D. SPECIAL PROBLEMS

(1) STUDY OF ASSOCIATIONS

A special session of the conference was devoted to discussion of work on associations. This subject of growing interest has many aspects; some of these have been dealt with already in the preceding sections.

Nomenclature

The terms *association* and *aggregate* have been used in the past. The term *association* was accepted for use in future work. In the case of the O associations, there was some difference of opinion whether or not those associations which contain B stars, but no O stars, should also be called O associations. This latter term has been used up to now by the Soviet astronomers. There are some striking cases, for instance, that of the association around h and χ Persei, where the earliest type stars are B1.

Lists of associations have been compiled by Morgan and collaborators[1] and by Markarian.[2] The listed objects are for the greater part identical, but the labelling is different. It was decided that this matter will be arranged between V. A. Ambartsumian and W. W. Morgan, who might also settle the question of the terms O and B associations.

A question which may have to be considered in the future is, which name to adopt in the cases of the small associations which resemble some of the larger open clusters in size and appearance. An example is NGC 2644, usually listed as an open cluster, but now rather considered as an O association. Morgan's suggestion of distinguishing on the basis of the diameter (smaller or larger than 10 parsecs, for instance) might prove most useful.

Internal motions

These have to be studied principally on the basis of the proper motions. Radial velocities are, of course, the only way to study internal motions of the distant associations where proper motions are unmeasurable. However, as the interpretation of the observed Doppler shift is complicated by secular changes and atmospheric phenomena, these observations have to be treated with caution. Radial velocities will also be useful for picking

out the stars with large motions relative to the mass centre of the association.

Proper motions can reveal internal motions only for the nearer associations (within 1000 parsecs). The brighter O and B stars in these associations are included in the list recommended for meridian observers and mentioned in Section C (2). For the fainter stars one will have to rely on photographic proper motions, possibly in combination with the reduction to absolute motions by means of the repetition of the AGK 2 (see Section C (3)) and with spectral classifications and photometry.

For the O associations these observations may yield information on the membership of later type stars and on the amount of the internal motions.

For the T associations proper motions can be obtained at present only for the nearest objects. Many of the T Tauri stars even at a few hundred parsecs distance are already fainter than photographic magnitude 12, the limit of the Astrographic Catalogue. For these a programme of first epoch plates will have to be set up. The question was discussed, whether the 48-inch Palomar Schmidt or the Lick Astrograph Survey would be sufficient for this purpose. This has to be investigated. Cameras with a large field will be required for the study of the T associations, as these usually occur in obscuring regions where reference stars are scarce. The most suitable, nearest regions for these observations may be the dark clouds in Ophiuchus and Scorpio, the nearer clouds in the great Rift, the regions of the O associations in Cepheus, Perseus, Orion, and Monoceros, and the Taurus clouds: and in the southern sky the coal-sack and, perhaps, the Carina region.

Attention was drawn by Ambartsumian to the importance of inclusion of open clusters with O and early B stars in the programmes for proper motion. According to Markarian, noticeable internal (expanding) motions exist, for instance, in the southern open clusters IC 2602. A working list of Trapezium systems is being drawn up at the Burakan Observatory. This will be a suitable subject also for double star observers.

Physical properties of stars in associations

As was pointed out by Ambartsumian, the possibility of systematic differences between the physical properties of stars in and outside associations has to be kept in mind. Such differences occur, for instance, in the case of the O stars connected with the Orion nebula, which differ in some spectral features from other O stars. This subject should further be pursued.

According to Parenago, there are also differences in the character and

number of variable stars associated with different O associations (Orion, Monoceros) which might represent different stages of evolution. Differences in the character of T Tauri stars depending on their location in HI and HII regions were noticed by Haro. According to Bok and Miss Hoffleit, there seem to be also systematic differences in the sizes of the globules in O and T associations.

Another important field for study are the light variations of T Tauri stars discovered spectroscopically in the T associations.

Absorbing matter in associations

There is evidence of deviations from the general law of reddening in the regions of high interstellar density in some associations. The situation is not quite clear as former results by Stebbins and Whitford, Schalén, and Sharpless, were not confirmed by Miss Dinant and Chalonge. This will be an interesting subject for photometric work; the nearest associations will be the most suitable as the absorption in distant associations cannot be separated from that in the nearer clouds.

(2) FUNDAMENTAL DETERMINATION OF THE CONSTANT *A* OF GALACTIC ROTATION FROM RADIAL VELOCITIES

There is still considerable uncertainty in the present determinations of this constant. These determinations were based mainly on the radial velocities of the apparently brighter O and B stars using adopted values for the absolute magnitudes; the latter were, however, rather uncertain especially in the case of the most luminous stars. A fundamental determination of the constant A based only on the stars with the most reliable absolute magnitudes is, therefore, much wanted. As a next step, we should like to try whether possible variations of the constant A as a function of galactic longitude can be detected.

