

24. COMMISSION DES PARALLAXES STELLAIRES ET DES MOUVEMENTS PROPRES

PRÉSIDENT: K. Aa. Strand.

MEMBRES: MM. Alden, Ali, Cecchini, A. N. Deutsch, Haas, R. G. Hall, Harris, Hertzsprung, J. Jackson, C. Jackson, Mlle Jenkins, MM. Kohlschütter, König, Lavdovski, Lindblad, Lourens, Luyten, E. G. Martin, W. W. Morgan, Nechvile, Paloque, Parenago, Podobed, Smart, Stearns, Tannahill, van de Kamp, van Rhijn, Vyssotsky, Wagman.

TRIGONOMETRIC PARALLAXES

The total number of completed trigonometric parallaxes is 10 823, which is an increase of 313 over the previous report. The increase is based upon reports received from the Allegheny, Cape, McCormick, Yale and Yerkes Observatories. It is estimated that approximately 750 of the total number reported are not listed in the Yale Catalogue.

The large number of parallaxes which have been determined over the past fifty years has led to a general belief at the present time that in the future little emphasis should be placed upon work in this field.

A more critical examination of the collected material shows that there is little reason for such optimism. First of all, due to the limited material upon which they were determined, a considerable number of the published parallaxes have such large accidental errors that it is questionable whether to use them either individually or for statistical purposes.

Secondly, the original programme drawn up by Schlesinger called for parallax determinations of all stars brighter than 5.5 magnitude, except stars of spectral type earlier than A, and late-type giants. With this programme completed, most programmes in recent years have been concentrated on faint stars showing dwarf characteristics, as discovered from proper motion surveys (Luyten) or spectral surveys (Vyssotsky).

The Schlesinger programme and the recent work on the nearby stars do not by any means supplement each other, with the result that there are considerable gaps, in the sense that for stars of certain spectral characteristics, we are still unable to derive accurate values for their absolute magnitudes.

Thirdly, the median parallax of the 1952 Catalogue is $0''.018$, which is less than twice the accidental error of $0''.011$ (p.e.) for the average of one of the smaller parallaxes, according to Hertzsprung. This shows that far too many stars with very small parallaxes have been included in the observing programmes, especially during the earlier period when Schlesinger's systematic programme was in effect.

The last report mentioned a study by Harris, confirming that the adjusted probable errors and weights used in the Catalogue were of the right order and that Schilt thinks the printed absolute parallaxes may require corrections up to $+0''.007$, the mean value being $+0''.0035$ for the eight observatories having published 400 or more parallaxes.

Parenago reports that an attempt to confirm or reject the corrections of Schilt was made by Dr Pavlovskaja. While the investigation indicated a positive correction, the uncertainty of the results made publication premature.

The question of the presence of a systematic error of the order of $0''.0035$ is not too important for the parallaxes larger than $0''.050$ but these constitute only 13% of the parallaxes listed in the Catalogue. For the median parallax, $0''.018$, this means an uncertainty of 0.5 in the absolute magnitude due to this error alone, which becomes significant in establishing the position of the bright end of the main sequence in the Hertzsprung-Russell diagram. Cluster parallaxes may solve this problem, but there are other groups of stars, such as subgiant K stars, high-velocity F stars, where trigonometric parallaxes of the order of $0''.020$ are needed to establish their absolute magnitudes.

If we look towards the future, it would seem desirable to bring the existing parallax

material on a statistically sound basis by eliminating those parallaxes in the Yale Catalogue which are based upon less than sixteen plates, stars for which the magnitude reductions to the comparison stars are unsatisfactory or performed with sectors giving reductions of more than six magnitudes. For the remaining stars, spectra and magnitudes of the comparison stars should, as far as possible, be determined. Such a revision would mean a drastic reduction in the total number of parallaxes for some series, but the overall material would provide data which would be statistically more acceptable.

To improve on the individually determined parallax, it would seem desirable to increase the number of plates in a series to a minimum of thirty-six plates, and preferably to fifty, which would lead to parallaxes with an accidental probable error of ± 0.005 . The minimum number of plates in a Yerkes parallax series has for the past several years been fifty and the number of plates in an Allegheny parallax series, according to Wagman, now approaches forty.

In addition to the groups already mentioned, accurate magnitude criteria for sub-dwarfs are most desirable. At the present time a series of sixteen sub-dwarfs listed in the *Parallax Catalogue* and having parallaxes between 0.020 and 0.040 are currently being re-observed at the Allegheny, Cape, McCormick, Sproul and Yerkes Observatories.

