

24. COMMISSION DES PARALLAXES STELLAIRES ET DES MOUVEMENTS PROPRES

PRÉSIDENT: M. S. A. MITCHELL, *Director of the Leander McCormick Observatory, University of Virginia, U.S.A.*

MEMBRES: MM. Adams, Alden, Bianchi, Cecchini, C. R. Davidson, Fox, Harper, Horrocks, J. Jackson, Jones, Jordan, Knox-Shaw, Lee, Lindblad, Lockyer, Luyten, Miller, Moffitt, Nechvile, Russell, Schlesinger, Shapley, Slocum, Smart, van Maanen, Van Rhijn, Voûte.

In November 1934 the President circulated a letter to the members of the Commission as follows:

Since the 1932 meeting the following projects have been completed, or are nearing completion:

- (1) The publication of many lists of trigonometric parallaxes.
- (2) The determination of the spectroscopic parallaxes of 4179 stars at Mt Wilson Observatory by Adams, Joy and Humason.
- (3) A discussion of systematic errors of trigonometric parallaxes by van Maanen and a re-discussion in the *Astrophysical Journal* of the same material by Mitchell and by Sterne.
- (4) The compilation of a second Yale Catalogue to include parallaxes completed before the end of 1934.
- (5) Substantial progress on the proper motions of 32,000 stars by Boss and his associates at the Dudley Observatory.
- (6) The publication at the Radcliffe Observatory of the proper motions of 32,000 stars from photographs on 115 Selected Areas.
- (7) The completion of the dynamical parallaxes of 2000 stars.
- (8) The completion of the proper motions of 18,000 stars derived from parallax plates at the Leander McCormick Observatory.
- (9) The publication at the Yale Observatory of the proper motions of 40,000 stars with a probable error less than $0''.010$ determined from photographs by re-observing in zones the *Astronomische Gesellschaft* stars.
- (10) The determination of the proper motions of 50,000 stars in the Southern Hemisphere by Luyten from Harvard photographs.

A work of very great importance has been the recent completion at Mt Wilson Observatory of the spectroscopic parallaxes of more than four thousand stars. For the dwarf stars, the mean spectroscopic parallaxes were made to fit the mean trigonometric parallaxes; for the giants, mean parallaxes from proper motions and radial velocities were supplemented to some extent by trigonometric results.

With the trigonometric parallaxes compiled for the Second Yale Catalogue of Parallaxes and the Mt Wilson spectroscopic parallaxes (also to be included in the Catalogue) Schlesinger is in a position to make a thorough determination of systematic errors. He hopes that by the time of the Paris meeting the Yale Catalogue will be in print and ready for distribution.

Many observatories have been securing photographs on trigonometric parallax programmes for two decades. From the beginning, the work of Commission 24 has been well organized. Moreover, the individual parallax observers have had the benefit of frequent conferences, with the result that programmes have been well conceived and put into execution. Experience has brought modifications both in

the taking of the photographs and in the measurements and reductions. Although each observatory has been responsible for its own programme, the aggregate of all has resulted in the determinations of the trigonometric parallaxes of representative groups of stars, such as bright stars, faint stars, stars of all spectral types, stars of large and small proper motions, visual binaries, stars of large radial velocities, Cepheids, etc. At the present time more than 500 trigonometric parallaxes are being completed annually.

The Paris meeting will afford an excellent opportunity for trigonometric and spectroscopic parallax observers to get together in order to discuss the present status of parallax programmes and plans for the future. Some of the trigonometric observers are planning to complete their present series of observations and will not put other stars under observation. It will be of great importance to ascertain what observatories are planning a cessation of parallax activities. Similarly, what are the spectroscopic parallax observers planning for the future? Up to the present, the parallaxes of nearly all the naked-eye stars have been determined. Parallax programmes may be extended indefinitely by going to fainter stars. Each observatory must decide for itself how much longer it is going to be worth while for it to continue on the concentrated work of parallax observations. The answer to this question will involve the problem of finding other projects that may be taken up efficiently and effectively by telescopes now engaged in parallax work. Especially for observatories with small staffs, parallax work, trigonometric and also spectroscopic, has been an ideal type of research. The parallax of each star is a separate contribution, the probable errors of the various contributing trigonometric series being approximately equal. In other words, the accuracy attained with smaller apertures and focal lengths differs little from the accuracy when great telescopes are employed. As many stars may be finished each year as circumstances permit. Each observatory must decide its own future depending on its telescope and its staff but especially upon what other fields of research may be taken up by long focus telescopes now engaged in parallax work. The Paris meeting offers an excellent opportunity for a free and frank discussion of all these problems together with plans for the future.

