

8. COMMISSION DE L'ASTRONOMIE DE POSITION

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It is with deep regret that we record the death of H. S. Spigl on 20 August 1962. H. S. Spigl, member of our Commission from Perth, Australia, worked industriously to restore his Observatory to an active status in positional astronomy. It is hoped that his efforts will bear fruit in the future.

This report is based largely on responses to letters sent out in June and October 1963 to all members of the Commission and to others engaged in researches that are of interest to the Commission. The response to both letters was gratifying and I wish to thank all of those who were kind enough to reply. In view of the difficulty of condensing over 60 individual letters into a single report, it is sincerely hoped that all errors, omissions, and inaccuracies will be made known in time for proper note to be made of them at the first session of this Commission in Hamburg.

The excellent bibliography appearing at the end of this report is due to the efforts of Drs van Herk, Slaucitajs, and Zverev, members of the Organizing Committee.

Drs Lévy (Chairman), Atkinson, and Zverev, members of the Organizing Committee, have agreed to serve as a Membership Committee for the Commission. Their recommendations will be made known at a later date.

The text of Resolution no. 1 adopted at Berkeley, along with a personal note, was transmitted to Prof. M. Correia de Barros, Reitor da Universidade do Porto, on 18 October 1961. A very favorable and courteous reply was received.

PROGRESS OF OBSERVATIONAL PROGRAMS ENDORSED AND ORGANIZED BY COMMISSION 8

AGK3R and SRS Programs. Details of progress of these programs will be reported by the Working Group on Photographic Catalogues of Stars to the Ninth Magnitude.

Double Stars. Zverev's list of double stars unsuitable for measurement on photographic plates has been extended to the south pole at the U.S. Naval Observatory. Stars from this list $+30^\circ$ to $+90^\circ$, are under observation at Strasbourg. The southern stars in this list will be observed by the Pulkovo-Santiago observers working in Chile.

A list of nearly 3000 close double stars selected by van Herk is under observation with the seven-inch transit circle at Washington.

Latitude Stars. A Working Group consisting of Drs Fedorov (Chairman), Atkinson and Melchior is making a study of the accuracy requirements for meridian circle observations of these stars. A report on their findings is expected at Hamburg. In this connection, a resolution adopted at the 16th Astrometric Conference U.S.S.R. laid plans for organizing meridian circle

observations of these stars as well as of bright, double, and PZT stars at observatories in the U.S.S.R.

The latitude stars are now under observation at the Engelhardt Observatory. The Uccle Observatory may soon be in a position to take part in the observations of stars used by the latitude services.

The determination of the declinations of 2100 stars of 12 zenith telescope programs was completed at Golosseyevo during 1962. This Observatory published a catalogue of declinations of 64 stars of the Kasan zenith telescope program during 1961 (45). (Please note that all keys to references refer to articles listed in the Bibliography.)

A catalogue of the results of observations 1949–1955, made with the U.S. Naval Observatory six-inch transit circle, will contain positions of the stars in the current list of the International Latitude Service, the Herstmonceux, Ottawa, Richmond and Washington PZT stars, and the Blaauw stars.

New proper motions are being computed by Melchior for the 440 stars in the lists of the ILS. Positions of these stars based on observations made at Uccle 1952–57, were published in 1959 (7).

Photographic Zenith Tube Stars. A program for relating the positions of 939 PZT stars to the system of the FK4 is in progress with the seven-inch transit circle at the U.S. Naval Observatory. These stars were selected from the Hamburg, Herstmonceux, Mizusawa, Moscow, Neuchâtel, Ottawa, Pulkovo, Richmond, Tokyo, and Washington PZT lists.

It should be noted that all stars of the Mount Stromlo PZT list were deliberately included in the Southern Reference Star list. These stars will be observed during the SRS program.

The observations of the Hamburg PZT stars made at Bergedorf during the AGK3R program were included among the observations of the latter stars sent to Washington. Observations of stars from several PZT lists were made at Herstmonceux during the AGK3R program.

A discussion of the results of observations made at Tokyo of stars in the Mizusawa, Richmond, Tokyo, and Washington PZT lists was published by Yasuda (62). The program of remeasuring and recalculating the Ottawa PZT observations 1952–60, still continues.