Surveys of stars in the solar neighbourhood clearly indicate that the parallax work is by no means completed. Luyten's proper motion catalogue of stars with yearly proper motions larger than 0.5 /year contains 1849 stars with 360 stars fainter than the limiting magnitude of 14 for telescopes now used in parallax work. This catalogue is by no means complete, since it does not cover all of the northern sky. This is shown by an unpublished study by Strand and Lenham of stars with large proper motions in the Orion region from plates taken with the 13-inch telescope of the Lowell Observatory. The region covering $11^\circ \times 13^\circ$ has sixteen stars with yearly proper motions larger than 0.5 , of which half were not previously known. Vyssotsky reports that out of the 876 M dwarf stars included in the four lists published by him and his assistants, only 266 have measured parallaxes.

Among the stars in the solar neighbourhood in need of accurate parallaxes are the M dwarf stars with hydrogen emission. Gliese has prepared a list of fifteen stars in this category which are in need of observations.

In general, it can be said that there is an urgent need for determination of trigonometric parallaxes of stars of extremely low luminosity. These stars, very late type M dwarfs, sub-dwarfs, and white dwarfs, are too faint to be observed with the telescopes now being used for parallax work.

Recent developments in telescope design have made it possible to build a reflector which has a minimum amount of flexure and a restricted field, free from coma. Such a telescope, with provisions for collimation, guidance, plate transport and timing done automatically, should lead to parallax determinations of greater accuracy than has so far been obtained with the conventional refractor. With an aperture of 60 inches, such a telescope would make it possible to obtain parallaxes of stars as faint as the 18th magnitude. The need of such an instrument appears to be critical, as expressed in resolutions at two recent conferences, the Conference on the Cosmic Distance Scale at the University of Virginia in April 1956, and the Conference on Double Stars at Victoria, B.C. in August 1956.

It also appears important to consider instrumental developments for automatic measurements of the photographic plates, using methods of recording which would make the data readily available for analysis by means of high-speed digital computers.

Among the topics suggested for discussion at the Moscow meeting are the following:

1. A re-endorsement of the recommendation passed by the Commission at the Dublin meeting in regard to urging observatories with large reflectors (40-inch and over) seriously to consider a programme of determination of trigonometric parallaxes for faint stars.

2. The organization of a laboratory having automatic measuring machines and a high-speed electronic computer to undertake the measuring of parallaxes for institutions willing to take parallax plates, but not in a position to measure or reduce them.

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3. Methods of identifying faint stars of interest to parallax observers.
4. New determinations of trigonometric parallaxes for nearby stars and for very bright stars for which no trigonometric parallaxes are available.

SPECTROSCOPIC PARALLAXES

Only one report has been received from members of this Commission. Morgan reports that work on the determination of spectroscopic parallaxes has been interrupted temporarily at the Yerkes-McDonald Observatories for detailed examination of the calibration problem. Unpublished results by Strömngren and Crawford now indicate that a satisfactory solution of the calibration problem for stars of classes O, B and A can be completed by the end of 1958. It is expected that the spectroscopic parallax program will be resumed within the next year.

PROPER MOTIONS

The following report should be supplemented by reference to the reports of Commissions 8, 23, 32, and 33, all of which report on proper motions.

Miss Jenkins has requested a correction to be made in connexion with the last report of this Commission, which stated that Yale Catalogue Zones $+60^\circ$ to $+90^\circ$ were being prepared for the printer. Actually, the plates in the declinations $+60^\circ$ to $+85^\circ$ have not yet been measured. The plates in the zone $+50^\circ$ to $+60^\circ$ have been measured at the Watson Scientific Computing Laboratory and the work on deriving proper motions from these measurements and the older catalogues of this zone is now approaching completion.

Luyten reports that he expects to complete before the General Assembly the Bruce proper motion survey, begun some thirty years ago. He states that the survey has produced some 85 000 stars in the southern and 17 000 stars in the northern hemisphere, mostly brighter than the 15th photographic magnitude and with motions larger than 0.05 annually. A catalogue of 1849 stars with proper motions exceeding 0.5 annually and a catalogue of 9867 stars in the southern hemisphere with motions larger than 0.2 annually have been published. The publication of the last catalogue was made possible by a subvention from the I.A.U.

