly unusual.

SHORT REPORTS

C. Jaschek reported on his observations of the Si- λ4200 stars; HR 3413, HR 5619, α Dor, τ Eri, and HR 5627. Many unclassified lines are present; lines of Fe III are also observed. Several of these stars have large magnetic fields.

Nancy Roman described studies made of stellar spectra from rockets fired above the Earth's atmosphere. The continuous spectrum of an FoIb star in the far ultra-violet agreed within one per cent with the theoretically predicted curve. At wave-lengths shorter than λ2400

the observed intensity distribution in the B star fell below that predicted by theory, while the Wolf-Rayet star, γ Velorum, showed even greater discrepancies (if one can accept any theoretical model as appropriate for a Wolf-Rayet star). The NASA group also studied the B-stars β Canis Majoris and ϵ Canis Majoris. In the visual and photographic regions of the spectrum these two stars are very similar but below λ2900 they have completely different spectra.

A. B. Underhill remarked that recent theoretical calculations indicated a decline in intensity below λ2400 as compared with earlier theoretical work and in harmony with the observations, although quantitative agreement had not yet been achieved. Greenstein remarked that the strong absorption wings of Lyman alpha would serve to depress the continuum and might account for this discordance. At the present time, however, no fully satisfactory theoretical treatment of the influence of the pressure-broadened lines upon the continuous spectrum has yet been given.

L. Frederick reported on developments of the image tube as applied to stellar spectroscopy in the infra-red. Spectrograms with a dispersion of 60 Å/mm covering the region near 10 000Å – 11 000Å were displayed. These technological improvements promise to revolutionize studies of this spectral region in stars and nebulae.

A. D. Thackeray (*Observatory*, **81**, 99, 1961) discussed the polarized halo around η Carinae. Then the meeting adjourned.

APPENDIX—ADDITIONS TO THE DRAFT REPORT

We append herewith two summaries of scientific programs which were not included in the *Draft Report*, because they were not received in time.

O. A. Melnikov has summarized further Soviet stellar spectroscopic studies.

Crimean Astrophysical Observatory. M. E. Bojartchuk and E. R. Mustel (**1**) studied spectra obtained by G. A. Shajn of DQ Herculis at its maximum in 1934 to assess the physical conditions in its atmosphere. They found a small turbulent velocity which they attributed to presence of a magnetic field. Although the metals appeared to have about the same abundance as in a normal star, C, N, O seemed to be more abundant and hydrogen less abundant. They regard it as unlikely that these effects can be produced by deviations from local thermodynamic equilibrium. They also discuss the possibility that the chemical composition of the star may vary with depth.

M. E. Bojartchuk (**2**) studied line intensities in 30 F-type stars (dispersion = 23·4 Å mm^{-1} at Hγ) to make a spectroscopic study of their atmospheres. He used a curve-of-growth method to compare stars of small and large velocities, finding carbon and iron contents eight times greater for the high-velocity stars than for low-velocity ones. The hydrogen/metal ratio is about twice as great in the high-velocity stars as in the low-velocity stars. In comparing metal contents of the two groups, Bojartchuk finds no appreciable difference, except Ba and Sr are possibly less abundant in the high-velocity stars than in the low-velocity ones.

The Crimean astrophysicists are also studying the physical parameters of atmospheres of the δ Scuti variables to see whether they represent a physical continuation of magnetic or metallic A stars or are type II stars.

A. A. Bojartchuk (**3**) has studied characteristics of the γ Cassiopeia envelope on 1940 spectrograms secured by V. F. Haze. This envelope was transparent in the continuum but opaque in the centers of the first lines of the Balmer series. He estimated a mass of about 10^{-10} that of the Sun and studied dilution effects and variations of the numbers of absorbing atoms in the envelope. The envelope did not change appreciably in 1940 and 1941; he concluded that

the line profiles cannot be explained by hypothesis of a rotating and pulsating envelope and he suggests a circulation of matter in the envelope. A. A. Bojartchuk (**4**) has also studied the spectrum of the super-giant star χ Cass with the 122-cm reflector. The composition differs but slightly from that of the other B stars, although a small deficiency of nitrogen and carbon is probable.

From a study of effects of magnetic fields upon the intensification of spectral lines Stepanov, Bojartchuk, and Efimov (**5**) concluded that neglect of magnetic intensification cannot affect estimation of abundance by more than a factor of 3. Hence the chemical abundance anomalies found in the peculiar A stars must be regarded as real. A study of the influence of a magnetic field upon the curve of growth for spots was made by Melnikov and Zhuravlev (**6**).