Blaauw and Parenago Stars. All programs of observations of these stars mentioned in the last report have been completed except the one at Washington. Final reductions of the Blaauw stars observed at Besançon, Herstmonceux, and Ottawa are in progress.

KSZ and FKSZ Stars. All stars in these lists were included in the AGK3R and SRS star lists. Preparations are under way for absolute observations of the FKSZ stars with the Wrocław Observatory's vertical circle and transit instrument.

Observations of the KSZ stars in the zone outside the AGK3R program were completed at Pulkovo, Nikolayev, Kasan, Tashkent, Kiev, and Odessa. All reductions are in progress. Final reductions are also in progress for the KSZ stars $+10^\circ$ to -10° , made at Bucharest.

Work has been started at Pulkovo and Nikolayev on the compilation of a fundamental catalogue of KSZ stars $+90^\circ$ to -30° .

Bright Stars, Fundamental Stars, Sun, Moon, Planets, and Asteroids. All of these objects north of -30° are included in the program of fundamental observations started during October 1963 with the U.S. Naval Observatory six-inch transit circle. Observations of the Moon, outer planets, and the four brightest asteroids are being continued at Tokyo. This program includes all bright stars in the Tokyo SRS zone, -10° to -30° , as well as fundamental stars between 0° and -35° , near the zenith, and in the northern sky. The determination of absolute declinations of the major and minor planets and fundamental stars is being continued with the Munich vertical circle.

In connection with the determination of absolute positions of the stars, meridian observations of the Sun and major planets are customarily made at Nikolayev, Pulkovo, Tashkent (α only) Moscow, Golosseyevo (δ only), and Kasan (δ only of Venus and Mars). The use of a Sukharev objective mirror filter in observing the Sun has greatly reduced the accidental errors of such observations. (This device is described by Sukharev on page 93, *New Instruments and Methods in Meridian Astronomy*, Moscow-Leningrad, 1959.) Duma (16) has investigated the use of observations of the Moon for determining the equator point.

All bright stars north of $+30^\circ$ are included in the current program of the Strasbourg Observatory and those between $+5^\circ$ and -10° are included in the Bucharest commitment to the SRS program. The Cape Observatory has included all bright stars in a fundamental program being conducted in conjunction with its SRS program.

The Cooke transit circle at Herstmonceux is engaged in a program of fundamental observations of FK4, FK4 Supp., and 6000 other stars with known radial velocities. This program also includes observations of the Sun, planets, and the four brightest asteroids.

Three extensive series of observations (2, 3, 4, 86, 107, 108) of bright and fundamental stars are being carried out by Russian and Chilean observers working at Santiago, viz., (a) absolute observations by Pulkovo methods of 1200 bright and faint fundamental stars, $+40^\circ$ to -90° , with the large transit (under construction) and the new photographic vertical circle designed by Zverev; (b) observations of over 700 bright stars, $+40^\circ$ to -90° , with a Zeiss transit brought from Pulkovo; and (c) differential observations with the Santiago Repsold meridian circle of over 1700 bright stars and 11504 SRS stars in the zone -25° to -90° . For the last program a large number of fundamental stars are being observed for the purpose of investigating the system of the instrument. The objective of the first two programs is the establishment of a relationship between the systems of the northern and southern fundamental stars. It is also planned to make photographic observations of the galaxies with a new meniscus astrograph now under construction.

Astrolabes. This report is undoubtedly incomplete as it contains information on the work of only a few of the astrolabes known to exist.

The Paris astrolabe is continuing its series of observations of the FK4 and FK4 Supp. stars. Since March 1963 this Observatory has had at its disposal the results from an astrolabe situated in Haute-Provence. Observations of 270 FK4 and FK4 Supp. stars are also being made with an astrolabe at Besançon. Systematic observations of 303 fundamental stars, $+30^\circ$ to $+87^\circ$, are in progress with a Danjon astrolabe at Pulkovo.

Experience, during the course of observing 200 stars, $+25^\circ$ to $+80^\circ$, with a Danjon astrolabe at Herstmonceux indicates the necessity of maintaining the instrument at night temperature if fundamental results are sought. Variations of the prism angle are thereby reduced. This instrument will be sent to the Cape Observatory for a three year program beginning April 1964.

The U.S. Naval Observatory astrolabe is being installed at Richmond, Florida. The São Paulo Observatory expects the delivery of a new astrolabe early in 1964. In the meantime, an astrolabe on loan from the U.S. Naval Observatory is being used.