He also reports the determination of proper motions for more than eighty-five faint blue stars, down to the 18th magnitude; these motions indicate that the large majority of the stars are distant coronal stars with absolute magnitudes brighter than $+3$.

Alden reports that relative proper motions have now been derived for 369 long-period variables of which 306 are from McCormick plates and sixty-three from Yale plates on southern variables. Another undertaking by the McCormick Observatory is a study of the proper motions of approximately 100 stars of spectral type R.

A communication received from A. N. Deutsch on proper motion studies is reproduced in full:

1. *Papers related to the problem of catalogues of faint stars using galaxies for the determination of absolute proper motions:*

(a) A Catalogue of 1508 extra-galactic nebulae in 157 areas of the sky in the declination zone from $+90^\circ$ to -5° selected for the determination of stellar proper motions, by A. N. Deutsch, V. V. Lavdovsky and N. V. Fatchikhin (*Pulkovo Bull.* **154**, 1955).

Observations with the Pulkovo normal astrograph were used for this catalogue. 609 galaxies were found suitable for precise astrometrical measurements.

(b) On direct reference of CFS stars to extra-galactic nebulae, by E. J. Bugoslavskaya, D. K. Karimova and V. V. Podobed (*Trans. of the Eleventh U.S.S.R. Conference on Astrometry*, 1955).

The advantages of direct reference of the faint CFS stars to galaxies were discussed and a list of supplementary stars in areas with galaxies was given.

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(c) On the reference of CFS stars to extra-galactic nebulae by means of small field astrographs, by A. N. Deutsch (*Trans. of the Eleventh U.S.S.R. Conference on Astrometry*, 1955).

A list of fundamental CFS stars to be photographed for their reference to galaxies via the background stars of magnitude 13 to 14 is given.

(d) The accuracy of determining the positions of extra-galactic nebulae on the photographs obtained with the large astrograph of the Sternberg Astronomical Institute, by D. K. Karimova (*Publ. Sternberg Astr. Inst.* 27, 1956).

The average mean error, $\pm 0''.15$, of the positions of nebulae exceeds twice that for the stars of magnitude 12 to 13.

(e) Among the papers in *Trans. of the Twelfth U.S.S.R. Conference on Astrometry* (in press) are:

Preliminary results of the photography of galaxies for CFS purposes with the 400 mm astrograph of the Central Observatory of the Ukr.S.S.R. in Goloseevo, by I. V. Gavrilov, I. G. Koltchinsky and A. B. Onegina.

Report of sub-commission on photographic astrometry for 1953–55, by A. N. Deutsch.

Comparison of the positions of extra-galactic nebulae on plates obtained with the 15-inch Moscow and Pulkovo normal astrographs, by K. N. Jakhontov.

(f) Among the papers contained in the *Trans. of the Thirteenth U.S.S.R. Conference on Astrometry* (in press) are:

The results and perspectives of astrometrical observations of galaxies by means of small field astrographs, by A. N. Deutsch.

The wide-angle astrograph of the Sternberg State Astronomical Institute, by E. J. Bugoslavskaya.

Photographic astrometry in Shi-Shan (Zô-Sè) Observatory, by Li-Hen.

The progress of first epoch observations for areas containing fundamental stars and galaxies is as follows:

Pulkovo. The photography of 157 areas in the zone from $+90^\circ$ to -5° is coming to an end. No less than three photographs are obtained for each area. The first epoch will be completed before the spring of 1958. Photography of 240 areas with fundamental CFS stars in the centre is continued.

Moscow. By means of the large astrograph ($D=380$ mm, $F=6.4$ m) photography of areas containing brighter galaxies was continued, and photography of areas with fundamental CFS stars was begun. Photography of areas with galaxies by means of a wide-angle astrograph ($D=230$ mm, $F=2.3$ m) was also started.

Kiev (Goloseevo). Photography of galaxies and fundamental CFS stars was continued by means of the astrograph ($D=400$ mm, $F=5.5$ m).

Tashkent. Control photography of areas with galaxies selected from NGC in the declination zone from -5° to -25° . First epoch observations of areas with galaxies in the declination zone from $+90^\circ$ to -25° is continued.

Bucharest. Photography of areas with brighter galaxies and fundamental CFS stars was continued by means of an astrograph ($D=380$ mm, $F=6.1$ m).

Shanghai (Zô-Sè). Photography of brighter galaxies and fundamental CFS stars is continued by means of an astrograph ($D=400$ mm, $F=6.9$ m).