A proposal for an improved determination of the constant A has been published elsewhere.[1] It is based on the fact that reliable absolute magnitudes of the main sequence B2 to B5 stars can be found from the proper motions of the brighter stars of these types ($m < 7{\cdot}0$). The constant A can then be found from the radial velocities of the faint, distant stars of apparent magnitude about 10. This programme requires the identification of the stars (which probably can be done on the plates taken already for the survey of super-giants), observations of magnitudes, colours, luminosities and spectral classifications of the individual stars, and radial velocities with probable errors below 4 km./sec.

The programme would be a rather extensive one, but the importance of a fundamental determination of the constant A in connexion with distance determinations in general seems large enough to justify the effort.

(3) TRIGONOMETRIC PARALLAXES

Trigonometric parallaxes of high accuracy are needed especially for two purposes:

Calibration of spectroscopic absolute magnitudes

With the development of new and very sensitive criteria for absolute magnitudes by means of the multi-colour photometry (see Section B (1)), the need for very accurate absolute magnitudes has also increased. They are wanted for the average relation between the measured photometric quantity and the absolute magnitude as well as for the determination of the cosmic scatter of the absolute magnitudes. For the present the first requirement would concern the F stars, for which the photometric criteria have been most accurately developed.

Absolute magnitudes and motions of sub-dwarfs

For this group, there still exists considerable uncertainty with regard to their luminosities. This is mainly due to the large peculiar motions, which make the method of parallactic motions unsuitable; particularly because of the pronounced selection of stars according to large proper motion. A particularly interesting aspect of the study of these stars is, that among them are objects of very high space velocity which in their orbit approach the galactic centre very closely,[1] and also the objects which enable us to estimate the velocity of escape from the Galaxy.

For both categories, lists of stars for which trigonometric parallaxes are most wanted will be drawn up and made available through the intermediary of the sub-commission for co-ordination of galactic research.

(4) STARS WITH LARGE PROPER MOTIONS

This subject has already been mentioned on pp. 37 and 38. Full profit can be derived from the proper motion data only when apparent magnitudes and spectral types (or multi-colour photometry) also become available. Work in this field has been done already by Luyten and collaborators,[2] but much more remains to be done. We refer to an outline of the problems involved, given by Luyten in *A.J.* **51**, 2, 1944.

In addition to these observations—which will constitute a very extensive programme—one might undertake a survey of more large proper motions, especially for the northern hemisphere. Ross' survey is complete only for proper motions exceeding 0″.4. Repetition of the Astrographic Catalogue plates might serve for this purpose, but they contain only stars brighter than 12·5, whereas for the study of the faint end of the luminosity law we are especially interested in the stars of still fainter apparent magnitudes. Perhaps the Astrographic Chart plates ($m < 14{\cdot}5$) can be used, if the multiple images on these plates do not hamper the discovery. However, full profit can be derived from the new discoveries only when a substantial number of them are observed for trigonometric parallax.

(5) INTERSTELLAR ABSORPTION: DEPENDENCE ON WAVE-LENGTH

In all statistical work where colour excesses are used as a measure for the total amount of absorption, knowledge of the dependence on wave-length is presupposed. Although there is evidence that a uniform law is applicable in the general region around the Sun, investigations of special regions or distant objects should be encouraged in order to find out how large the deviations from the uniformly adopted law can be. Work on this line has already been done by Stebbins and Whitford,[1] Schalén,[2] Van Rhijn[3] and others.

(6) INTERSTELLAR POLARIZATION

This subject was only briefly touched upon at the conference. It seemed desirable to review possible fields of research for new observers.

Measures of the interstellar polarization have been done mainly by Hiltner and by J. S. Hall. Hiltner has concentrated on observations of OB stars up to the largest possible distance in the galactic plane. His observations are supplemented by photometry and spectroscopic observations which will furnish the data on interstellar reddening and on distances, which are necessary for the interpretation of the polarization data. Hiltner has also measured some stars in clusters and associations, and is now preparing for measurements of the dependence of polarization on wave-length. Hall has concentrated, on the detailed phenomena in associations and star clusters. It is hoped that these observations will provide the basis for the study of the relation between the run of the magnetic lines of force and the spiral structure in the Galaxy and of the local deviations in the alignment of the polarizing particles.

An important field of research which is still untouched is that of the polarization in the region around the Sun up to, say, 300 parsecs. A complete scanning of this volume of space seems particularly interesting when it is supplemented with accurate observations of the distances and colour-excesses of the measured stars.

Further objects for measurement are the faint Cepheids (and other variable stars) which will supplement the observations of the OB stars, and double stars of different separations.

https://doi.org/10.1017/S0074180900213624 Published online by Cambridge University Press