On account of the comparatively long time interval now available, proper motions of faint stars can be derived with high accuracy from trigonometric parallax photographs. When supplemented by photographic and photovisual magnitudes and spectral types, much valuable information may be obtained regarding solar motion, secular parallaxes, star streaming, galactic rotation, precession corrections and space absorption. From a discussion such as that completed at the Leander McCormick Observatory on the proper motions of 18,000 stars on parallax plates, the direction of the solar apex is found at right ascension 19.0 hours and at declination, $+36^\circ$ with a probable error of 2° . This apex derived from faint stars differs about 15° from that at 18^h and $+30^\circ$ determined from bright stars. Unfortunately, there is comparatively little information regarding the speed of the sun's motion with respect to the faint stars. Many authorities seem to think that possibly the sun's velocity with respect to faint stars is greater than the value of 20 km. per sec. derived from the bright stars.

It would therefore seem desirable that Commission 24 should have a joint session in Paris with Commission 30 on Radial Velocities and also with Commission 33 on Stellar Statistics.

In the report presented at the 1932 meeting, information was given about the various observing programmes. Without duplicating what is already published in the

1932 report, will you be good enough to give information concerning such of the following topics as are appropriate to the work of your observatory?

1. What is your grand total of parallaxes to the end of 1934, i.e. measures completed and ready to publish?
2. What are your plans for the continuation of the work?
3. What changes in technique (in photographing, in measurements and in reductions) have you put into effect since 1932?
4. What progress has been made on proper motion programmes since 1932?
5. Have you any special recommendations to make in regard to any phase of the work?

Brief summaries of the answers received are given, separated according to different phases of the work. For convenience of reference, the participating observatories are arranged in the same order as in the 1932 report.

TRIGONOMETRIC PARALLAXES

YALE UNIVERSITY OBSERVATORY, Johannesburg, South Africa. 26-inch Photographic Refractor.

(1) Up to the end of 1934 this Observatory had published in the *Astronomical Journal* just 1000 parallaxes. In addition, 174 parallaxes have been completed and are ready to publish. Dr Alden, who is in charge at Johannesburg, reports that all the plates have been secured for a total of about 1350 objects.

(2) Our present programme includes all stars brighter than 5.5 in the Henry Draper Catalogue south of declination $+10^\circ$ except those whose spectra are of the B-type. We are not planning to continue this programme beyond these limits of magnitude, declination, and spectral type. In addition, some two hundred stars of large proper motion are being observed. In the coming years we intend to augment this latter number by several hundred.

(3) Since 1932, we have developed a projection method for measuring parallax plates (*Monthly Notices*, **93**, 382, 1933). This is now regularly employed on both measuring machines at New Haven. We have also made experiments with a photo-electric method for measuring parallax plates. While this calls for no skill whatsoever in making the bisection, it does require some experience in manipulating electrical instruments. It proves to be a rapid method and slightly more accurate than any other that we have employed. It is possible that after further experimenting this method or a modification of it will be adopted.

A new general Catalogue of Parallaxes containing all the determinations by trigonometric and spectroscopic methods is being prepared, and it is expected that this Catalogue will be in print and distributed before the meeting in July, 1935. The total number of stars whose parallaxes have been determined by either or both of these methods will be in the neighbourhood of eight thousand.

The writer takes this opportunity for urging again that observers should indicate what the reasons are that led to the selection of each star as a parallax object. This information is essential for any statistical study of the results.

