

## REFERENCES

- (1) G. Münch, *Publ. Astr. Soc. Pacif.* **65**, 179, 1953.
- (2) O. C. Wilson, *Ap. J.* **119**, 197, 1954.
- (3) P. W. Merrill, *Ap. J.* **116**, 344, 501, 523, 1952.
- (4) G. H. Herbig and J. H. Moore, *Ap. J.* **116**, 348, 1952.
- (5) D. H. McNamara, *Publ. Astr. Soc. Pacif.* **65**, 144, 1953.
- (6) E. R. Dyer, *Astr. J.* **59**, 218, 221, 1954.
- (7) *Mem. R. Astr. Soc.* (in the Press).
- (8) L. A. Panaiotov, *Pulkovo Bull.* no. **152**, 87, 1954.
- (9) *Ap. J.* **116**, 654, 1952; **117**, 234, 1953; *Publ. Astr. Soc. Pacif.* **65**, 88, 1953.
- (10) D. M. Popper, *Ap. J.* **120**, 316, 1954.
- (11) R. Petrie, *Publ. Dom. Astrophys. Obs.* **9**, 297, 1953.
- (12) O. Struve and R. P. Kraft, *Ap. J.* **119**, 299, 1954.
- (13) A. J. Wesselink, *Mon. Not. R. Astr. Soc.* **113**, 505, 1953.
- (14) W. W. Morgan and A. Blaauw, *Ap. J.* **119**, 625, 1954.
- (15) N. U. Mayall, *Publ. Astr. Soc. Pacif.* **66**, 132, 1954.
- (16) R. Minkowski, *Ap. J.* **119**, 208, 1954.
- (17) R. M. Petrie and B. N. Moys, *Mon. Not. R. Astr. Soc.* **113**, 239, 1953.
- (18) D. G. Ewart, *Mon. Not. R. Astr. Soc.* **113**, 553, 1953.
- (19) O. C. Wilson and M. Coffeen, *Ap. J.* **119**, 197, 1954.
- (20) A. Sandage, *Astr. J.* **59**, 162, 1954.
- (21) H. F. Weaver, *Astr. J.* **58**, 177, 1953.

### 30b. SUB-COMMISSION ON WAVE-LENGTHS

#### *Review of the fundamental system*

The present phase of the sub-commission's work has been completed with the determination of wave-length standards for single-prism spectra of B stars. It is perhaps appropriate now to review briefly the construction of the homogeneous system which extends from types B0 to K8, inclusive. The first step was to set up a system which embraced spectral types F5 to K8 and gave velocities in agreement with those calculated from the accurately known motions of members of the solar system (1, 2). This was followed by investigations linking the A-type spectra with the later types through the use of moving clusters and visual binaries (3, 4). Finally, the B-type spectra were brought into the system by connecting them with the A stars, again making use of galactic clusters and visual binaries (5). At each step care was taken to see that the adopted wave-lengths did, in fact, reproduce velocities in agreement with previously verified results. It is considered that the system is now sufficiently homogeneous to allow of a discussion together of radial velocities of stars in the range B0 to K8.

The desirability of testing the system by calculating radial velocities of moving clusters from parallaxes and proper motions has been suggested in a previous report. This does not appear to be possible at the present time because of the limits encountered in measuring parallaxes except in the case of the Ursa Major cluster, the nearest of such groups. Here a recent calculation of the space motion, using only the data of positional astronomy, confirms the radial velocities of member stars measured with the revised wave-lengths (6).

A large body of observations and measurements has been required to set up the fundamental system, and it appears to be unnecessary for this to be repeated. It may be assumed that the wave-lengths determined at Victoria will apply generally to spectrograms of comparable purity and dispersion. Each observer should, however, verify this by measuring an adequate number of spectrograms and inspecting the agreement of each line with the adopted velocity. Lines which show significant departures from the standard

velocity should be omitted, or their wave-length changed to conform. Spectra with broad lines should be included as well as those exhibiting sharp features. A sufficient number of well-observed stars is included to supply velocity standards (1). By proceeding as outlined, an enormous saving in labour is effected and the resulting radial velocities will be on a sound system. Similarly, observers with spectrographs differing considerably from those used in setting up the system may determine effective wave-lengths with a minimum of effort by employing the standard stars.

### *Suggestions for future work*

Important extensions to the existing system remain to be made, as follows:

#### *O stars*

A number of galactic clusters and some binary systems offer the possibility of connecting the O stars with later types, but the observations will be difficult to make and their interpretation will be complicated because of the possible existence of a substantial 'red-shift'. It may be preferable to study selected O stars with high-dispersion and to proceed as suggested (5). This extension will be carried out at Victoria by Miss A. B. Underhill.

#### *M stars*

Similar remarks apply to the spectra of type M, where a liaison with the existing system is very desirable. It has been suggested by the Radcliffe astronomers that the visual region should be used because of the lesser complication introduced by blends and because of the greater visual brightness. This suggestion should be explored fully before the more difficult photographic region is attempted, but it must be remembered that prismatic spectrographs usually give very low dispersion longward of 5000 Å. It appears that many of the wave-lengths found to be suitable at K8 may be used in early M spectra (7), but the Me variables require to be studied afresh. Dr W. S. Adams writes that he has found high-dispersion (coudé) spectra of classes G, K, M to show a number of recognizable unblended lines so that solar wave-lengths may be used to obtain radial-velocities. He also recommends that observers using low-dispersion instruments for types G, K, M fix attention on a number of well-defined blends to be used after their effective wave-lengths are found. It appears that the attack upon the M-type spectra should be made by studying a representative list of stars with the highest available dispersion.

#### *Special classes*

The late-type giants of classes R and N and certain variable stars require standardizing studies. Radial velocities of these objects are of special value in studying questions of stellar evolution and stellar populations. Here also it would appear to be necessary to employ very high dispersion and transfer the velocities to a low-dispersion system.

The question has been raised by one member whether this sub-commission might now be discharged. The problems mentioned above would seem to require its continued existence in order to promote and encourage efforts to solve them. It is to be noted that the membership of this sub-commission is now very small, and representation is necessary from observatories engaged in radial-velocity observations.

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#### REFERENCES

- (1) *Contr. Dom. Astrophys. Obs.* no. 4; *J. R. Astr. Soc. Can.* **40**, 325, 1946.
- (2) *Contr. Dom. Astrophys. Obs.* no. 12; *J. R. Astr. Soc. Can.* **42**, 220, 1948.
- (3) *Contr. Dom. Astrophys. Obs.* no. 10; *J. R. Astr. Soc. Can.* **41**, 311, 1947.
- (4) *Contr. Dom. Astrophys. Obs.* no. 11; *J. R. Astr. Soc. Can.* **42**, 213, 1948.
- (5) *Publ. Dom. Astrophys. Obs.* **9**, 297, 1953.
- (6) *Contr. Dom. Astrophys. Obs.* no. 31; *Mon. Not. R. Astr. Soc.* **113**, 247, 1953.
- (7) *Publ. Dom. Astrophys. Obs.* **9**, 167, 1952.