Kopylov (**7**) at the Crimea studied equivalent widths of the Balmer lines, the Balmer discontinuity and the numbers of the last observable lines of the Balmer series for about 300 stars in classes O to F. He obtained the logarithm of the electron density by both the Unsöld method and the Inglis-Teller formula. He has also investigated atmospheres of 26 super-giants by means of the curve-of-growth method, and changes in spectral line intensities in several super-giants, particularly ϕ Cass, 89 Her and ν Cep.

The Crimean workers have also studied the accuracy attainable in absolute-magnitude determinations from equivalent widths of the hydrogen lines, and concluded that there exists a "cosmical" probable error of $\pm 0^{m}\cdot 30$ due to variations in relative H abundance and other factors that influence the intensity of the H lines.

R. N. Kumalgorodskaya of the Crimean Astrophysical Observatory measured profiles of emission lines $\lambda 4686$ He II and $\lambda\lambda 4631$-34 N III in 8 Of stars including 9 Sge, 68 Cyg, HD 19 322, ξ Persei, S Mon, HD 206 267, and λ Cephei and established a variability of the equivalent widths with time.

A spectrophotometric study of AG Draconis carried out at *Burakan Observatory* by N. L. Ivanova and M. A. Arakelian (**8**) shows a steady increase in intensity from the Balmer limit to λ 3100 Å. N. Z. Ivanova found variations of about 0·5 magnitudes in the short-wave region of the spectrum of X Persei in 1955–7. I. D. Kupo (**9**) at Alma Ata carried out an extensive spectrophotometric study of χ Ophiuchi.

The "spectroscopy" group of the *Paris Observatory*, astrophysical department located at Meudon (R. Herman, V. Doazan, M. Lacoarret, S. Weniger, M. Duval) regularly obtained low-dispersion spectra of Be stars north of $-20°$, and brighter than the seventh magnitude. In addition, particular Be stars are observed with the coudé spectrograph of the 193-cm telescope at Haute Provence Observatory.

In some stars, the line profiles show rapid, large variations, *e.g.*,

(*a*) HD 37 202 ($=\zeta$ Tauri), the Balmer line profile variations seem to be related to phase (**10**).

(*b*) The main absorption of the Fe II lines in HD 50 138 agrees with a period of about 70 days with an amplitude of about 20 km/sec, whereas the secondary absorption has a much greater velocity (amplitude about 170 km/sec). Similar effects are found for H and Ca II (V. Doazan).

(*c*) V. Doazan also finds that the shell lines in HD 45 910 are very complex and the components may have quite different velocities. The He I line velocities (which are difficult to measure) seem to be in opposite phase to the shell lines.

Numerous spectra obtained of the shell of HD 217 050 indicate that the present shell is stable. (**11**)

M. Lacoarret finds that a large number of low-dispersion spectra of HD 174 237 indicates

two periods. One of 2·5 years applies as far as the emission of Hα is concerned, the other involving profile variations of the Hα line is a little more than a day.

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29*a*. SOUS-COMMISSION POUR LA THEORIE DES ATMOSPHERES STELLAIRES

Report of Meetings

PRESIDENT: C. de Jager.
SECRETARY: Anne B. Underhill.

Business meeting, 18 August 1961

The President, C. de Jager, announced that the Secretary would be A. B. Underhill. Names of the Vice-President and members of the organizing Committee for Commission 36 (which is the new form of the Sub-Commission) have been submitted to the Executive Committee for confirmation. The following were later appointed:

Vice-President: K. H. Böhm

Organizing Committee: E. R. Mustel, R. N. Thomas, A. B. Underhill, H. van Regemorter, M. H. Wrubel

After the *Draft Report* had been adopted with minor corrections, the President reviewed the colloquia which were organized in 1959 and in 1960 under the auspices of Sub-Commission 29*a*.

A. B. Underhill reported on the Progress of the Working Group on Nomenclature which is under the chairmanship of M. Rudkjøbing. Attention was directed towards the need for a single, clear system of notation for the mass absorption and scattering coefficients and for related quantities such as the optical depth. It was decided that the work of this Group should continue and that attempts be made to clarify further the notation used in transfer theory. It was recommended that roman or italic letters be used so far as is possible rather than greek letters.

M. H. Wrubel, chairman of the Working Group on Co-operation in the Exchange of Computer Information relating to Stellar Atmospheres, gave a brief report. The problem