respects. For example, some years ago Dr J. Jackson recommended that the re-observation of stars in the GC, especially many of those not in the PGC, be undertaken as soon as possible in order to strengthen the GC where its improvement is most needed. This programme, together with meridian circle programmes that will provide a more uniform spacing, promises within a relatively short span of years a rich system of the brighter stars to which both meridian circle positions and photographic positions of the fainter stars can be referred with much greater certainty than was possible during the past twenty-five years.

The Yale programme owes much to the contributions made by the observatories that furnished the meridian circle observations for the reduction of the plates. In the past star positions were specially observed at Leiden, at the Lick Observatory and Washington. The recent catalogues have depended particularly on star positions observed at the Cape Observatory and Greenwich. In the immediate future we hope to make good use of the catalogues to be published by the U.S. Naval Observatory in Washington.

I have deliberately limited my remarks to the Yale programme and questions immediately related to it. It differs in various ways from the AG programme, from the U.S.S.R. programme and from the Cape programme. Each of these attacks on our common problem has its own particular merits. Each is distinctly different in general procedure, and the independent results will be important. It seems to me that astronomy is best served if these various projects continue side by side.

Dr Nemiro: The programme of the Yale Observatory on the astrographic catalogue is very important. Only one point can be mentioned—that the catalogues of reference stars which were used are based on different systems.

6. REPORT FROM THE CAPE OBSERVATORY

By R. H. Stoy

A programme of photographic astrometric work on faint stars was initiated at the Cape Observatory by Sir Harold Spencer Jones in 1930. Its aim was to do for the sky south of $-30°$ what the Yale Observatory in America and various observatories in Germany and Russia were doing for the sky north of $-30°$ Though somewhat interrupted by the war, the work has progressed steadily and it is anticipated that the whole project will be finished by 1960.

In the south a fresh selection of stars had to be made since it was not possible merely to reobserve the stars in the AG catalogues as was done by Yale. Most of the stars that have previously been observed with transit circles have been included in this new selection and to them have been added stars chosen from the HD and CPD catalogues to secure, as far as possible, a uniformity of distribution. The great majority of the stars observed have visual magnitudes between $7^{m}{\cdot}0$ and $10^{m}{\cdot}0$ and there are on the average 9·1 of them per square degree.

No special provision was made for the zones between $-40°$ and $-52°$, since this part of the sky is already well covered by the Cape Astrographic Zone Catalogues which give the positions and proper motions of 41,400 stars brighter than $9^{m}{\cdot}5$ CPD—an average of 13·8 stars per square degree.

The necessary photographic observations were and are being made with a three-component Taylor-Taylor-Hobson lens of 13 cm. aperture and 2 m. focal length (giving a scale of 102·3″/mm.). After the plates for the first zone ($-30°$ to $-35°$) had been taken, the lens was stopped down to $f/23$ to improve the definition near the edge of the field. For the first two zones ($-30°$ to $-35°$ and $-35°$ to $-40°$) a field of $5° \times 5°$ was measured on each plate, but for all subsequent zones, this field was reduced to $4° \times 4°$ in an attempt to secure greater accuracy.

Suitable reference stars for reducing the photographs are selected and observed with

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a transit circle so that the mean epoch of the meridian observations is the same as that of the photographs. On the average, there are $1\frac{1}{4}$ reference stars per square degree and their mean visual magnitude is $8^{m}\cdot5$. Since the positions of stars of all spectral types are being measured on the plates, it has been found desirable not to restrict the choice of reference stars to one particular narrow range of spectral type, but to include stars of all types so that any colour effects there may be in determining the position of a star photographically (e.g. field distortions of the lens depending on colour, differential atmospheric dispersion, etc.) can be effectively controlled.

For the three zones observed before the war, the positions of the reference stars were obtained with the old non-reversible Airy Transit Circle differentially with respect to about 200 'fundamental stars' selected from the First Cape Catalogue for 1925. As the fundamental stars were about three magnitudes brighter than the reference stars, a slight magnitude equation crept into the positions of the latter, but this was detected and its effect removed by an analysis of the differences of the positions of these stars as observed visually and photographically. For the zones observed since the war, the position of the reference stars has been obtained with the Gill Reversible Transit Circle. The 'fundamental stars' have been selected from the GC and the observations have been made with a reversing prism and with wire screens to equalize the magnitudes of the stars observed. For the purpose of the zone work, the observations are reduced differentially, but they are actually made fundamentally and the normal observations of the Sun and planets are obtained. The derived 'night corrections' are available for correcting the system of the 'fundamental stars'

The present position of the work is as follows:

The catalogues for zone $-30°$ to $-35°$ (13,000 stars, mean epoch 1932.5) and zone $-35°$ to $-40°$ (12,000 stars, mean epoch 1936.5) are at the printers, while that for the zone $-52°$ to $-56°$ (9000 stars, mean epoch 1938.5) is being typed.