The Bucharest and Shanghai Observatories share the zone from $+90^\circ$ to -35° .

Toulouse. Photography of galaxies in the zone from $+90^\circ$ to -5° by means of normal astrograph was started.

Thus observation of galaxies in the northern part of the sky from $+90^\circ$ to -5° is carried out by means of three normal astrographs (Pulkovo, Tashkent and Toulouse) with focal ratio 1/10.

In regard to the southern hemisphere, the following was revealed from the correspondence with other observatories (substantial aid was rendered in this correspondence by P. Couderc, President of Commission 23, who distributed a special circular letter). Besides the normal astrograph in Tashkent, the San Fernando Observatory is willing to observe the zone from -5° to -25° .

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The Santiago (Chile) Observatory has consented to carry out for control purposes direct observations of areas with galaxies in the zone from -25° to -90° selected from NGC.

The same zone may also be photographed by the Santiago Observatory, as well as by the Cordoba (Argentina) and Perth (West Australia) Observatories. If one of these observatories would also consent to observe the zone from -5° to -25° , it would be possible to obtain photographs of areas with galaxies by means of no less than three normal astrographs.

The fundamental CFS stars in the zone from -5° to -25° will be selected in the nearest future, while those in the zone from -25° to -90° will be chosen after the areas with galaxies for this zone have been established.

2. *Investigations of motions in associations:*

(a) Expansion of Association Cepheus II, by N. M. Artiukhina (*Publ. Sternberg Astr. Inst.* **27**, 1956).

From the investigation of proper motions of sixty-one stars it was concluded that the expansion of the association is real. (A paper by N. M. Shakhovskoj, 'Investigation of stellar association Cepheus II', in which the proper motion data are not used, is also published in the same volume.)

(b) Stellar motions in associations, by A. I. Lebedinsky and O. V. Khorosheva (*Astr. J. Moscow*, **33**, 1956).

According to investigations of twenty-five stars in the Lacerta association, of seventeen stars in Perseus II, and seventeen stars in Cepheus II associations, a mutual motion of two groups of stars in the same direction, but not an expansion, has been discovered.

(c) On stellar motions in Cepheus II association, by O. V. Khorosheva (*Astr. J. Moscow*, **33**, 1956).

Investigation of sixty stars in this association confirmed the preceding conclusion.

(d) Investigation of proper motions of stars in the region of the Orion association, by G. V. Akhundova (Efimova) (*Pulkovo Bull.*, Dissertation, in press).

Proper motions of about 400 stars in the region of the Orion association were determined in Pulkovo from an extensive observational material. No expansion was discovered. The Trapezium of Orion stars also did not reveal any expansion with observational errors (see P. P. Parenago, *Publ. Sternberg Astr. Inst.* **25**, 1954).

3. *Investigation of motions of clusters and of the motions of stars in their vicinity:*

(a) Determination and investigation of proper motions of stars in the North Pole region of the Galaxy, by N. M. Artiukhina (*Publ. Sternberg Astr. Inst.* **26**, 1955).

Photographs of Coma Berenices and stars in its surroundings, obtained at Moscow, Pulkovo, Tashkent and Oxford Observatories, served as the main observational material. A catalogue of relative proper motions of 1073 stars is given.

(b) Proper motions of stars in the neighbourhood of the M71 and the H II 20 clusters, by N. M. Artiukhina (*Publ. Sternberg Astr. Inst.* **27**, 1956). A pair of plates obtained with the 38 cm Moscow astrograph with a time-interval of forty years was used and absolute proper motions of the clusters were obtained. A catalogue of proper motions of 1372 stars is listed.

(c) Determination of proper motion of the cluster NGC 6910, by A. B. Onegina (*Bull. Central Obs. Acad. of Sci. Ukr.S.S.R.* **1**, 1956).

The proper motion of the cluster was determined from two pairs of plates obtained by means of the Pulkovo normal astrograph with time intervals of thirty-two years. A catalogue of proper motions of 129 stars is listed.

(d) The galactic star cluster NGC 6705, by P. Savitzky (*Astr. Circ. U.S.S.R.* **165**, 1955). This is a repetition of the work of 1949. But the plates used this time have a larger difference in epoch (fifty-five years), and a larger number of stars (1617) was measured. Four pairs of plates were used. The proper motion of the cluster, its distance and diameter were obtained.

