

## 26. COMMISSION DES ETOILES DOUBLES

PRÉSIDENT: Professor P. van de Kamp, Director of the Sproul Observatory, Swarthmore College, Swarthmore, Pennsylvania, U.S.A.

MEMBRES: Arend, Baize, Couteau, A. N. Deutsch, Dick, Djurkovic, Finsen, Güntzel-Lingner, Hertzprung, Jeffers, Jonckheere, Kuiper, Luyten, P. Muller, Strand, van Albada, van Biesbroeck, van den Bos, Wierzbinski, Woolley, Zagar.

### INTRODUCTION

A general feeling exists that the field of visual double-star observations requires more observers and a better knowledge of what observations are required. To that latter end, closer co-operation between observers and the 'users' of these observations is needed.

Concern has been expressed about the future of measurements of visual binaries. A large proportion of essential measures is being made by a few veteran observers, some of whom find it increasingly difficult to obtain observing time with large instruments. The situation should be remedied lest the study of visual double stars be seriously impeded. This would unfavorably affect the progress of all fields of astronomy which are vitally dependent on the data which can be obtained only from a continued systematic study of visual binaries. Every effort should be made by directors of observatories and others to make time available to observers of visual double stars. In this field, particularly, there is an obligation upon present-day astronomers to their successors.

A summary of work done or in hand, based on the reports received, is given here.

### VISUAL OBSERVATIONS

*Babelsberg*, 65-cm refractor (Dick): pairs below  $2''.5$  separation.

*Beograd*, 65-cm refractor (Djurkovic and Dačić): difficult pairs with regard to separation, magnitude and magnitude difference.

*Herstmonceux*, 28-inch refractor (van der Riet Woolley): systematic program of 569 pairs of known or suspected orbital motion between  $25^\circ$  and  $100^\circ$  north polar distance, the primaries being chiefly brighter than the eighth magnitude. Generally, the filar micrometer is used for position angle only and the separations are obtained with the comparison image micrometer.

*Johannesburg*,  $26\frac{1}{2}$ -inch refractor (Finsen, van den Bos, Knipe, Churms, Lategan and Smuts): Van den Bos obtained 4 664 measures at Union Observatory and 5 732 measures at Lick, McDonald and Yerkes Observatories up to 15 August 1960.

Finsen concluded his interferometric survey of all stars between  $+20^\circ$  and  $-75^\circ$  declination down to magnitude 6.5, which is now being repeated in part and extended to fainter stars. To date, 9 481 examinations of 6 157 stars have been made, yielding 57 new pairs. The total number of interferometric measures of new and previously known pairs made between 1 September 1957 and 31 August 1960 is 1168.

*Lick*, 36-inch refractor (Worley): a visual survey of all M-dwarf stars accessible to the 36-inch refractor was begun on 1 July 1959. By October 1960 nearly 700 stars had been examined and the survey was some 85% complete. To the 170 known binaries in this class the present survey has added 26 new double stars with separations less than  $15''$ , as well as 12 wider pairs. The new pairs include nine objects with separations less than  $1''$ . A number

of new physical companions were found for stars in the Yale Catalogue of Bright Stars. About 600 measures of close binaries and M-dwarfs have been made. More than 200 photometric observations of close binaries, mostly with known orbits, have been made with a Muller-type polarizing photometer.

Spectroscopic observations of selected binaries have been made by Bidelman, Stephenson and Williams.

*McDonald*, 82-inch reflector and *Yerkes*, 40-inch refractor (Van Biesbroeck): close double stars. An eyepiece interferometer is being constructed to survey the brighter stars in the northern hemisphere.

*Meudon*, 83-cm refractor (Muller): renovation of the large refractor is under way. Eventually this instrument will be primarily devoted to double-star observations.

*Munich*, 28-cm refractor (Heintz): the reduction of meridian-circle observation of binaries is in the final stage.

*Nice*, 38-cm refractor (Couteau): neglected pairs in rapid motion, Jonckheere-stars and search for new pairs among spectroscopically known dwarf stars and nearby stars. Whenever one component is fainter than the eighth magnitude, the filar micrometer is used; in other cases, the Muller double-image micrometer.

*Paris*, 38-cm refractor (Baize); 24-cm refractor (Muller).

