CONCLUDING REMARKS

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We have had today for the first time a confrontation of the views of many astronomers about the use of ultraviolet spectroscopic and photometric data in the field of spectral classification.

Dr. Jaschek recalled us that much work has still to be done from the ground since only 14% of the stars up to the tenth visual magnitude have M.K. spectral types. The current accuracy is around one tenth of a spectral type and 0.6 of a luminosity class. Jaschek notes that the luminosity classification from spectral inspection is superior to what is obtained from photometric data, a fact which is not surprising if we recall that lines are much more sensitive to pressure effects than the continuum. However, the introduction of a third parameter seems necessary, although it is not clear what this parameter should be.

Can the ultraviolet observations improve the situation as far as the nature and the accuracy of the classification are concerned ? It is perhaps too early to answer this question, but we may try to summarize the various trends of thought over this question.

Low resolution (30 Å - 50 Å) observations, as summarized by K. Nandy indicate the gross characteristics of the spectral features. It is not obvious that the study of such features will lead to a better classification than the visual data, especially if the photometric accuracy is not very high. Nandy has proposed a new photometric system based on the reddening-free Φ and Ψ parameters, somewhat similar to the Q parameter. The luminosity effect is apparent when a Φ, Ψ diagram is used, while Φ is essentially a spectral type indicator. Van Duinen and Wesselius reported on a similar exercise using more accurate photometric data from the ANS satellite. They propose to use an index α combining colour indices at 2500 Å, 2200 Å, and 1800 Å in order to determine the star's effective temperature, while a quantity similar to β (in the uvby β system), and based on wide and narrow filter measurements centered on 1550 Å would be luminosity dependent.

A classical but very attractive approach has been followed by K. Henize and his coworkers, who center their efforts on two important spectral features around 1400 and 1550 Å, mainly due to Si IV and C IV respectively in the O and early B types. These features are easily measurable on 2 to 12 Å resolution objective prism spectrograms. With such a material, it is easy to distinguish emission components in the C IV line. Henize proposes a classification scheme based on the strength of the C IV feature (for luminosity) and on the Si IV / C IV ratio (for the spectral type). Because of the wide range of variation of such a

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ratio, this scheme leads to an appreciable refinement in the spectral type, at least in the 09-B2 range, while emission components may be linked to absolute luminosity. The quality of the spectra makes it is possible to locate the areas where UV observations are likely to lead to some progress.

While the first systems mentioned above tried to provide classification systems based almost exclusively on UV measurements, Henize's work represents an important step in integrating ultraviolet criteria in a more general scheme, using both visible and UV spectra, that may ultimately result in a new, more adequate classification system.

A useful luminosity criterion, based on the Fe III lines around 2078 Å has been mentioned by Farragiana, Lamers and Burger. It requires spectra with a resolution of about 2 Å and may lead to improvements in the luminosity classification of B0 to B5 stars. On the other hand, the classification of very hot objects will certainly benefit from the EUV observations as those obtained by Dr. Lampton.

Dr. Code has presented to us a very complete atlas of the OAO-2 spectra and there is no doubt that this work represents a great wealth of data not only for spectral classification but also for a more direct determination of atmospheric parameters, as we have seen from the work of Dr. Rountree-Lesh.

We have just seen what detailed spectra look like in the 1000 - 1450 Å range thanks to the high resolution synthetic photographic spectrograms and tracings.

We will have to wait for their publication for examining the richness of such material. According to W.P. Bidelman, the general behavior of the lines is entirely consistent with the adopted classification of these objects. It is not clear that improvements in the classification may be easily reached, and this is not surprising because of the enormous amount of lines seen in this wavelength range ; it means that most of the features we observe are blends, to say nothing about the many interstellar lines spread all over the spectrum. Using a comparable resolving power, Dr. Kondo has been able to show that the study of the strength, shape and width of the Mg II resonance lines (at 2795.5 and 2802.7 Å) and of the subordinate lines (at 2798 and 2790.8 Å) are very useful indicators of spectral type, luminosity chromospheric features, over a wide variety of stars (from B to M), despite the presence of interstellar components. Width measurements of the emission features will be particularly useful for absolute magnitude determination.

In conclusion, my impression is that we still do not know exactly how to use the ultraviolet data in order to integrate them in the classification schemes. In order to be useful the photometric data will certainly need to reach a good accuracy, comparable to what is obtained in the visible region. Otherwise, although colour indices may vary in a wider range than in the visible, this gain might be lost, especially if we consider the important effects of interstellar and circumstellar continuous absorption. As far as the use of line features is concerned, it seems that a resolution of 2-5 Å is needed in order to derive sufficiently accurate criteria. At high resolution, care must be taken to discriminate carefully the stellar, circumstellar and interstellar components. As far as the additional parameters to our traditional two dimensional classification scheme is concerned, no clear indication emerges so far. However, it is already certain that ultraviolet spectra will be good indicators of phenomena like abundance anomalies, mass loss and chromospheres.

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