

- (3) That attention be called to the latent information regarding stellar distances in the long series of spectrograms obtained for other purposes, and that observatories be urged to discuss this material.
- (4) That parallax observers be recommended to obtain two or three plates of each field after a lapse of about ten years, and that these be measured in both right ascension and declination, with a view to determining the average proper motion of the comparison stars in both coordinates with a probable error of about  $\pm 0''.003$  per annum.

#### (25) PHOTOMÉTRIE STELLAIRE.

The Committee met on May 5, Prof. Seares in the chair, and the report (p. 69) was presented for discussion.

Prof. Sampson reminded the Committee that an extended discussion on photometry had taken place at an early meeting of the *Carte du ciel*. Sir David Gill had then expressed the opinion that we could not really stop short of a discussion of the magnitude of a star from one end of the spectrum to another. This point had not been recognised in the report, and he had suggested an appropriate addition. Prof. Sampson desired that this tradition of Gill's should be re-affirmed and carried on in accordance with our modern knowledge, and despite various renewed and increased difficulties.

Prof. Seares proposed that this addition should be adopted\* and stated that the whole question had been very well placed before the Committee by Prof. Sampson. The proposal was adopted.

In response to a request for further suggestions, Dr. Shapley said that Prof. Sampson's proposal was in harmony with the point of view of the Harvard observers. Spectro-photometry was really fundamental, and work in this direction was being undertaken at Harvard. It was difficult to decide whether the question really belonged to the Committee on Stellar Classification or to that on Photometry.

Mr. Stratton pointed out that Mr. Adams had already handed on the question to the photometric committee. Prof. Sampson concurred with the view that the question was at present mainly a photometric one, but it should serve as a link between the two committees; colour curves were serrated by absorption lines. The distribution of intensity in the continuous spectrum offered a very suitable field of research.

The amended report was adopted for presentation to the General Assembly.  
It was resolved—

That continued investigations of the distribution of intensity in the continuous spectra of different classes of stars are very desirable.

#### (26) ÉTOILES DOUBLES.

Dr. Aitken presided and presented the provisional report and proposed agenda for the meeting (p. 83). The outcome of the proceedings has been summarised by Dr. Aitken in the following statement of recommendations and resolutions:—

- (1) *Central Office*: It is recommended that a Central Office for matters relating to double star astronomy be maintained, and that its functions be liberally construed.
- (2) *Definitions and Symbols*: The Committee recommends the adoption of a uniform system of definitions and symbols for the elements of a double star orbit, and for the apparent position angle and distance

\*This has been added as a footnote at the end of the report p. 82.

of a double star. Specifically, for the latter the symbols  $\theta$  and  $\rho$ ; and for the former, the symbols  $P$ ,  $T_0$ ,  $a$ ,  $e$ ,  $i$ ,  $\bar{\omega}$ ,  $\Omega$ , and  $n$ , with the definitions proposed by the Committee on Notations (p. 22). When spectrographic observations have fixed the ascending node of the orbit, it is recommended that the appropriate sign (+ or —) be prefixed to the  $i$ .

- (3) *Observations*: (a) It is recommended that the observer, as a rule, limit the number of separate nights' measures of a double star at any given epoch to from two to four. A single night's measure has, in general, little weight; measures on more than four nights at one epoch are desirable only in exceptional cases.

(b) The Committee deprecates the measurement year after year of pairs known to show little or no relative motion or proper motion, unless there is some specific reason for continuing such measures.

(c) Further experimental work with the reversing prism ocular is recommended. (See Section 4, g.)

- (4) *Personal Equation*: A major source of embarrassment in double star work is the presence of systematic error in the data. While the amount and frequency of this error is probably overestimated, its real existence and detrimental influence are unquestionable. The suggestions that follow look to the setting up of a standard with reference to which the double star observations of any astronomer may be controlled and thereby all of the data reduced to an approximately homogeneous system.

The Committee suggests that there be prepared a list of about 50 binary stars in accordance with the principles set forth below, and that every double star observer be requested to include this list in his programme, and to observe each star that is within the resolving power of his telescope once or twice every year. As it seems probable that systematic error of observation is somewhat closely related to astigmatism, every person seriously undertaking to carry out this programme of observing should have his eyes examined from time to time, and should include in his record a statement of the constants that determine the amount and nature of this astigmatism.

Principles to be followed in selection of Observing List:—

- (a) The introduction of the interferometer into current astronomical practice suggests that a serious effort should be made to determine its suitability to the establishment of a standard system of double star data. There should, therefore, be included in the observing programme a number of binary stars whose components are of about equal brightness, and whose distances range from 0".1 or less up to the maximum amount readily dealt with by the interferometer.
- (b) In order that the system to be determined may be applicable to past and future generations of observers, there should be included in the observing programme a suitable number of binaries of short periodic time, e.g., fifty years. Observations made at successive returns of these stars to the same part of the orbit will thus bridge over the gap from generation to generation by furnishing comparable observations.