*Uccle*, 45-cm refractor (Arend and Dommangot): pairs with separations almost always less than 2", and frequently below 1".

#### PHOTOGRAPHIC OBSERVATIONS

*Abastumani*, 40-cm refractor and *Pulkovo*, 65-cm refractor (Deutsch): at Abastumani, observational data were obtained for the study of multiple systems of the Trapezium type (Ambartsumian's list, *Reports of Burakan Observatory*, XV, 1954); at Pulkovo, plates of double stars and trapezia were also taken.

*Bosscha*, 60-cm refractor (Pik-Sin The): work is continuing with special attention to fast-moving pairs.

*Dearborn Observatory*; *U.S. Naval Observatory* (Strand): the program on photographic observations of double stars with the 18½-inch Dearborn refractor was terminated in April 1958. A total of 1519 multiple-exposure plates had been taken since the program was started in June 1948.

In October 1958, a program of photographic observations of double stars was started with the 26-inch refractor of the U.S. Naval Observatory and on a part-time basis with the 24-inch refractor at the *Lowell Observatory*. During the two years this program has been in operation plates of 205 double stars were obtained. At Washington 394 plates were taken and 494 at Flagstaff during four observing periods of one month each, which testifies to the excellent observing conditions prevailing at the latter location. The plates are measured on a machine equipped with a digitizer for direct reading of the measurement on punched cards. The time required for measuring a plate has been reduced to nearly half the time needed when measurements are recorded manually. All reductions are carried out on the IBM 650 computer using a program written by O. Franz.

*Lick*, 36-inch refractor (Jeffers): 700 measures, for a great part by Hertzprung and his collaborators.

*Lowell*, 24-inch refractor (Fredrick): double-star observations using image intensifying devices have been made with the Lowell 24-inch refractor. Close pairs of equal magnitude down to  $0''.45$  have been observed using a planetary lens, cascaded image tube and a high-speed motion-picture camera. At separations of  $0''.9$  and larger, pairs having magnitude differences of 3 magnitudes have been successfully resolved. The mean error of separation was approximately  $\pm 0''.05$ , that of the position angles about  $\pm 3^\circ$  for smallest separation, improving to  $\pm 1^\circ$  as the separation increased. The refractor proved to be superior to the 24-inch reflector in this type of work.

*Minnesota* (Luyten): wide doubles with common proper motion especially those containing white dwarf components. First results, available soon, should lead to information about the masses of white dwarfs.

*Munich*, 11-inch refractor (Heintz): measures by eyepiece photography are being continued. A scale of  $1 \text{ mm} = 1''.4$  is reached and on good nights separations of  $1''$  may be obtained.

*Potsdam*, 50-cm refractor: in close co-operation with the visual observations at Babelsberg Experiments with projections through the eyepiece, proposed by W. Rabe, were made with different optical systems. (Güntzel-Lingner): pairs with noticeable orbital motion and separations less than  $2''$ . With the 20-cm Zeiss-astrograph: neglected pairs greater than  $6''$  separation.

*Sproul*, 24-inch refractor (van de Kamp and Lippincott): the work on mass-ratios and parallaxes of visual binaries is being continued as well as the search for and subsequent study of unresolved astrometric binaries.

Hertzsprung stresses the importance of gratings for observation with large  $\Delta m$ .

#### ORBITS

Calculations of orbits continue to be made by Arend, Baize, Dommanget, Finsen, Güntzel-Lingner, Hertzsprung, Muller, van den Bos, Wierzbinski, Hopmann and others. Rectilinear orbits have been derived by Arend, by Dommanget and by Nys.

Couteau has made a study of the eccentricities, separations and semi-axes of 410 orbits, leading to a predicted number of binaries between different limits of magnitudes and separations. He has also made a comparative study of dynamical and trigonometric parallaxes.

Non-periodic orbital criteria have been given by Dommanget, and by Hopmann, who believes non-periodic, or temporary, systems to be in the majority. The relation between double stars and associations has been studied by Dommanget and by Hopmann.

To carry out orbital determinations and improvements, Güntzel-Lingner has prepared a catalogue of 2 400 visual pairs, which is being kept up to date. He plans to publish the observations made of these pairs since the ADS in loose sheets to be brought up to date from time to time.