FRANK SCHLESINGER, *Director*

ALLEGHENY OBSERVATORY, Pittsburgh, Pennsylvania, U.S.A. 30-inch Photographic Refractor.

(1) Parallaxes measured and ready to print, 1302. Observations finished and ready to measure, 180. Under observation, 510. Listed for observation, 126. Grand total, 2118.

(2) With our very limited staff, and with a telescope so well suited for accurate parallax work, we expect to continue our parallax programme indefinitely, finishing those stars already started or listed and adding other stars of special interest, such as stars fainter than mag. 5.5 of large proper motion, or of interest for other reasons.

(3) We have had made an absorbing screen reducing about 6.6 magnitudes. With this screen, all available bright stars will be observed, or if before observed at Allegheny with very short exposures and narrow sector, will be reobserved. These stars will be referred to comparison stars of pg. mag. 12.3.

(4) Many doubles have been listed for observation for distance and angle, for parallax, for proper motion, for mass ratios and for dynamical parallaxes. This is being done by Dr Burns. Mr Daniel has taken some regions with 20 minutes exposure to provide for proper motions of stars down to pg. mag. 14.

FRANK C. JORDAN, *Director*

ROYAL OBSERVATORY, Cape of Good Hope. 24-inch Photographic Refractor.

(1) Parallaxes completed to end of 1934 equal 620.

(2) It is proposed to continue the work on similar lines. At certain right ascensions, e.g. 2 h., there are few stars which are known to have a large proper motion and some additional stars have been added to the working list at these R.A.'s solely on account of spectral type K5 or Ma. When work is carried to stars of proper motion less than $0''.40$, stars are selected, if available, in the Zone -40° to -52° covered by our Astrographic Catalogue.

Besides stars of large proper motion, a few bright stars have been added to our list because they have been found elsewhere to have a fairly large parallax. (We have put on Sirius and Canopus, using a 10 mag. filter with faint comparison stars and a 5.0 filter and shutter with brighter stars.)

J. JACKSON, *Director*

ROYAL OBSERVATORY, Greenwich, England. 26-inch Photographic Refractor.

(1) Parallaxes published to end of 1934 equal 583.

(2) The programme of observations has been changed by adding faint stars with proper motion between $0''.20$ and $0''.30$. At present there are about 500 stars on the working list, many of these being faint. To finish this programme will require more than 10 years.

H. SPENCER JONES, *Astronomer Royal*

Mt WILSON OBSERVATORY, Pasadena, California, U.S.A. 60- and 100-inch Reflectors.

(1) Total number of parallaxes is 394.

(2) Besides some stars of special interest on account of their spectral type, the programme contains now largely faint stars of large proper motion.

As a suggestion to parallax observers, who are in doubt what objects to put on their programme, I went recently through my card catalogue of parallaxes, to see to what amount stars with proper motions $> 0''.50$ per year have well determined

parallaxes. For the stars observable in the northern hemisphere, there are now known 798 such stars. For 290 stars, two or more parallaxes are available, for 173, one parallax. For the 310 stars south of -25° , these figures are 34 and 112, respectively. Here seems a useful field for parallax observers. Some observers, however, will be afraid of tackling the fainter stars, which would require longer exposures than they have been accustomed to. However, all instruments now used for parallax work can easily reach photographic magnitude 11. For this class there are 140 stars with none and 120 with one parallax only, for the observers in the northern hemisphere and 75 with none and 96 with one parallax south of declination -25° .

For stars of magnitude 11-13, which I think could be put on the programmes of most observatories without making the exposures too long, there are for the observers in the northern hemisphere 129 with none and 46 with one parallax, and south of declination -25° , 43 and 14. For most observers, stars fainter than magnitude 13 may give serious difficulties; here the figures are 66 with none and 7 with one north of -25° and 46 and 2 south of -25° .

A. VAN MAANEN

YERKES OBSERVATORY, Williams Bay, Wis., U.S.A. 40-inch Visual Refractor.

- (1) Total parallaxes amount to 373.
- (2) Our intention is to continue the work substantially without changes.