The first catalogue of results with the Paris astrolabe was published in 1961 (25). A comparison of these results with other recent observations was made by Guinot (24). The astrolabe results obtained at Curaçao were discussed and published by Scheepmaker (56).

Other Star Catalogues Published and in Preparation. The First Greenwich Catalogue for 1950.0 containing the results of observations made with the Airy transit circle 1931–1938 is nearly ready for publication. Proper motions were computed for all non-N₃₀ stars.

The Second Cape Catalogue for 1950.0 is nearly completed. New proper motions were computed for many of the stars.

A catalogue of fundamental positions observed 1949–1955, with the U.S. Naval Observatory six-inch transit circle will be published during 1964. In addition to the FK4 and FK4 Supp. stars north of -30° and the Blaauw, PZT, and latitude stars mentioned earlier, this catalogue will contain positions of the Sun, Moon, planets, four asteroids, and a spaced list of 3087 stars in the zone $+35^\circ$ to $+50^\circ$. The formation of a catalogue of positions of the Sun, Moon, planets, asteroids, and fundamental stars observed 1956–1962 is in progress.

Meridian circle positions of 1570 stars and 8 planets observed at Munich were published by Heintz (29).

Tokyo observations of the Moon, outer planets, and four brightest asteroids made during 1961 were published (61). Those for 1960 and 1962 as well as declination observations 1951–1959, are being prepared for publication. A catalogue of 4135 stars to the 8.9 magnitude, $+5^\circ$ to -5° , was published by Tuzi (58).

Catalogues of the southern faint fundamental stars, the La Plata E-zone, and absolute declinations of 157 FK3 stars are being prepared at La Plata.

All meridian circle observations made at Paris during the past 15 years are now being compiled into catalogues. The results of observations of the intermediary stars $+5^\circ$ to $+15^\circ$, made at Nice 1912–1914, were published by Fayet (21).

Observations of the FK4, FK4 Supp. and other stars observed at Ottawa in recent years will be ready for publication in about two years.

The compilation of a catalogue of absolute positions of 531 faint and 514 bright stars observed with the large transit instrument and vertical circle at Pulkovo will be completed in 1964. Right ascensions of 122 stars, $+70^\circ$ to $+90^\circ$, observed with the model of the Sukharev horizontal meridian transit were published by Timashkova (82). The discussion of the declination observations of 2367 Backlund-Hough stars made at Melbourne 1928–40, has been completed at Pulkovo. The reductions of the right ascensions are in progress.

The reductions of the declinations of 1792 bright stars -30° to $+90^\circ$, and faint stars -20° to $+90^\circ$, observed with the vertical circle at Golosseyevo are under way. A catalogue of 625 bright stars of the Pulkovo program, observed at Nikolayev, will be completed during 1965.

A catalogue of 90 circumpolar stars observed at Tashkent was completed by Kim Gun-der (77). Observations of 198 stars, $+77^\circ$ to $+90^\circ$, were completed at Kiev and observations of 600 circumpolar stars brighter than 8.5 magnitude were completed at Kharkov. This Observatory is also completing the reductions of observations of 1407 stars, $+79^\circ$ to $+90^\circ$, made during 1909–1914.

Catalogues of right ascensions were compiled from observations made by the Time Services at Pulkovo (71), Nikolayev (75, 76), Leningrad University, Leningrad Institute of Metrology (85, 99), and the Sternberg Institute (8). These catalogues are of high internal accuracy and should contribute heavily to the improvement of the fundamental system. The Pulkovo catalogue is of special interest because it is based on observations obtained with Pavlov's photo-electric transit instrument. This catalogue compares extremely well with results from the astrolabe and other instruments (See Fundamental Catalogues). In addition, Time Service observations are being compiled into catalogues at Irkutsk and Kharkov.

The Odessa Observatory is now determining positions and proper motions for 160 eclipsing variable stars. This Observatory is also reducing observations of the Nikolayev AG stars made during 1930–1935.

FUNDAMENTAL STAR CATALOGUES AND RELATED SUBJECTS

FK4. The Fourth Fundamental Catalogue (FK4) appeared during 1963 (22). This volume represents the outcome of the revision of the FK3 which commenced in 1957. It contains

positions and proper motions for 1535 fundamental stars for the equinoxes and epochs 1950.0 and 1975.0. A description of the method of compiling the catalogue and the average values of the mean errors of the FK₄ system are given in the introduction to the volume. The mean errors of the individual positions and proper motions within the system of the FK₄ are printed for each star in the body of the catalogue.