The two zones $-56°$ to $-64°$ (14,600 stars, mean epoch 1945.5) were observed together as were the zones $-64°$ to $-80°$ (18,000 stars, mean epoch 1948.0).

Through the kindness of the Astronomer Royal, the zone $-56°$ to $-60°$ (7600 stars) is being measured and reduced at the Royal Greenwich Observatory, while at the Cape work on the zone $-60°$ to $-64°$ (7000 stars) is complete and the final copy for press is being written out. The plates for the zone $-64°$ to $-68°$ are almost completely measured and much preliminary work has been done for the remaining zones.

The reference stars for the part of the sky between $-80°$ and the south pole are now being observed as part of the present programme with the Gill reversible transit circle and it is planned to photograph these zones during 1953.

The catalogues so far completed give the following information in successive columns:

Current number; Durchmusterung number; RA for 1950.0 to $0^{s}\cdot01$; precessional coefficients for T and T^{2}; declination for 1950.0 to $0''\cdot1$; precessional coefficients for T and T^{2}; the centennial proper motion in RA in units of $0^{s}\cdot01$ and of $0''\cdot1$; the centennial proper motion in declination in units of $0''\cdot1$; the probable error of the proper motion; the photographic magnitude; the photo-visual magnitude; the colour index and the spectral type.

The positions and proper motions are on the FK 3 system. Wherever possible at least two earlier sources not less than 20 years and not more than 75 years before the plate epoch were used in the derivation of the proper motions, but such sources were not always available and for about 20% of the stars in the more southerly zones, no previous precision observation of position exists. The old places were reduced to the FK 3 system by means of the published corrections and brought forward to 1950.0 using Newcomb's precessional constants.

The magnitude and colours are on the S system and were specially determined for these catalogues. The spectral types are from the Henry Draper catalogues or, for stars not in the HDC, are new classifications made available through the kind co-operation of the Harvard Observatory. For the catalogues so far completed, some 10,000 such new classifications have been made.

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It may be added that, with very few exceptions, all the GC stars within a zone have either been measured on the plates or have been observed with the transit circle together with the reference stars for that zone. In addition, all the GC stars between $-30°$ and $-52°$ are at present being observed with the Gill reversible transit circle. Thus it seems probable that nearly all the GC stars south of $-30°$ will have been reobserved at the Cape by the end of 1955, the greater number of them in the ten years from 1945 onwards.

Prof. Zverev stressed the extreme importance of the astrometric work of the Cape Observatory, which is still the only one actively engaged in fundamental work in the southern hemisphere, and expressed the hope that this work could be taken up by other southern observatories.

Dr Jackson remarked that this concluded the first half of the programme and that the afternoon would be devoted to extra-galactic nebulae.

Afternoon Session. Dr Nemiro, *Chairman*

A few questions which arose from the morning session were first considered.

Prof. Kopff moved the following: It is recommended that Commissions 8 and 8*a* be asked to draw up a definitive programme for meridian circle observers in order to obtain a single catalogue of faint fundamental stars.

After discussion, Prof. Kopff's suggestion was adopted with the following addition moved by Profs. Oort and Zverev: Special programmes of stars important for stellar astronomy should be worked out along with other commissions (e.g. 24, 33 and 37).

7. PURPOSE AND REQUIREMENTS FOR PROPER MOTIONS OF FAINT STARS

By J. H. Oort

I. Purposes

These may be classed under four headings:

(*a*) Systematic motions at different points in space.
(*b*) Distribution of 'random' motions.
(*c*) Check on distances of faint stars as determined by spectrographic methods.
(*d*) Distances and motions of special types of stars.

Comments

(*a*) These determine the constants A and B of differential galactic rotation, and also deviations from the fundamental values of these constants, due to random motions, and related with the density distribution of stars.

(*b*) In a well-mixed state there must be a definite relation between velocity and density distribution. In a state such as is actually observed, which is *not* well-mixed, the velocity distribution shows the direction in which the density distribution will change with time. Determination of the velocity distribution in as many and as distant regions as possible is of essential importance.

(*d*) Proper motions are still our principal basis for calibrating absolute magnitudes of supergiants, RR Lyrae variables, long-period variables and several other types of stars.

Particularly interesting problems are presented by the expanding groups of early-type stars. Such expansions are likely to occur quite generally. They can best be studied from proper motions.

II. Requirements

(*a*) For the constants A and B probable errors of about $0''.0002$ per annum (i.e. half the present probable errors) should be aimed at. An extremely strong tie between faint stars and the bright fundamental stars will be essential; much better than any obtained

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