G. W. MOFFITT

VAN VLECK OBSERVATORY, Middletown, Connecticut, U.S.A. 20-inch Visual Refractor.

- (1) Number of parallaxes completed, 94.
- (2) We plan to continue the programme as in the past, concentrating upon stars of special interest, chiefly stars from ninth to eleventh magnitude with large proper motion. We have also on the programme a few variable stars, binary stars and first magnitude stars.
- (3) We have made no changes in technique since 1932.
- (4) We have done nothing as yet towards finding the proper motions of stars on our plates, other than the parallax star.
- (5) I would recommend that special attention be paid to an accurate determination of the magnitudes both of the parallax stars and of the comparison stars.

FREDERICK SLOCUM, *Director*

SPROUL OBSERVATORY, Swarthmore, Pennsylvania, U.S.A. 24-inch Visual Refractor.

- (1) Our grand total of parallaxes at the end of 1934 is 340.
- (2) We are planning to continue our work along the lines that we have hitherto followed. We are particularly stressing the determination of parallaxes of binary stars which promise to give information regarding the mass-ratio of the components. As a matter of fact, the binary part of our programme was chosen in the beginning for determination of the masses of binary systems and also for determining the mass ratio of components. The latter problem would be very much affected in the right way if we could have better magnitudes and particularly better relative magnitudes of the components.

JOHN A. MILLER, *Director*

STOCKHOLMS OBSERVATORIUM, Stockholm, Sweden. 24-inch Photographic Refractor.

(1) The parallax work which was started at the beginning of 1933 is in progress, and will yield its first results in 1935. We expect to get 25 parallaxes measured or ready for measuring next year.

(2) We plan to proceed with the determination of parallaxes for a list of stars containing (a) stars of large proper motions with few or no previous determinations, (b) stars of interest on account of their spectral characteristics, especially stars which by the spectro-photometric criteria of absolute magnitude studied here are in any way remarkable, and for which a trigonometric parallax may be of value.

(3) Regarding change of technique, we should only like to point out the advantage of a fine motion in position angle in the comparator of Gaertner type. This was introduced on our Gaertner machine by a very simple device.

BERTIL LINDBLAD, *Director*

R. OSSERVATORIO ASTRONOMIC DI BRERA, Milano, Italy. 40-inch Reflector.

(1) In 1932 we started observations for trigonometric parallaxes and have secured about 1000 plates.

(2) The present programme consists of 60 stars of large proper motion and about 8.5 visual magnitude.

E. BIANCHI, *Director*

LEANDER McCORMICK OBSERVATORY, University of Virginia, U.S.A. 26-inch Visual Refractor.

(1) A total of 1160 parallaxes finished.

(2) Work will be continued without substantial changes.

S. A. MITCHELL, *Director*

SUMMARY OF TRIGONOMETRIC PARALLAXES

Observatory	Number measured	Work started	Main features of programme
Allegheny	1302	1914	Bright stars (except B-type) north of -10° declination
Bosscha	150		Faint p.m. stars.
Cape	620	1926	Stars with p.m. exceeding $0^{\circ}.3$ and south of -10° declination
Dearborn	193	1913	Faint p.m. stars, without sector
Greenwich	583	1913	Stars north of $+64^{\circ}$ declination
McCormick	1160	1914	Bright stars all types, visual binaries, p.m. stars, etc.
Mt Wilson	394	1913	Stars on spectroscopic programme, faint stars, etc.
Sproul	340	1912	Visual binaries
Upsala	17	1894	Varied
Van Vleck	94	1925	Faint p.m. stars
Yale	1174	1925	Bright stars (except B-type) south of $+10^{\circ}$ declination
Yerkes	<u>373</u>	1903	Varied
GRAND TOTAL	6400		

SPECTROSCOPIC PARALLAXES

MT WILSON OBSERVATORY, Pasadena, California, U.S.A. 60- and 100-inch Reflectors.