(e) Investigation of motions of open star clusters, by N. M. Bronnikova (*Pulkovo Bull.*, in press). A summary and a critical survey of all, up to the present time, known proper motions of open clusters are listed. From measurements of several pairs of plates with differences in epoch of about 40 years, obtained with the Pulkovo normal astrograph, proper motions of four clusters, NGC 1513, 1960, 2099, and 6705 were determined. The influence of

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the selection of different systems of reference stars is discussed. A catalogue of proper motions of 4000 stars is given (*Pulkovo Publ.*, in press).

(f) V. V. Lavdovsky (Pulkovo) has finished the measurements and the reduction of proper motions and magnitudes of 20 000 stars in the regions of stellar clusters NGC 129, 457, 581, 752, 869, 884, 1907, 1912, 2168, 6885, 7092 and 7209. The catalogue is ready for print.

4. Separate papers:

(a) Investigation of proper motions of planetary nebulae NGC 6720 and stars in its surroundings, by A. A. Latypov (*Publ. Obs. Astr. Tashkent*, Ser. II, 5, 1957).

The proper motion of the nebula was determined from six pairs of plates, obtained by means of the Tashkent and Pulkovo normal astrographs with an epoch difference from forty-four to fifty-five years. A catalogue of proper motions of 431 stars is listed.

(b) Determination of the precession constant from the proper motions of stars in their plane, by P. I. Bakulin (*Publ. Sternberg Astr. Inst.* 26, 1955).

This investigation is based upon the proper motions of 870 stars, mainly of B0–B5 spectral classes and super-giants. Proper motions were improved on the GC system. Positions and improved proper motions of 959 stars are listed. The obtained corrections of Δp and ΔE agree very well with the results of the majority of former investigations.

(c) Near-polar star with large proper motion, by H. I. Potter (*Astr. Circ. U.S.S.R.* 181, 1957). Stellar magnitude of this star is 11.8, centennial motion 28"33.

(d) On the change of proper motion of the Star Gr. 1830, by A. B. Onegina (*Astr. Circ. U.S.S.R.* 167, 1956).

From measurements of plates obtained by means of the Pulkovo normal astrograph and a comparison with the earlier data, the author concluded that the proper motion of this star increases by 0"02 during forty-five years.

(e) Determination and investigation of proper motions of stars in η Cygni region, by Z. I. Kadla (*Pulkovo Bull.* 20, no. 154, 1955).

A catalogue of absolute proper motions of 1746 stars is listed.

(f) Photography of first epochs of variable stars by means of the Moscow 380 mm astrograph is continued.

(g) Investigations of proper motions in the surroundings of ten bright stars, by A. B. Onegina (*Bull. Central Obs. Acad. of Sci. Ukr.S.S.R.* 2, no. 1, in press).

5. Studies on binaries discovered from proper motion observations:

(a) On wide stellar pairs, by P. G. Kulikovskiy (*Astr. Circ. U.S.S.R.* 171, 1956).

173 systems with known parallaxes and radial velocities and over 1000 systems with common proper motions were investigated. It was shown that wide pairs do not represent any particular kinematic group.

(b) On the group motion of stars, by P. Savitzky (*Astr. Circ. U.S.S.R.* 174, 1956).

Among 5000 stars for which the proper motions were found in the regions of some open star clusters, 2% were binaries and 0.7% triple systems.

(c) Binary and multiple stars found in 115 northern Kapteyn areas from their common proper motions, by A. N. Deutsch (ready for press).

Approximately 300 binary and multiple stars were discovered among 10 000 stars with proper motions larger than 0"015 in 115 Kapteyn areas. Their main characteristics were considered statistically.

(d) Wide pairs and multiple systems found according to proper motions of stars contained in McCormick Observatory catalogues, by A. B. Onegina (in press).

Dr Akbar Ali reports from the Nizamiah Observatory that a comparison was made between the Oxford astrographic zone +32° and +33° and those in the Potsdam catalogue, for the purpose of obtaining proper motions. A list of 282 proper motions has been published (*J. d. Obs.* 39, 9–10, 1956.) Two more lists, containing the results of comparing 59 regions comprising 1100 proper motions with probable errors of $\pm 0"010$, are nearly ready for publication.

König at Heidelberg has published the proper motions of ninety-nine stars in the vicinity of 17 Comae (*A.N.* 283, 1, 1956). He is continuing the proper motion studies

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from comparisons of old and new plates taken with the Bruce telescope, concentrating on stars with yearly proper motions larger than 0.05 , and is particularly interested in high velocity stars. He wishes that further information about these stars, in the form of magnitudes and spectral types, be obtained by astronomers with more powerful telescopes.

