

4. COMMISSION DES ÉPHÉMÉRIDES

PRÉSIDENT: M. L. J. COMRIE, *Superintendent of H.M. Nautical Almanac Office, Royal Naval College, Greenwich, London, S.E. 10, England.*

MEMBRES: MM. Brouwer, Brown, Da Costa Lobo, Fayet, Fukumi, Hagihara, Herrero, Kopff, Peters, Robertson, Volta.

At the 1932 meeting three proposals before the Commission were referred to the directors of the national ephemerides (*Trans. I.A.U.* 4, 222, 282).

- (1) That the equation of time be given with the same sign in all almanacs.
- (2) The question of duplicate printing.
- (3) The possibility of adopting a uniform system for star positions.

Although the directors have discussed these by correspondence, they wish to take the opportunity of verbal discussion in Paris before presenting their final report. The proposal that duplicate printing of apparent places of stars should be eliminated has been favourably received. A joint meeting with Commission 8 is being arranged for the purpose of discussing the selection and positions of future fundamental stars; at present the general trend of opinion favours the adoption of the FK₃ of the *Berliner Jahrbuch*.

The agenda for the meeting in Paris are:

- (1) *Reports from directors of national ephemerides.*
- (2) *The Belgrade Annuaire.* This publication, which gives the apparent places of 240 Eichelberger stars not included in any other ephemeris, was not able to appear in 1935. The calculations have been done up to 1940, but the commencement of an active observing programme with only a small staff has absorbed all the available energy. The Director (Prof. V. V. Michkovitch) states that a small grant for two or three years would enable publication to be resumed.

- (3) *Standard Equinoxes.* The discussion, with Commission 20, of the following proposal:

"That, as from 1938 January 1, the equinox used for expressing the elements of cometary orbits and for cometary ephemerides shall be that of 1950.0. Further that, as from the same date, the equinox used in giving observed positions of comets shall be that of 1950.0, unless the observer, for good reasons, uses some other equinox and expressly draws attention to the equinox used."

All the tabular matter required is provided by the *Nautical Almanac*, which is omitting the Sun's co-ordinates X , Y , Z for the equinox of the beginning of the year from 1938 onwards. The equinox of 1950.0 is being used by the Rechen-Institut for minor planets from the beginning of 1938.

- (4) *The provision of ephemerides of Vesta, and perhaps one or two other asteroids.* This was first put forward at the meeting of Commission 8 in Leiden (*Trans. I.A.U.* 3, 227), and was again discussed at Cambridge (*Trans. I.A.U.* 4, 28, 243). Since then an investigation of the theory of the motion of Vesta has been given by Voronoff in *A.N.* 6092-93, while Eckert has continued his preparations for calculating positions by mechanical quadratures with the aid of Hollerith machines. Proposals for the determination of systematic corrections to star positions by observation of minor planets have been made by Dneprovski (*Poukhovo Bulletin*, 13, No. 1), Noumerov (*Leningrad Bulletin*, No. 32) and Brouwer (*A.J.* 1022). It seems desirable that the calculation and publication of accurate ephemerides of the minor planets required should be undertaken, and, if necessary, shared by various almanacs.

- (5) *Removal of the strictures on the use of G.M.T.* The *Nautical Almanac* is in the position of being compelled, by Admiralty orders, to use the expression Greenwich Mean

Time for mean time counted from midnight, a practice not countenanced by the Union. The general adoption of Greenwich Civil Time in Great Britain is precluded by the incidence of Summer Time. The Superintendent of the *Nautical Almanac*, without asking members of the Union to change their present practice, would like to see the removal of the ban on the designation that he is compelled to use, and proposes "That the advice to astronomers 'not to use the letters G.M.T. in any sense for the present' (*Trans. I.A.U.* 3, 224, 300) is no longer deemed necessary. Use of the letters G.M.T. should conform strictly to the practice of the *Nautical Almanac* (1935, p. 772), namely that, if the time to which the letters are appended is before 1925 January 1, the day used begins at noon, while if the time is later than that date, the day used begins at midnight."

(6) *Publication of 7- and 8-figure tables.* The production of these tables was announced in 1932. No publisher willing to undertake unsubsidised publication has been found. It is proposed that the Union be asked to adopt the following resolution:

"That this Union considers early publication of the 7- and 8-figure tables of the four principal trigonometrical functions for every second of arc prepared by Prof. Peters and Dr. Comrie to be highly desirable in the interests of science generally."