A detailed report on the formation of the right ascension system of the FK₄ has been given by Gliese (23). The formation of the declination system of the FK₄ as well as the derivation of the individual corrections to the positions and proper motions of the FK₃ will be described in a subsequent publication of the Rechen-Institut. Tables of the systematic differences, FK₄ – GC and FK₄ – N₃₀, due to be published in 1964.

Comparisons of the FK₄ right ascensions with modern observations were made by Guinot (24) and Scott (57). The former included recent results with astrolabes at Paris and Neuchâtel and the Pulkovo photo-electric transit; the latter comparison, in addition to the above results, included a recent program with the U.S. Naval Observatory six-inch transit circle. Both comparisons show a general agreement among modern instruments in indicating that small $\Delta\alpha_s$ and $\Delta\alpha_x$ terms still exist in the FK₄, the latter being most pronounced around 16 hours right ascension in the zone +5° to +7°. It is Guinot's impression that, in general, the individual corrections to the FK₃ were underestimated. The article by Scott includes graphs of the differences, N₃₀ – FK₄, in the forms $\Delta\alpha_s$ and $\Delta\delta_s$ for the epochs 1930, 1950, and 1970. These curves indicate a satisfactory agreement at all epochs between +8° and –3°. South of –3°, the agreement between the two catalogues is not entirely satisfactory at 1930 and becomes worse for the later epochs. A situation of this kind is not favorable for the Southern Astrometric Programs now in progress.

FK₄ Supplementary Catalogue. This catalogue was formed by applying the systematic differences, FK₄ – FK₃, to the 1987 stars of the 'Supplement-Katalog des FK₃,' (FK₃ Supp.). Since none of the FK₄ Supp. stars contributed to the formation of the FK₄ system and since no attempt was made to improve the internal accuracy of their positions and proper motions, the stars of the FK₄ Supp. cannot be regarded as primary representatives of the FK₄ system. The purpose of the FK₄ Supp. is mainly to stimulate further observations of its stars with the aim that they may be included as fundamental stars in a future improved fundamental system.

Preparatory Work for the Revision of the Albany General Catalogue, GC. A large number of star catalogues that may serve for a revision of the GC have been placed on punch cards at the Pulkovo, U.S. Naval, and Yale Observatories, at Potsdam-Babelsberg, and at the Astronomisches Rechen-Institut, Heidelberg. This project is being energetically continued.

The Astronomisches Rechen-Institut is developing machine programs for the identification of stars in different catalogues and for computing catalogue comparisons. An investigation of the magnitude errors of the GC is in progress.

Index der Sternörter 1925–1960, Index II. Prof. Dr J. Hoppe reports the status of the new star index as follows:

Volume I	Anonymae	published 1961.
II	– 0° to – 22° (BD)	published 1962.
III	– 22° to – 40° (CoD)	to be published late 1964.
IV	– 41° to – 89° (CpD)	in manuscript during 1964.
V	+ 0° to + 10° (BD)	published 1963.
VI	+ 11° to + 20° (BD)	to be published early 1964.
VII	+ 21° to + 30° (BD)	to printer late 1964.
VIII	+ 31° to + 50° (BD)	in manuscript during 1964.
IX	+ 51° to + 89° (BD)	to be ready in 1965.

Geschichte des Fixsternhimmels, Abteilung II, Southern Sky. Dr G. Felsmann reports that the remaining volumes, 18 and 19, covering 17 hours and 18 hours right ascension of the southern sky will appear during the next three years; the final half volume appearing in 1966.

An index for the northern GFH has been prepared at the U.S. Naval Observatory and may be made available in the form of magnetic tape or punch cards to a limited number of institutions. Work on a similar index for the southern sky will be resumed when the publication of that work has been completed.

Cordoba Durchmusterung. A new edition of these volumes is being printed. Difficulties have postponed its publication.