At Stockholm first-epoch plates are now practically finished, in a program aimed at the determination of proper motions in selected regions near the galactic equator. P. O. Lindblad has measured two pairs of plates of M 37 for proper motions, both manually and with the automatic measuring machine at the Watson Scientific Laboratory. The automatic machine was found to have a mean error of $\pm 0.6\mu$ for one setting on a star image, or six times smaller than the mean error of a manual setting.

Paloque writes in regard to the Fourth Toulouse Catalogue, which has been reported in previous progress reports of this Commission. The first 10^h of right ascension have now been published. The catalogue contains proper motions of standard stars between declinations $+4^\circ$ and $+12^\circ$. The proper motion study of variable stars from Plaut's list within the zone is also being continued. A study of the displacement of the photographic images and the deformation of the emulsion of the photographic plate, for the purpose of evaluating the precision of proper motion data from photographs, has been published in *Ann. Obs. Toulouse*, xxv.

Vasilevskis reports that the proper motions of all AG stars in the northern hemisphere will eventually be determined by a repetition of AG Catalogues and by referring them to the frame of galaxies through the Lick programme.

At the Lowell Observatory second-epoch plates are now being taken with the 13-inch telescope to match the plates taken in connexion with the search for Pluto. The survey covers the entire sky north of declination -40° to a limiting magnitude of 17 (phot.). With a time interval of nearly thirty years, the yearly proper motions are determined with a mean error of ± 0.07 . It has tentatively been decided to publish all proper motions larger than 0.3 /year.

A study has been made by Strand of the Orion Nebula Cluster, based upon plates taken with the Yerkes 40-inch refractor. From ten pairs of plates with fifty years' time interval, the yearly proper motions have been determined with an accuracy of ± 0.0006 . The study shows an expansional age of the cluster equal to 300,000 years.

Among the topics suggested for discussion at the Moscow meeting are the following:

1. The question of a repetition of the old Bruce plates for the sake of obtaining at least preliminary values of absolute proper motions referred to faint galaxies.
2. Since the Lick programme promises to yield the proper motions of stars down to a photographic magnitude of 18, it becomes impossible to measure all the faint stars and a careful criterion of selection has to be worked out. Vasilevskis urges the Commission to initiate a discussion on this problem and work out some general criteria of selection, possibly in co-operation with Commission 33.
3. Means of extending the Lick programme to the southern hemisphere.

K. Aa. STRAND

President of the Commission

Report of Meeting. 14 August 1958

PRESIDENT: K. Aa. Strand.

SECRETARY: O. G. Franz.

TRANSLATOR: Mme Zd. I. Kadla Mikhailova.

The President opened the meeting with a brief report on the present state of parallax programs. While Allegheny and Cape are continuing their general programs the Yale station at Mt Stromlo is now getting under way on a similar program. Sproul is continuing its special program on stars with large parallaxes and on binaries for parallaxes and mass-

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ratios. Except for finishing up nearly completed series no further work is contemplated in this field at Yerkes at the present time. He reported about plans to initiate a small parallax program of stars with apparent magnitudes of 15 to 16, using the 40-inch reflector at the Flagstaff Station of the U.S. Naval Observatory. The purpose of this study is to gain experience in regard to the planning of a large astrometric reflector with an aperture of at least 60 inches.

The President next called attention to the publication (*Astr. J.* 63, 149, 1958) of the proceedings of 'The Cosmic Distance Scale Conference', which took place in April 1956 at the University of Virginia. Several of the papers should be of particular interest to the members of the Commission, as well as the two resolutions passed by this conference.

Luyten asked the Commission to draw up a resolution to accelerate the construction of a large astrometric reflector. The President suggested that the Commission affirm the resolution passed by the Virginia conference. The Commission unanimously adopted the following recommendation (resolution no. 41):

We affirm the resolution adopted by the Virginia Conference on the Cosmic Distance Scale held in 1956 which reads: One of the most urgent needs of astronomy is the determination of the distances of stars fainter than the thirteenth magnitude. Such stars are too faint to be observed with long-focus refractors, also, existing reflectors were not designed to meet the astrometric requirements. The conference therefore recommends that an engineering study be made with the aim of producing a design for a reflector that will be suitable for the above mentioned purpose. A Cassegrain type of reflector is indicated, with the secondary mirror more rigidly mounted than is customary. The aperture should be at least 60 inches so that stars of the eighteenth magnitude can be observed with exposure times not exceeding about twenty minutes. The instrument should be located at a site with a climate that is reasonably uniform throughout the year with regard to percentage of clear sky and quality of seeing. Such an instrument will be usefully employed for many decades.

