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III. CALIBRATION PROBLEMS: THE VICINITY OF THE SUN

A most significant contribution to the all-important problem of the calibration of criteria for absolute magnitude has been published by Blaauw (**1**). The chapter is in two parts, each subdivided into three sections. For stars of spectral class A to M, Blaauw shows how the Mount Wilson absolute magnitudes may be adapted to modern use and he provides (his Table 3, p. 401) also mean visual absolute magnitudes for each MK spectral-luminosity class. He discusses calibration procedure used in the work of Oke, of Hossack and Halliday, and of Wilson and Bappu. For O and B stars and for supergiants, Blaauw presents first a summary of fundamental data on absolute magnitudes using the main sequence fitting procedure, starting from the Hyades and leading to a zero-age main sequence of H. L. Johnson and others. He then gives special attention to the Scorpio-Centaurus Association, with results that confirm the Johnson values, and lists his recommended values in his Table 3 (page 401). There is a brief discussion of the work of Petrie and others and Blaauw notes especially the promise for the future of work on H-beta intensities.

A further comprehensive survey of luminosity criteria has been published by Voigt (**2**). The first part of this survey article describes the principal features of the MK system and of the classifications and luminosity systems developed at Paris and in Sweden. The systems employed by Strömgren and Gyldenkerne are described and also the basis for multi-colour photometry. We note here that colour studies in the far infra-red are becoming increasingly important for future work on galactic structure. The article has a listing of normal colour indices and it contains a tabulation of the absolute magnitudes recommended by Schmidt-Kaler. At the same meeting of the Astronomische Gesellschaft, Schmidt-Kaler (**3**) presented a new calibration of the MK system in which the conclusion is drawn that the most luminous supergiants in the range O to F8 have identical constant absolute magnitudes $M_{pg} = -8{\cdot}4$. We note that in the Large Magellanic Cloud, there are eight stars with values of $M_v < -9$; in other words, there exist supergiants with absolute magnitudes approximately one magnitude brighter than the value quoted by Schmidt-Kaler.

Much work is under way on the calibration and interpretation of multi-colour indices. Strömgren (**4**) has published a comprehensive summary of his work and that of his associates. We note here especially the work of Gyldenkerne, who has established three independent astrophysical parameters, which may give useful clues with regard to the ages and past evolution of the G and K giant stars. Gyldenkerne has completed H-beta photometry for stars classified as Ao in the Bright Star Catalogue, north of $-10°$, and four-colour measurements u, b, v, y are under way. Three-dimensional classification in the K, N, M system of Gyldenkerne (**5**) has been extended to G5 to K3 of selected stars.

Extensive work on multi-colour photometry is in progress at Kitt Peak Observatory (Crawford, Strömgren) and at Mount Stromlo Observatory (Graham, Gascoigne, Westerlund, Walraven). The Walravens are completing the analysis of their material gathered at the Leiden Southern Station. Crawford (**6**) has published U, B, V data and H-beta indices for 501 stars of spectral types B8 and B9 brighter than $V = 6{\cdot}5$, north of $-30°$, and Graham (**7**) has provided a considerable body of data for stars of the southern hemisphere.

Basic work on spectral-luminosity classification continues to have the attention of Swedish astronomers. Ljunggren and Oja have published two papers on the subject (**8**), (**9**). They have investigated by spectrophotometric techniques from objective prism spectra for 400 field stars and 45 Praesepe stars, and, from the analysis of this material and published data, they have arrived at improved values for the absolute magnitudes and intrinsic colours of stars classified on the Uppsala system. Larsson-Leander (**10**) has calibrated the Stockholm classification system and finds that the intrinsic colours for the Stockholm classes are the same as those for the MK classes of the same name, with the exception of main sequence stars later than dG 5.

Kraft and Preston have developed a new method for obtaining absolute magnitudes of G and K-type stars. In essence, it depends on the fact that the width of the Doppler core of H-alpha in absorption is linearly correlated with the width of the K_2 emission, hence there is a 'Wilson-Bappu' effect in reverse for H-alpha in G and K-type stars. The method is being applied by Kraft to stars found on objective prism plates photographed at Tonantzintla for a 60° sector of the Milky Way, Auriga to Puppis, and permits the identification of G and K supergiants, which is of interest for studies of spiral structure and galactic rotation.