- (c) In order that the observing programme may be executed with like facility in both hemispheres of the earth, a considerable part of the stars chosen should lie not too far removed from the equator.
- (d) As it seems probable that systematic error may be in some degree dependent upon difference of brightness in the components, due heed should be paid to this circumstance in the selection of the observing list.
- (e) If this programme were carried out there would be gradually accumulated an amount of material extremely valuable for orbital determinations, and it seems desirable to include in the list stars having such characteristics of orbital motion as make them of special interest; *e.g.*, 70 Ophiuchi should be included as a conspicuous instance of disturbed orbital motion for which no explanation is now forthcoming. Zeta Cancri presents a different type of disturbed motion whose peculiarities are worth further study, etc. In general, triple and multiple stars would be a valuable part of such programme, since we possess no adequate theory of their motion, and it is possible that observation may precede theory at this point and help in its development.
- (f) If this programme were undertaken by a considerable number of observers, they might well report annually their results to the central office, which would compile and publish them from time to time.
- (g) No consideration is given above to the use of a prism ocular, but it seems desirable that each observer should determine for himself the extent to which his observations may be improved by such a device.
- (5) *Measures to Supplement Micrometer Observations* : (a) The photographic measurement of double stars is recommended to observers having the necessary equipment. The observing lists for such measures should include, first, pairs as close as can be successfully measured by photographic methods; secondly, wider pairs chosen to add to our knowledge of the relative masses of the components and of the proper motions of double stars. Parallax observers, it is suggested, may well utilise the plates in their possession for an investigation of pairs of the latter class. Further experimental work is desirable to determine the limits of angular separation and of magnitude at which photographic measures of a double star become more accurate than visual measures. The systematic errors of photographic measures of double stars should also be investigated more fully.
- (b) Interferometer measures are desirable, not only for the investigation of pairs too close for the micrometer, but also to provide data for the study of systematic errors (see Section 4, a).
- (6) *Co-operation* : The Committee is of the opinion that the Central Office, referred to in Section (1), will find its most important function to be the promotion of co-operation among double star observers. To this end, it is recommended that observers advise that office, if it be maintained, as to their programmes of observation. The office should be prepared to send lists of stars needing remeasurement to any observer

making request for such lists, and, also, to supply data to any astronomer for the computation of a double star orbit, or for other investigations, at the cost of the clerical labour involved. It is desirable that lists of the known double star orbits, with some indication of the accuracy of each orbit, be published by this office at suitable intervals.

- (7) *Publication of Measures*: It is recommended that the published data should always include the date (to 3 decimals), the position angle, distance, and estimate of the seeing (weight) of each measure. The aperture of the telescope, the power of the eye-piece used, the estimate of the magnitudes of the components, and, for close pairs, a statement as to whether or not the components were "separated" are also desirable data. Further, each pair should be designated by a general catalogue number as well as by its name, and the co-ordinates of position should be given. These should be for one of a very few standard epochs, 1900, 1950, or such other epochs as may be adopted by general agreement among meridian observers.

Publication of the same measure in more than one place should be avoided, except when shorter lists are combined into a collected catalogue (*e.g.*, Dembowski's collected measures).

- (8) *General Catalogues*: The Committee recommends that the Extension to Burnham's General Catalogue of Double Stars, which was begun by Burnham himself, and carried far toward completion by the late Professor Eric Doolittle, and which is now being continued by Professor Aitken, be published in the near future. The Committee also expresses the hope that Innes's New Reference Catalogue of Southern Double Stars, which is essentially complete, may soon be published. Efforts should be made to have these two catalogues correspond as fully as may be possible both in the matter of included data and in the printed form. It is recommended that the stars in the Burnham Extension be arranged in order of right ascension for the epoch 1950, and be given consecutive numbers; but that, when the star is found either in the original General Catalogue or in Jonckheere's Catalogue (*Mem. R.A.S.* 65), the number there assigned to it also be preserved.

#### (27) ÉTOILES VARIABLES.

Dr. Shapley presided over a well-attended meeting of this committee, and presented the report (p. 84) for discussion. The following recommendations and resolutions were adopted for submission to the General Assembly:—

- (1) That the preliminary report be accepted as the adopted report of the Commission on Variable Stars.
- (2) That the Commission should at once undertake to prepare, and to submit to the Union for publication, the appendices proposed in the provisional report (p. 91).
- (3) That the Commission recommends the different variable star organisations to enter into correspondence, through their presidents or otherwise, on questions of observations and the discussion and publication of work on variable stars.
- (4) That the Commission welcomes the formation of the organisation centred at Lyons for the co-operation of amateur astronomers in the study of variable stars, and suggests that this organisation should act