The next topic brought up for discussion was proposed by Wagman, who had suggested that a plan be discussed to establish a laboratory having automatic measuring machines and a high-speed electronic computer to undertake measuring and reducing of parallax plates obtained at observatories which are willing to take such plates, but do not have the staff to carry out measurements and reductions. The President pointed out that a program has been written at Dearborn Observatory to carry out on an IBM-650 electronic computer the reduction of fifty plates, with 200 images. The program includes the computation of the parallax factors, the parallax and proper motions with their mean errors. He furthermore expressed his belief that observatories hitherto not engaged in parallax work would probably do so if they were relieved from measuring and reducing the plates. After some discussion between A. N. Deutsch, Luyten, Bugoslavskaya, and Strand about the type of measuring machine most useful for this purpose, the President suggested that no resolution concerning the organization of such a laboratory be passed at this meeting. It was agreed that a complete report should be furnished at the next I.A.U. meeting on all progress made in connexion with the development of automatic measuring facilities including Vasilevskis' project.

With regard to the problem of identification of faint stars of interest to parallax observers Gliese remarked that in 1955 Beyer had called attention to the fact that he had not been able to identify all objects contained in Kuiper's *Catalogue of Stars* with parallaxes exceeding $0''.10$. Gliese suggested that an accuracy of $1''$ in right ascension and $0.1''$ in declination for stars with parallaxes exceeding $0''.050$ should be sufficient, since about 50% of these stars have proper motions exceeding $0''.50$ and can therefore easily be identified. Luyten pointed out the difficulties in publishing finding charts for large numbers of stars. In reply to a question by the President, whether or not the Palomar Sky Atlas could be used for identification purposes, Luyten pointed out that co-ordinates of faint stars given with respect to the edges of the charts would be impractical since the prints of these charts might not be centered accurately enough. He suggested, however, the possibility of giving rectangular co-ordinates of a faint object with respect to the nearest BD star.

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In reply to a question about the Greenwich parallax program, Hunter reported that the 26-inch Greenwich refractor, dismantled in 1939, has now been re-erected at Herstmonceux and that he had secured the first parallax plates with the instrument the night before he left for Moscow. The new program would include all accessible members of Gliese's list of stars closer than 20 pc, together with those nearby objects contained in the Yale catalogue for which only one parallax has yet been secured, or where existing observations are discrepant. Stars on the old Greenwich program would be retained if of sufficient interest.

The President remarked that many of the brightest stars in the sky had been observed in the early period of photographic parallax work, and the results had not attained modern precision. He expressed the hope, particularly now that Greenwich was restarting its parallax program, that observers would reinstate such stars on their working lists. He recommended the use of an objective grating in connexion with rotating sectors to achieve the necessarily large magnitude reductions.

Parenago reported that he had made a study of parallax desiderata and suggested that the list be included in the minutes of the meeting. This was approved. The stars in the following list are identified by their number in the 1952 *General Catalogue of Stellar Parallaxes* or by their co-ordinates for 1900.0:

Stars with a great dispersion in their parallax determinations for which new determinations are needed for improvement of absolute magnitudes, tangential-velocities and masses (for double stars): 7, 106, 177, 184, 186, 189, 233, 274, 287, 328, 394, 450, 456, 462, 464, 479, 488, 541, 543, 558, 560, 603, 611, 647, 663, 681, 721, 724, 734, 757, 763, 805, 865, 905, 952, 1076, 1084, 1164, 1280, 1314, 1365, 1370, 1380, 1393, 1539, 1627, 1813, 1954, 2037, 2065, 2074, 2146, 2192, 2247, 2298, 2306, 2312, 2323, 2345, 2361, 2366, 2429, 2601, 2614, 2625, 2665, 2738, 2974, 2978, 3010, 3011, 3039, 3047, 3153, 3200, 3206, 3285, 3300, 3343, 3373, 3483, 3490, 3511, 3552, 3604, 3636, 3684, 3740, 3773, 3873, 3855, 3857, 3860, 3884, 3916, 3962, 3964, 3996, 4042, 4063, 4093, 4109, 4127, 4165, 4239, 4275, 4296, 4371, 4722, 4747, 4762, 4829, 4868, 4906, 4959, 5070, 5258, 5329, 5349, 5357, 5377, 5404, 5493, 5528, 5532, 5539, 5561, 5569, 5587, 5631, 5640.