Parallax determinations by the spectroscopic method which have been in progress at the Mt Wilson Observatory for a number of years have been brought together in a catalogue of 4179 stars now in press. A copy of this catalogue has been sent to Dr Schlesinger and the results will be included in his forthcoming General Catalogue.

The material in this list has been reduced upon a uniform system and includes stars of types F to M together with a number of A-type stars for which the absolute magnitudes have been determined from line-intensities. Most of the stars in the previous list of 1646 stars have been reinvestigated and additional lines have been utilized in the final results. In addition to a great number of stars from Boss's *Preliminary General Catalogue*, the list contains many stars of large proper motion, Selected Area stars and visual binaries. The extensive spectroscopic material now available at Mt Wilson for Cepheid variables is being reserved for special discussion.

The spectroscopic absolute magnitudes in the case of dwarf stars have been based upon a reduction system depending upon trigonometric parallaxes entirely. In the case of giant stars, primary use has been made of mean parallax values derived from parallactic and peculiar motions, but with some reference to trigonometric parallaxes as well.

The present observing programme at Mt Wilson on spectroscopic parallaxes includes the remaining stars of types F to M in the Boss Catalogue, a list of stars with measured trigonometric parallaxes which have not been observed spectroscopically, about 150 stars in the Selected Areas and some faint stars of very large proper motion. Especial attention is being given to dwarf stars of type M.

W. S. ADAMS, *Director*

DOMINION ASTROPHYSICAL OBSERVATORY, Victoria, B.C. 72-inch Reflector.

As stated in the last Report, Plaskett and Pearce correlated the intensity of interstellar calcium with the distances of the stars. This relation was used by Pearce to deduce the spectroscopic parallaxes of 297 (now 305) O to B7 stars.

Moreover, from 839 such stars with proper motions having probable errors $\pm 0''.0149$, they deduced mean parallaxes after all known systematic effects were removed. These included: (1) Raimond correction, (2) precessional correction as derived by the authors, (3) effect of Kapteyn's Scorpius-Centaurus stream motion of 154 stars, (4) solar motion, and (5) galactic rotation. The mean results are printed in *M.N.* 94, 600.

No spectroscopic parallax work has been possible on Class A stars since the last Report.

W. E. HARPER, *Acting Director*

NORMAN LOCKYER OBSERVATORY, Sidmouth, England. 12-inch Refractor.

- (1) No further parallaxes published or ready to publish since 1932.
- (2) Work is being continued and extended to stars of mag. 7.5 (in north declination). At present only B-type stars are being investigated.
- (3) (a) Faster plates are being made. (b) Study of the effect of peculiarities in spectra on the reduction curves. (c) Employment of parallaxes from interstellar Ca lines as checks.

WILLIAM J. S. LOCKYER, *Director*

OSSERVATORIO DI BRERA, Milano, Italy. 40-inch Reflector.

The conclusion of the spectroscopic parallaxes of about 1200 stars mainly of A and F types, which was hoped to be finished in 1933, was delayed on account of the following circumstances. A close inspection of the spectra has convinced us that by means of a simple estimate it is very difficult to establish a good relationship between spectral characteristics and absolute magnitude. Thus we thought it necessary to base the spectroscopic parallaxes upon accurate measurements of the spectra. A microphotometer is now being constructed in the Observatory workshop and is hoped to be ready for May 1935. The work on spectroscopic parallaxes will then be taken up again.

Meanwhile we have continued here to investigate the distribution of absolute magnitudes of stars of the different spectral types, mainly with regard to the problem of dispersion of the frequency curves. Working on this subject, L. Gratton and E. Krüger have begun to investigate the distribution of the absolute magnitudes of the G stars (Harvard, F8, G0, G5) by means of proper motions and radial velocities. 134 new proper motions have been computed from meridian observations to complete the list of the proper motions of stars brighter than 6.5 (*R. Osservatorio di Merate, Publ. no. 7*). This investigation will be finished in June 1935.

E. BIANCHI, *Director*

PROPER MOTIONS

OBSERVATORY, Cambridge, England. 12-inch Photographic Polar Siderostat.