OBSERVATORIES: DISCUSSIONS AND INSTRUMENTS

One of the most important developments in positional astronomy since the last General Assembly is the conclusion of agreements between the Academy of Sciences of the U.S.S.R. and the University of Chile whereby means were established for co-operation in astrometric work in the southern hemisphere. These agreements led to the establishment, in October 1962, of a Working Party of four astronomers from the Pulkovo Observatory at Cerro Calán, the new site of the Chilean National Observatory just outside the city of Santiago. The expedition was initially equipped with a new vertical circle and a Zeiss transit from Pulkovo. A large transit instrument and a meniscus astrograph will be sent to Chile as soon as their construction is completed. Russian and Chilean astronomers, working together, have started the three ambitious programs described earlier under bright stars, etc. The large number of clear nights at Santiago has permitted a remarkable rate of progress on these programs. It is anticipated that all observational work will be completed in $3\frac{1}{2}$ to 4 years. Microscopes and cameras manufactured in Leningrad have been installed on the Repsold meridian circle to photograph the circle. A special photographic device for measuring the photographs of the vertical circle and the meridian circle is being made in Pulkovo under the direction of Sukharev.

The meridian circle at the Hamburg-Bergedorf Observatory is undergoing extensive modernization in preparation for its installation at a site near Perth, Australia during 1965. Among the improvements will be new photo-electric micrometers for observing the stars and reading the circles. The circles were redivided at the U.S. Naval Observatory. In addition to the usual divisions, the circles were engraved with a system of dots which will permit the detection of degrees and minutes by photo-electric methods. The photo-electric apparatus was designed by Hög (32).

An electronic-mechanical device for obtaining the mean instants of transits was constructed at Nikolayev by Ivakin and Ilkin. This device greatly facilitates the process of reducing an observation. Ilkin also of this Observatory developed an improved device for photo-electric registration of star transits. Both developments will be described in the Publications of the Pulkovo Observatory.

The Bordeaux meridian circle has been equipped with an entirely new micrometer incorporating motor driven threads and a synchro system for recording zenith distance micrometer readings. A novel system has been developed for reading the microscopes by remote control. In the near future it is planned that the micrometer and microscope readings will be registered in machine-readable form. Work is also being done on a method for automatically recording meridian transits.

A digital recording system has been installed on both U.S. Naval Observatory transit circles (1). The recent acquisition of a digital barometer and thermometer for the six-inch transit circle now makes it possible to have all records from that instrument produced in machine readable form. The pivots of this instrument were relapped and polished during 1963.

Equipment will be installed on the Askania meridian circle at the Royal Observatory of Belgium, Uccle, for registering the right ascension on a perforated tape to an accuracy of one millisecond. All reductions will be programmed for an IBM 1620.

The use of a reporting console with the Cooke transit circle at Herstmonceux has greatly relieved the observer of clerical work during an observation. The azimuth of this instrument is being determined in three ways, viz., successive upper and lower culminations of circumpolar stars, adopted positions of the FK4 stars, and by use of the meridian marks. Provisional results do not indicate that any one of the methods is clearly superior. There appears to be an, as yet, unexplained inter-relation between the methods.

New cameras for photographing the circle of the Gill instrument at the Cape Observatory were installed during 1961. The resulting increase in scale of the photographs has led to a marked improvement in the declination measures. Apparatus for photographing the circles has also been installed at Kiev and Wroclaw.

A new photo-electric measuring engine and cameras designed by Fukaya for photographing the circle have been put into use at Tokyo. A synchro system for recording declination micrometers designed by Hara is also in use.

A new house for the Paris meridian circle is under construction. New housing was recently completed for the meridian circle, vertical circle, and transit instrument at Belgrade. The Belgrade instruments were assembled and installed during 1963. Both Observatories suffered construction delays.

The Cordoba meridian circle has been erected at San Juan. A new motor drive according to the design of Adams (1) has been obtained. New collimators designed by Landi and Platzeck are being manufactured. These collimators are reflecting telescopes of 20 cm diameter and 250 cm focal length and are contained in a tube about 60 cm long. The main mirrors contain four holes each for viewing the meridian marks.

Meridian circle work has been suspended at La Plata pending the completion of the modernization of the Lick instrument and the erection of the La Plata instrument at La Leona. Observations at the latter site are expected to start in 1964.

The old transit circle at Ottawa was retired after the completion of the AGK3R program. Meridian circle work has also been suspended, it is hoped only temporarily, at Besançon, Heidelberg, and Munich. The Perth Observatory is in the process of being re-established at a new site outside the city. Although plans do not specifically sanction the continuation of meridian circle work, there is every expectation that they may do so.