The reports of the activity of the various members and their institutions are as follows:

American Nautical Almanac Office. The latest volumes of the *American Ephemeris and Nautical Almanac* have been increased by

- (a) A list of faint occulted stars, magnitudes 6.6–7.5, taken from Hammond's catalogue of zodiacal stars not yet published.
- (b) Tables for computing the reduction from mean to apparent place of all occulted stars.
- (c) Predictions of occultations for three additional stations in the United States.

Beginning with the volume for 1938, the positions of all occulted stars will be taken from Hammond's catalogue.

Corrections to the Moon's mean longitude, and to its latitude, were determined by means of reductions and discussion of occultation observations; these corrections were utilised in obtaining the corrected times and positions of the total solar eclipse of 1936 June 19. A pamphlet giving special information relative to this eclipse is in preparation.

- (d) The mean and apparent places of 62 stars, making a total of 887 stars.
- (e) A table giving the angular distance of the Moon from the Sun, for use in computing the radial velocity of the Moon.

During the last year we were able to devote more time to work on the new zodiacal catalogue than in previous years. The work of obtaining a set of normal positions approximately at the epoch 1905, using the positions in eleven catalogues, is completed. Normal positions approximately at the epoch 1915 for the zodiacal stars of the Backlund-Hough list, based on the positions of six catalogues, have also been completed. Positions of about 1600 stars not contained in Hedrick's Zodiacal Catalogue are being computed, using all the catalogues listed by Hedrick, together with eighteen additional catalogues. These eighteen catalogues are also used to obtain corrected positions of the stars of Hedrick's catalogue. This part of the work, which is nearly completed, will furnish normal positions of the stars of the new zodiacal catalogue earlier than 1900. About 350 stars brighter than the seventh magnitude not contained in the preceding lists are being reduced, using all available data. As soon as the results of observations of zodiacal stars made at the Cape Observatory become available, we will proceed to the determination of modern

positions; these observations are necessary to augment Hammond's catalogue, prepared at the U.S. Naval Observatory.

Astronomisches Rechen-Institut. The important change in the *Berliner Astronomisches Jahrbuch* is the adoption of the Third Fundamental Catalogue of the *Jahrbuch* (FK3), which was completed in 1933. As the portion of the *Jahrbuch* concerning the stars had been printed several years previously, on account of the international exchange, corrections (from 1936 onwards) are given for the years 1934 to 1939 to Auwers' *New Fundamental Catalogue*, which has been in use up till now. Beginning with 1940, the *Berliner Jahrbuch* will be based on the FK3.

An extension of the FK3 is in preparation. The 662 supplementary stars included in the *Berliner Jahrbuch* for 1936 (including 32 circumpolar stars between $\pm 80^\circ$ and $\pm 90^\circ$) are to be added to the 925 stars hitherto appearing in the NFK; on the other hand 52 stars, which do not comply with the conditions laid down for inclusion in the Fundamental Catalogue, will be omitted from the NFK (*A.N.* 5537). The extended Fundamental Catalogue, which will contain 1535 stars, including 26 northern and 26 southern circumpolar stars, is arranged in accordance with the following principles:

- (1) The stars are distributed uniformly over the sphere.
- (2) Known double stars with distances between $0''.5$ and $5''$ (except *Sirius*, *Procyon*, *Castor* and α Centauri) are not shown.
- (3) As many stars as possible have been taken from the present Almanacs, and the remainder from Backlund-Hough and Boss. In choosing these, the material of the *Geschichte des Fixsternhimmels* has been utilised to permit the selection of stars with as many old observations as possible.

Among tables published are:

J. PETERS, *Präzessionstafeln für das Aequinoxtium 1950.0* (in part collaboration with K. Pilowski); *Veröff. des Astr. Rechen-Instituts*, No. 50 and No. 51.

G. STRACKE, *Tafeln zur Theoretischen Astronomie*, by J. Bauschinger, 2nd edition, Leipzig, 1934.

P. V. NEUGEBAUER, Lohse, *Tafeln für Numerisches Rechnen*, 2nd edition, Leipzig, 1935.

Dr D. Brouwer. After seeing Prof. Noumerov's plan for determining systematic corrections to fundamental declinations of stars from observations of selected minor planets (*Bull. de l'Inst. Astr. Leningrad*, No. 32) the possibility of developing a scheme that would yield a more complete determination of systematic corrections to the systems of both right ascension and declination was considered. *A.J.* 1022 presents a plan of systematic observations of fourteen selected minor planets during a period of ten years, at one or more observatories north of the equator and one or more south of the equator. The geocentric positions of these planets will be as nearly uniformly distributed between declinations $+30^\circ$ and -30° as was possible with suitable objects.