Hoffleit reports that work is well under way on the revision of the Yale Catalogue of Bright Stars, a project that is of great importance for the work of members of Commission 33, and is especially relevant to the problems under discussion in the present section of the Report.

Jaschek and Jaschek have completed a search for southern Be stars in the range Bo to B5, $V < 6{\cdot}5$, and are in the process of analysing this material with special reference to the Scorpio-Centaurus stream (**11**).

The search for faint M giants has importance for problems of galactic research. Blanco (in association with Pascu) (**12**) has found that, for giant M stars, $B-V$ is practically independent of the subclass, changing only from 1·55 for Mo to M5 to 1·90 for M7. $V-I$, on the other hand, increases from 1·10 at Mo to 5·30 at M9. Classification of very faint M giants thus becomes possible.

The programme on the search for luminous stars in the northern Milky Way (a finding list of OB stars and supergiants to $m = 13$, with $-12° < b < +12°$) is being continued at the Warner and Swasey and Hamburg-Bergedorf Observatories (**13**); Volume II has been published (**14**) and Volumes III and IV are in press. This means that we shall soon have available the catalogue for the whole range $15° < l^{II} < 145°$. Volume V (145° to 190°) is almost finished and the work on Volume VI (190° to 230°) is well under way. The H-alpha survey for Volume I is in press and Volume IVa, containing identification charts, has been published (**15**). Pesch (**16**) has studied spectroscopically and photometrically, mostly with the 36-inch and 82-inch McDonald reflectors, 50 B, A and F supergiants from Volumes I and II of the catalogues named above. He finds that the luminosity classes assigned in the Catalogues are systematically too bright. Luyten has continued his investigations of faint blue stars and finds that in high galactic latitude their numbers continue to increase at least as far as the twenty-first magnitude. From proper motions determined for more than 600 of these stars, some as faint as the twentieth magnitude, he finds that the percentage of genuine white dwarfs among them is vanishingly small for stars brighter than the thirteenth magnitude and increases steadily to about 25% at magnitude 17. While their luminosities seem to range all the way from those for normal main sequence stars to those of white dwarfs, there appears to be some possibility that a subdivision into three main groups can be made. If so, then the mean absolute magnitude of these groups are around + 3 to + 4, around + 8 (U Geminorum stars) and fainter than + 11 (white dwarfs).

Other searches were continued for faint stars of large proper motion on plates taken with the Palomar 48-inch Schmidt telescope, mainly to find more stars of very low luminosity and more white dwarfs.

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IV. THE SPIRAL STRUCTURE OF THE GALAXY

Problems relating to the spiral structure of our Galaxy are fairly evenly distributed over the areas of activity assigned to Commissions 33, 34 and 40. It is obviously our task to limit ourselves here primarily to a Report on stellar distribution, leaving the gas, optically, to the Report for Commission 34 and radioastronomically to that for Commission 40. The only stars and star-groupings that are of interest for the study of the spiral structure of our Galaxy are the youngest stars, clusters and associations, OB stars of spectral class earlier than B2 and clusters and associations with one or more stars earlier than B2. Cepheid variables with periods of 10 days and greater have a marginal interest. Since young stars and clusters and associations have random velocities often as great as 10 km sec^{-1}, they will move from their places of origin by 100 pc in 10^7 years. Hence, stars or clusters with ages greater than 3×10^7 years are of little use for the tracing of spiral arms.

At IAU/URSI Symposium no. 20, several methods were discussed for the tracing of the spiral arms of our Galaxy.

1. The 21 cm line of H I yields the most extensive material, but for the interpretation of the observed profiles one needs a reliable velocity-distance law of circular motion and knowledge about a possible expansion (or contraction) velocity at various distances from the galactic centre (see Report for Commission 40).

2. The most direct approach is through the measurement of distances for individual young stars, clusters and associations—with due attention to the problems of space reddening and interstellar absorption.

3. Studies of optical radial velocities of OB stars and emission nebulae—especially when these are properly correlated with analyses based on 21 cm profiles for the same regions—can provide evidence, *if* one is prepared to accept the most likely form for the law relating distance from the galactic centre and circular velocity of rotation. The interferometric velocities for faint emission nebulae measured by Courtès (1) hold much promise for the future.

4. The study of single and multiple interstellar absorption lines can yield results of great value, since they refer only to the region between the Sun and the star in the spectrum of which they are observed and not beyond (see Report for Commission 34).