There are still too many unjustified orbit calculations; a detailed catalogue would reveal a great waste.

#### PUBLICATIONS

Measures, orbital determinations and the results of various investigations continue to be published for a considerable part in the following:

*Annales de l'Observatoire Royal de Belgique; Annals of Bosscha Observatory; The Astronomical Journal; The Astrophysical Journal Supplements; Astronomische Nachrichten; Bulletin Astronomique; Bulletin de l'Observatoire Astronomique de Beograd; Bulletin Pulkovo Observatory;*

*Circulaire d'Information* (UAI Commission des Etoiles Doubles; Muller); *Communications de l'Observatoire Royal de Belgique*; *Journal des Observateurs*; *Monthly Notes of the Astronomical Society of South Africa*; *Publications of the Astronomical Society of the Pacific*; *Publications Babelsberg Observatory*; *Publications Yerkes Observatory*; *Royal Observatory Bulletins*; *Astronomical Journal of the U.S.S.R.* (Moscow); *Union Observatory Circulars*.

#### DOUBLE STAR CATALOGUE

Jeffers wishes members of the Commission to present their ideas of the form in which the forthcoming Index Catalogue should be published. The project is described in detail in *P.A.S.P.* 69, 322, August 1957.

It is not believed that it will be expedient to publish the catalogue of observations. The material, however, will be available to those who desire it. The Index Catalogue, on the other hand, may merit a wider distribution. It is hoped that the northern and southern sections can be distributed together, as a unit, to those interested. It is planned to publish the material as a single volume, with appropriate indices and explanations which will contain the essential data on double stars over the entire sky. As the two sections of the Index Catalogues will be recorded on special IBM cards, the complete material could also be made available in the form of a duplicate of the card file with approximately 50 000 cards, a form that would have the advantage of flexibility if not that of compactness.

The immediate objectives are to complete the catalogue of observations and the Index, and to publish the latter. Also it is planned at the Lick Observatory to maintain both these catalogues. Supplements to the Index Catalogue, or revisions of it, will be prepared when they are needed.

1 January 1961 has been set as the date beyond which no double star observations of old or new pairs will be considered in the published Index Catalogue. 1 July 1961 is the date now set for the completion of the entire project.

#### PROPOSALS

There is wide-spread interest in the form and continuation of the new double-star catalogue of Jeffers and van den Bos. Several observers plan revision of their programs after the appearance of this catalogue.

Couteau would like to have made available true anomalies beginning with  $e = 0.8$ , for small values of the mean anomaly. He advises orbit computers not to mix, in one mean value, the measures made by different procedures.

Güntzel-Lingner suggests that a collection of all astrophysical and astrodynamical parameters of the components of visual binaries with known orbits be prepared and made available to all astronomical institutes. Particular attention should be given to the great gaps existing in our knowledge of various quantities, such as spectral types.

Heintz proposes a recommendation to Commission 30 (Stellar Radial Velocities) to make measures of radial velocities for visual double stars. Apart from their dynamical significance such observations would contribute material for the spectral and luminosity classification of the components.

Van Albada desires closer contact between astrophysicists and double-star observers. He stresses the importance of good collaboration and a rational division of tasks between photographic and visual double-star observers. He proposes the publication of a list of pairs, selected on the basis of their physical properties and apparent magnitude, for special study.

Van den Bos proposes repeated inspections, at suitable intervals, of a selected list of stars, sufficiently small in number—say the stars with parallaxes greater than  $0''.05$  and the stars with proper motions greater than  $0''.5$  per year—preferably with telescopes of large aperture, so as to include the close and very faint pairs. (Non-eclipsing) variable stars at or near minimum light should be inspected. He also proposes a systematic survey of stars between magnitudes 9 and 13, restricted to Kapteyn's selected areas, using adequate optical power. This would imply inspecting some 12 000 stars, limiting the field to  $1^\circ \times 1^\circ$  in higher and  $\frac{1}{2}^\circ \times \frac{1}{2}^\circ$  in lower galactic latitudes.

Several observers stress the need for astrophysical observations and for the continued scrutiny of nearby single and double stars to detect duplicity and multiplicity.

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*President of the Commission*