Part of the available time is still being devoted to the measurement of proper motions by the method of superimposing a recent plate photographed through the glass on an early plate taken directly. Nearly all of the suitable fields photographed before 1912 have been measured.

W. M. SMART

NATIONAL OBSERVATORY, Praha, Czechoslovakia.

In the determination of proper motions of the stars down to the 16th photographic magnitude, one region was added to those previously examined, the co-ordinates of the centre of this region being $RA = 18^h 50^m$, $Dec = +33^\circ$; 104 stars with proper motions greater than $0''.02$ per year were detected in the field of 4 square degrees.

The observatory having no more early photographs, the investigations were directed along theoretical lines. In two problems progress has been made:

(a) The distribution of the stars in space, according to Dyson's law of density and the corresponding frequency function of proper motions was determined as a function of galactic latitude and longitude;

(b) From the frequency function of restricted proper motions were determined the direction of the apex of the sun and the position of the major axis of the velocity-ellipsoid (the direction of the vertices of stellar motions), according to the Schwarzschild ellipsoidal theory. A new method for these determinations, based on the dissymmetry of the frequency function, was disclosed. Numerical results will be published as soon as possible.

V. NECHVÍLE

RADCLIFFE OBSERVATORY, Oxford, England. 24-inch Photographic Refractor.

The publication of the *Radcliffe Catalogue of Proper Motions in the Selected Areas, I-II5*, brought to an end the programme upon which the Observatory embarked twenty-five years previously. The catalogue contains the proper motions of over 32,000 stars down to a mean photographic magnitude of 15.3 and with a mean probable error of $\pm 0''.0037$. These stars have furnished a satisfactory position for the Vertex of preferential motion, but it seems impossible to determine from the proper motions of such faint stars a position of the Solar Apex which is independent of that assumed in the reduction of the proper motions from relative to absolute.

Owing to the approaching removal of the Observatory to South Africa, it has not been found possible to measure the plates which have been taken of twenty of the "Special Areas." Dr van Rhijn has, however, undertaken to measure and reduce the plates in seven of these areas.

H. KNOX-SHAW, *Director*

KAPTEYN ASTRONOMICAL LABORATORY, Groningen, Holland.

Since 1932, Raimond and I have published a paper about the proper motions of the Hyades (*M.N.* 94, 508) and I have made a reduction of the spectroscopic parallaxes to a uniform system (*M.N.* 92, 744). As stated in the report of Commission 32 on the Selected Areas, we have measured some plates taken at the Alger Observatory for the determination of the proper motions in the zone declination 0° , but the work has been temporarily interrupted by a reduction of the staff of the Kapteyn Laboratory.

P. J. VAN RHIJN, *Director*

ROYAL OBSERVATORY, Cape of Good Hope.

The relative proper motions in declination of the parallax stars have been determined from plates taken at an interval of five years or more for the first 214 stars. The results will be published in the parallax volume. It is proposed to do so for the other stars when a sufficient interval has elapsed.

The work on the proper motion of stars in the Zone -40° to -52° is nearing completion. This has been done by comparison of plates taken with the Astrographic Telescope with an average interval of about 30 years. All the areas have been re-photographed so that there are generally two or more determinations for each star except in the end zones -40° to -41° and -51° to -52° .

All stars down to magnitude 9.5 on the C.P.D. scale have been measured, and in addition fainter stars with conspicuous proper motion (over 5" a century). The copy for press giving the proper motions of the 20843 stars in the Zone Catalogue has been completed. A second volume will give the results for the 20554 fainter stars. This volume will give right ascension, declination, precession, secular variation and proper motion. A start has been made in writing out the copy for press.

J. JACKSON, *Director*

ROYAL OBSERVATORY, Greenwich, England.

It is intended to determine the proper motions of all stars whose parallaxes are measured at Greenwich; two plates with a time interval of at least 10 years from the first epoch parallax plates will be obtained. The probable error of the proper motion in each co-ordinate will be about $\pm 0''.002$. 109 stars are at present on the list for proper motion determination.