A new quartz oscillator will soon be in use at Abbadia.

The San Fernando transit circle has been equipped with bright wire illumination to aid in the observations of the faint SRS stars.

In addition to the large number of instrumental improvements enumerated above, many of the usual but, nevertheless, important investigations were carried out during the last three years. Calibrations of the circles were either completed or planned at Abbadia, Lund, Santiago, Washington, and Wroclaw, and studies of the pivots were made at Kiev, Santiago, and Washington. Rather detailed investigations of the flexure were carried out for the meridian circles at Kasan, Lund, San Fernando and for the Ertel vertical circle at Pulkovo. The results of studies of the flexure and thermal influences on the Lund instrument were published by Hansson (28).

While working with the Brorfelde transit circle, van Herk, by means of thermo-electric measurements found that temperature gradients possibly as high as 0.1°C per meter could build up in the dome. There was some indication the high winds or no wind at all were more productive in creating these gradients than light winds.

An evaluation of the performance of the Brorfelde photographic transit circle is in progress. A recent study by Laustsen and Jensen of 3400 differential observations of stars between -10° and the north pole indicated that the mean error of a single observation is $\pm 0.018^s$. Nielsen is making a determination of the diameter errors of this instrument.

The adjustment and testing of Sukharev's horizontal meridian circle at Pulkovo is well advanced. Experimental observations are planned in 1964. The Ottawa mirror transit circle has been completed except for the circle which is being regraduated at the U.S. Naval Observatory. Limited observing in the right ascension co-ordinate started in August 1963. The design of the proposed mirror transit circle at Herstmonceux has progressed and a complete set of general arrangement drawings and specifications has been prepared. (Further remarks on this instrument were submitted to Commission 9.) The pivot errors, level and azimuth constants of the Oporto mirror transit circle have been investigated. Further investigations of the stability of the mirror indicated the need for certain modifications for which funds are now being sought.

Studies of the performance of the modified portable meridian circle at Hannover strongly suggest the use of an instrument of this type for improving the positions of the fundamental stars. Its light weight, rigid construction, and the features developed at Hannover eliminate a large number of systematic errors common to larger instruments.

COMMENTS

1. Dr Fricke and his collaborators at the Rechen-Institut propose, in substance, that Commission 8 consider the following resolution. 'It is recommended that publishing institutions make their observational and other star catalogues available in machine readable form, preferably on punch cards.'
2. Dr Gliese and others recommend a discussion, at the Hamburg Meeting, of the fundamental system and its possible improvement.
3. In view of the extensive efforts being put into methods for recording times of transit, Dr Sémirot suggests that a brief discussion of this subject be held at Hamburg.
4. An investigation is being made by P. Lacroute, by use of AGK3 plates taken at Hamburg, to determine the extent by which overlapping plates may be used to improve plate constants, or, on the other hand, to reduce the meridian circle work on reference stars. In this connection, attention is directed to papers 18, 19, 20 and 33 in the Bibliography and to the report of Sub-Commission 8a for the Berkeley Meeting. Results of such studies may eventually serve as guides in the planning of future astrometric programs.
5. An effort will be made to hold a meeting of the SRS Committee immediately before the Hamburg Meeting. Interested observers are invited to attend. The principal subjects for discussion will be, (a) the SRS list; (b) southern double stars to be recommended for meridian circle observations; (c) the fundamental system in the southern sky and methods in use for relating the reference stars to it; and (d) the status of SRS commitments.
6. The Proceedings of the 16th Astrometric Conference, U.S.S.R., should be of great interest to the members of Commission 8.
7. Dr Wünschmann suggests that it would be desirable to have a conventional table of refraction based on normal values of the Earth's atmosphere up to about 80 km. The construction of such a table should depend on constants derived from analyses of modern absolute observations of stars taken from various parts of the Earth. On this subject, Dr Pilowski directs attention to a paper by H. G. Loser, recently submitted to the *Astr. Nachr.* An extensive summary of refraction literature was prepared by A. I. Mahan (39). Other remarks on refraction will be found in papers (42) and (70) in the Bibliography.

8. The study of the irregularities of the marginal zone of the Moon was completed by C. B Watts (60).

F. P. SCOTT

President of the Commission

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