

4. THE ESTABLISHMENT OF THE DISTANCE SCALE IN THE GALAXY

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1. The present distance scale in the Galaxy depends to a large extent on cluster work. Even for the calibration of the luminosities of Cepheids, considerable weight is now attached to the information found for Cepheids occurring in clusters. Also, the calibration of early-type super-giants is referred to cluster distances as, for instance, in the case of the double cluster h and χ Persei, which contains most of the super-giants available for calibration purposes.

2. Current distances of clusters are based almost exclusively on the distance of the Hyades, which can be geometrically determined by means of the stream elements derived from the proper motions and radial velocities. A second basic piece of information is provided by the Scorpio-Centaurus association, the distance of which is also derived from geometric considerations.

3. For the Hyades, the present uncertainty in the distance arises mainly from the uncertainty in the stream motion expressed in km/sec. The direction of this motion, that is the position of the convergent point of the proper motions, can be determined with high accuracy, but the stream velocity, derived from the radial velocities may well be in error by 1 or 2 km/sec. This error corresponds to a possible error in the distance of 3%. This error systematically affects all the distances based on the Hyades. The possibility of an error in the stream velocity used in current investigations is apparent from the fact that the stream velocity is different when derived from the various spectral types (see J. A. Pearce, *P.A.S.P.* **67**, 23, 1955). Thus, the values derived from the A-type stars and from G-type stars differ by 2 km/sec. We should like to draw the attention of the radial-velocity observers to this point.

4. The present uncertainty in the distance of the Scorpio-Centaurus association is considerably larger than that in the distance of the Hyades. One may therefore wonder why this association should be considered at all in the establishment of the distance scale. The reason is that, if for instance one wants to determine the distance of h and χ Persei by means of the Hyades, one has to do this via a few other clusters of intermediate stages of evolution. In this process, (see, for instance, H. L. Johnson, *Ap.J.* **126**, 121, 1957, and A. Sandage, *Ap.J.* **125**, 422, 1957) each step introduces additional errors in the distance found for h and χ Persei. On the other hand, it appears possible to connect the luminosities of the h and χ Persei stars directly with the Scorpio-Centaurus association by means of B-type stars of common characteristics.

Therefore a strong effort to improve also the distance determination of the Scorpio-Centaurus stars appears justified. This will require both better radial velocities and better proper motions. The stars might be selected from the most recent list of members as given by Bertiau (*Ap.J.* **128**, 533, 1958) which contains about 80 stars brighter than 7th magnitude. At present errors in the distances of the Scorpio-Centaurus stars can be ascribed as follows:

due to errors in the proper motions: $\pm 10\%$;
due to errors in the radial velocities: $\pm 7\%$.

In addition to this, one wants to check the correctness of the interpretation of the state of motion of the Scorpio-Centaurus stars which is used in the determination of the distances. The precision of the available observational data is not yet sufficient to recognize the relative motions of the stars in the association, not even reliably to estimate the internal velocity dispersion. Observations should be pushed far enough as to allow us to determine the nature of these internal velocities.