H. SPENCER JONES, *Astronomer Royal*

YALE UNIVERSITY OBSERVATORY, New Haven, U.S.A. and Johannesburg, South Africa.

We are continuing our work with plates of very large field, and from the positions thus derived we are computing proper motions by comparing with the Astronomische Gesellschaft positions of forty or fifty years ago. These yield motions whose probable errors average from $0''.005$ to $0''.012$ for the various zones, this difference being almost wholly a result of the difference in accuracy of the Gesellschaft catalogues concerned. Since the 1932 meeting, we have derived in this way and published in the *Transactions of the Yale Observatory* the proper motions of approximately nineteen thousand stars between declinations $+20^\circ$ and $+30^\circ$. With a camera mounted at Johannesburg we have secured all the necessary photographs between declinations -2° and -30° . About 85 per cent. of the measurements in the zone from -10° to -20° have been completed and the reductions carried to nearly the same stage. From a discussion of more than half the material we conclude that the probable error of a zone place, the mean of the measurements of two plates, is $0''.10$.

By means of plates taken with both the camera (focal length 2.0 metres) and the 26-inch photographic refractor (focal length 11.0 metres) we are deriving proper motions of faint stars in the Selected Areas 116 to 205 and in sixteen of the Areas in the Special Plan. These observations are aimed to yield proper motions on an absolute basis sensibly free from magnitude effects. The details of this work will be found in the report of Commission 32 (Selected Areas).

FRANK SCHLESINGER, *Director*

HARVARD COLLEGE OBSERVATORY, Cambridge, Massachusetts, U.S.A.

We have continued steadily our work on the proper motions of southern stars in co-operation with Dr W. J. Luyten of the University of Minnesota. During the past three years a considerable share of the time of the 24-inch Bruce telescope at the Boyden Station of the Harvard Observatory has been devoted to repeating early plates. The programme is nearing completion so far as the regions are concerned for which the time interval is satisfactory. The photographs are being made under the supervision of Dr J. S. Paraskevopoulos, superintendent of the Boyden Station. Magnitude sequences for the brighter stars on these plates are being provided for Dr Luyten from published and unpublished Harvard sources by Miss S. F. Mussells.

HARLOW SHAPLEY, *Director*

UNIVERSITY OF MINNESOTA OBSERVATORY, Minneapolis, Minn. U.S.A.

In co-operation with the Harvard Observatory, the undersigned is engaged in a survey of proper motions of faint stars in the southern hemisphere by means of the Blink Microscope. The material consists in pairs of plates, taken with the Bruce 24-inch refractor, having a scale of $1 \text{ mm.} = 1'$, and interval of slightly over 30 years, and generally showing motions down to $0''.030$ per annum. Of the 1009 plates required to cover the southern hemisphere completely, no old plates are available for 62 regions, leaving 947 pairs of plates to be examined. Of these about 120 are of 3 hour-exposure, showing stars as faint as eighteenth magnitude (photographic), the remainder generally going as faint as sixteenth magnitude.

Where the scope of the investigations is considerable, involving the examination of at least 20,000,000 stars, and since it is being carried out by the undersigned

almost single-handed, and with but meagre resources, it has been decided to divide the work into several parts, as follows.

(a) The *examination* of all pairs of plates in the blink microscope, by the undersigned personally, as fast as possible, in order to detect and measure at least those stars of large proper motion which are of chief interest to parallax observers. At the present moment nearly 450 pairs have been examined, and a total of 50,000 moving objects found. It is hoped that by the end of the academic year the entire area south of declination -30° will have been completed.

(b) The *measurement* of all motions found in the extreme south polar area, south of declination -60° . This comprises 18,500 stars, 13,000 of which have already been measured and reduced; it is hoped to finish measurements on the remainder in one more year.

It may be mentioned here that in this area which has now been completely examined, 165 stars with an annual proper motion exceeding $0''.5$ have been found, some as faint as $17^m.7$. Only 38 of these stars were known before.