Observations have been started at the Southern Station of the Yale Observatory in Johannesburg, South Africa. Arrangements for securing observations at an observatory north of the equator have not yet been completed. Dr Eckert of Columbia University has undertaken the accurate calculation of the orbits by numerical integration. The present undertaking of the Yale Observatory is to be regarded primarily as experimental. If successful it may lead to a suggestion of an international project of similar nature.

Prof. E. W. Brown. The annual discussion of occultations to determine the deviation of the Moon from its tabular place continues. At present about one

thousand immersions at the dark limb are being used each year. The comparisons of the results with the Greenwich and Washington meridian observations are satisfactory as far as the annual mean deviation is concerned, but the annual term in the longitude and the fourteen-month term in the latitude not present in the meridian observations have not received any satisfactory explanation. A summary of the results for the nine years 1923–31 was published in the *Monthly Notices*, 93, No. 8.

Tables much more extensive than those of Runkle for the development of the disturbing function have been published in collaboration with D. Brouwer, The logarithms of the first twelve coefficients in the expansion of the first, third, fifth, and seventh powers of the inverse distance are given to eight and seven places of decimals as far as $\alpha = 0.84$, and formulæ to compute them for higher values of α are added. Special values for certain functions in elliptic motion with applications for perturbations of Jupiter and Saturn are added, together with schedules for double harmonic analysis.

The calculation of the principal perturbations of Jupiter's eighth satellite in collaboration with D. Brouwer has been completed. The theory is numerical and includes all powers of the ratio of the mean motions, the satellite's eccentricity and inclination, together with the portions depending upon the above parameters and the first powers of the eccentricity of Jupiter's orbit and of the ratio of the parallaxes. After the redetermination of the constants by comparison with observation, the results should have sufficient accuracy to predict the satellite's position for observational purposes for many years to come.

H.M. Nautical Almanac Office. The volume of planetary co-ordinates for the years 1800–1940, referred to the equinox of 1950.0, was published in 1933. The volume for 1940–1960 is now in active preparation, and should be available by 1938.

Variations have been replaced by finite differences and logarithms by natural values.

A new occultation machine, based on the model made by the late Mr J. D. McNeile, has been installed. This enables the times of occultations to be read directly with a probable error of $\pm 1^m$; these times are then refined by differential corrections. An extended programme of prediction, covering practically all the observing centres except those in U.S.A., commences with the year 1937. For stars between magnitudes 6.5 and 7.5, whose positions were supplied by the *American Ephemeris*, Besselian elements have been computed and occultations predicted.

Several new calculating machines have been installed. A 6-register National will integrate from sixth differences, or difference a function to the fifth difference, printing all its results; quantities in degrees (or hours), minutes and seconds, as well as decimal quantities, can be handled. A Hollerith multiplying punch is being used for about 750,000 multiplications, largely arising in the conversion of heliocentric co-ordinates to geocentric; the machine multiplies two 7-figure numbers and records the product in five seconds.

Authority has been obtained for the publication of a 7-figure table of the natural values of the four principal trigonometrical functions for every second of time. The 7- and 8-figure tables for every second of arc, produced in collaboration with Prof. J. Peters, are now completed, but await the means of publication.

Office of the Almanaque Nautico. No report.

Office of the Connaissance des Temps. Depuis 1932. Afin de faciliter les interpolations, on a ajouté les différences premières dans les tableaux fournissant, de 10 en 10 culminations, les positions apparentes des étoiles fondamentales.

1934. Dans les tableaux fournissant les quantités nécessaires pour le calcul des réductions au jour, on a donné les logarithmes et aussi les nombres.

1935. Un tableau spécial fournit le temps sidéral moyen et les valeurs de $N \cos \omega$ et $dN \cos \omega$.

On publie, de jour en jour, les positions apparentes de 69 circumpolaires.

1937. En ce qui concerne les fondamentales, on a ajouté les positions moyennes des 240 étoiles publiées jusqu'en 1934 par l'observatoire de Belgrade.

On donne les positions moyennes des étoiles occultées de grandeur 6.5-7.5, d'après l'*American Ephemeris*.

On publie tout ce qui concerne les occultations visibles à Lyon, Strasbourg et Toulouse (renseignements fournis par le H.M. Nautical Almanac Office).

L. J. COMRIE
President of the Commission