Stars having large parallaxes based only on a single determination: 246, 522, 662, 791, 873, 966, 992, 1238, 1484, 1892, 2213, 2238, 2291, 2292, 2316, 2640, 2642, 2699, 2810, 2933, 2943, 2949, 2976, 3079, 3112, 3124, 3547, 3823, 4205, 4380, 4539, 4652, 4709, 4947, 5092, 5339, 5397, 5434, 5617, $13^{\text{h}} 15^{\text{m}} 5 + 48^{\circ} 19'$, $21^{\text{h}} 38^{\text{m}} 0 + 82^{\circ} 36'$.

Stars having small parallaxes but for which additional determinations are needed for improvement of absolute magnitudes and masses (for double stars): 344, 1373, 1475, 2200, 2337, 2423, 2575, 3063, 3246, 4495, 4647, 4701, 4812, 5580, 5716, ($17^{\text{h}} 42^{\text{m}} 6$, $+25^{\circ} 48'$) (Albitzky star, HD 161817).

Stars for which a check on existing determinations is needed: 9, 352, 1231, 2266, 4222, 5625.

C. O. R. Jaschek then presented a list of metallic-line stars and of peculiar stars which are much in need of parallax determinations to establish the absolute magnitudes of these objects. The expected range of the parallaxes is between $0''.020$ and $0''.040$. So far about 200 stars of these types are known, but only about eighty of them have good proper motions. The President pointed out that a large plate material will be needed to establish these parallaxes with some certainty, but attempts should be made to secure observations of at least a representative group of these objects.

Upon request Brouwer reported that the National Science Foundation still lends support to the project of building a 20-inch astrograph in the southern hemisphere. Although the funds have not yet been secured, they would probably be available by next year. The search for a good site for the instrument has been completed in Australia and the location of the station has been selected.

The Commission unanimously adopted the following resolution (no. 40):

Commission 24 notes with satisfaction the progress of the site testing in Australia as reported by Dr Brouwer. The present importance of building this instrument cannot be over-emphasized. Attention should also be called to the urgency of this work. It is hoped that funds for this instrument can be provided without delay.

COMMISSION 24

Morgan reported briefly on the situation with regard to spectroscopic parallaxes. He pointed out that the amount of effective work concerning spectroscopic parallaxes has almost gone to zero. This however is only a temporary phenomenon, not a permanent decline. The reasons for this temporary interruption are the following: Twenty years ago it was found that the calibration of the system of spectroscopic parallaxes was unsatisfactory. There are great practical difficulties in translating the easily observed effects in the spectra into actual luminosities. However, the situation has now improved markedly. Great advances have been made through work, partly theoretical, partly observational, done by Strömgren who showed that observational parameters pertaining to the evolutionary stage can be considered in addition to spectral type and luminosity. These results are contained in Strömgren's Halley lecture (*Observatory*, 78, 137, 1958). The present situation appears to be as follows: the problem of calibrating spectroscopic parallaxes for early type stars has in principle been solved. In the next years large programs of spectroscopic parallax determinations can be planned and embarked upon. So far, however, only early-type stars can be considered.

In the ensuing discussion B. Lindblad agreed with Morgan's initial statement only as far as work of high precision is concerned. He pointed out that much effective work is being done at the present time giving results of rather statistical value with larger dispersion in the resulting absolute magnitudes. He suggested that possibly only work of the highest accuracy, leading to small dispersions in the resulting luminosities, should be defined as spectroscopic parallax work.

The President then proceeded to the discussion of problems related to proper motion work. Luyten reported that a catalogue of stars in the northern hemisphere with proper motions exceeding $0''.2$ was being prepared. In order to permit publication of this catalogue the following financial resolution was unanimously agreed to by the Commission (resolution no. 39):

Commission 24 requests a subvention of \$1000 to aid with the publication of a catalogue of stars in the northern hemisphere with proper motions exceeding $0''.2$.

This would be similar to the catalogue for the southern hemisphere, containing nearly 10,000 stars, for the publication of which a subvention was received at the Dublin meeting. The northern catalogue will probably contain some 7000 to 8000 stars.

The Commission then approved the *Draft Report* and the meeting was adjourned.