(c) The *discussion* of these proper motions will lead to valuable information concerning the best way to finish the measurement and discussion of the stars found in the other regions, and will thus serve as a guide to future work. It is expected that the entire programme will yield at least 80,000 proper motion stars.

(d) Apart from the measurement referred to under (b) only those objects are now measured whose motion appears to be very large and it is hoped in this way to prepare a catalogue of all stars brighter than photographic magnitude 14 with proper motions in excess of $0''.5$ annually.

(e) Furthermore, those *double stars* of wide separation and common proper motion which reveal themselves in the blink microscope are measured and reduced. Two lists of such stars have already been published, a third is in the press.

(f) Finally, entirely incidental to the aim of the work, it may be mentioned that upwards of 1000 new *variable stars* have been discovered. Approximate positions and estimated magnitudes for these are published at frequent intervals.

W. J. LUYTEN, *Director*

STOCKHOLMS OBSERVATORIUM, Sweden. 18-inch Astrograph, 40-inch Reflector.

Our proper motion programme contains 96 open star clusters, 40 regions in the central band of the Milky Way, and 9 regions near the Pole of the Milky Way. About 200 plates have been taken on this plan. We plan to have at least four plates or 8 images in each epoch. Limiting magnitude about 13.5 photographic.

In addition, we plan a proper motion work where small extra-galactic nebulae are taken as standards of reference. The fields are as well distributed in galactic longitude and latitude as possible. A few plates have been taken and seem to be rather promising. Certain precautions have of course to be taken regarding smallness and symmetry of the nebulae used. In some regions there are several measurable nebulae on the plate. In regions where nebulae are more scarce, a selected nebula is placed in the centre of the field.

BERTIL LINDBLAD, *Director*

MT WILSON OBSERVATORY, Pasadena, California, U.S.A.

From plates taken at the 80-foot focus of the 60-inch reflector, Willis has derived the proper motions in 113 fields, containing a star from Boss's *P.G.C.* as central star; the total number of stars measured is 2289, the probable error in R.A. or

declination is less than $0^{\circ}.002$. Willis has also derived photographic magnitudes for these stars. The majority have magnitudes between 12 and 15.

Since 1932, van Maanen has derived the proper motions of 21 planetary nebulae; the results are published in *Mt. W. Contr.* 463. In 1925, I started with the 60-inch reflector a programme for the determination of proper motions of Cepheid variables and it was intended to use an interval of 10 years or more. (The same programme was started at the Leander McCormick Observatory.) For 150 fields, three or more first epoch-plates of good quality are now available.

That same year I started with the 100-inch a programme for the determination of proper motions for spiral nebulae, having a stellar or almost stellar nucleus. There too a minimum interval of 10 years was accepted. For 74 fields, two or more exposures of 30^m are now available for the first epoch. The work of finding faint stars of large proper motions in the Selected Areas (*Mt. W. Contr.* 412) is being continued.

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DYNAMICAL PARALLAXES

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Since the publication, in 1929, of *Dynamical Parallaxes of 1777 Double Stars*, the Princeton Catalogue has been revised and extended. The revision is based on late double star measures in Aitken's *Double Star Catalogue* and literature published before November 1932. A list of 308 new parallaxes of A double stars has been published by Aitken and Miss Moore*. Our card catalogue now contains parallaxes for 2072 stars including 123 based on orbital elements. The revised list has not been published but the results have been sent to Schlesinger.

The dynamical parallaxes are based on the mass-luminosity relation. A comparison of these parallaxes with trigonometric and spectroscopic parallaxes, including unpublished material kindly furnished by Schlesinger and Adams, indicates that very little change in this relation is necessary for either giants or dwarfs. The total number of stars available for investigation of mass is approximately five hundred and sixty†. Further work on the study of masses is in progress.

Dr W. J. Finsen of the Union Observatory has completed the dynamical parallaxes of 531 stars south of declination -19° . About 400 are new parallaxes.

HENRY NORRIS RUSSELL, *Director*

S. A. MITCHELL
President of the Commission

* *Lick Bulletin*, No. 451, 1933.

† *Science*, May 12, 1933.