4. COMMISSION DES ÉPHÉMÉRIDES

Président: M. L. J. Comrie, *Scientific Computing Service Limited*, 23 *Bedford Square, London, W.C.* 1. (*Late Superintendent, H.M. Nautical Almanac Office.*)

Vice-Président: M. G. Fayet, *Observatoire de Paris, Paris* (14ᵉ). *France.*

Membres: MM. Brouwer, E. W. Brown, F. M. da Costa Lobo, Fukumi, Herrero, Kopff, Leuschner, Michkovitch, Noumerov, Peters, Robertson, Sadler; Mlle Vinter Hansen.

The agenda for the meeting in Stockholm are:

(1) Report on the progress of the FK3 catalogue, and the volume of apparent places of the stars in this catalogue.

(2) At the meeting in Paris it was suggested that the value of the Gaussian constant k should be fixed, and the President was asked to consult people known to be interested. As complete agreement appears to have been reached, the following resolution will be moved: "That the value of the Gaussian constant k shall be taken as 0·01720 20989 50000, the unit of time being the mean solar day for 1900·0."

Various consequences of this adoption may be enumerated thus:

	No.	Log
k	0·01720 20989 50000	8·23558 14414 88214
k^2	0·00029 59122 08286	6·47116 28829 76427
k''	3548·18760 69651	3·55000 65746 64673
k'	59·13646 01161	1·77185 53242 81030
$k°$	0·98560 76686 01425	9·99370 40738 97386
$\frac{2\pi}{k} = P_0$	365ᵈ·25689 83263	2·56259 84268 69901

If the mass of a body is negligible,

$$\text{Period} = P_0 a^{\frac{3}{2}} \text{ mean solar days}$$
$$= a^{\frac{3}{2}} \text{ "Gaussian" years of } P_0 \text{ days}$$
$$= 1·00004 02701\ a^{\frac{3}{2}} \text{ tropical years of } 365·24219 \text{ days}$$
$$= [0·00001 74887]\ a^{\frac{3}{2}}$$

The unit of distance is the radius of a circular orbit in which a body of negligible mass would revolve round the Sun in P_0 mean solar days.

(3) The following resolution, adopted by the General Assembly at the Paris meeting: "Commissions 4, 8, and 20 are requested to consider the advisability of restoring to positional astronomy the term in the annual aberration depending on the eccentricity of the Earth's orbit, and to report at the next meeting of the Union."

The trend of the opinions expressed by members of this Commission in correspondence is against any change. Further discussion with the other Commissions concerned is necessary before a report can be made.

(4) The following proposal by Professors Kopff and Peters:

"Most modern star catalogues give, in addition to the annual precession, the so-called secular variation, i.e. the centennial variation of the annual precession. It is proposed that, in future, star catalogues should give the second term of the

power series in time (in which T is measured in centuries) in the same form as the third term is now given, namely

$$\frac{1}{6}\frac{d^3\alpha}{dT^3} \quad \text{and} \quad \frac{1}{6}\frac{d^3\delta}{dT^3}$$

so that the series become

$$\alpha = \alpha_0 + \frac{d\alpha}{dT}T + \frac{1}{2}\frac{d^2\alpha}{dT^2}T^2 + \frac{1}{6}\frac{d^3\alpha}{dT^3}T^3$$

$$\delta = \delta_0 + \frac{d\delta}{dT}T + \frac{1}{2}\frac{d^2\delta}{dT^2}T^2 + \frac{1}{6}\frac{d^3\delta}{dT^3}T^3$$

and therefore $\quad \dfrac{1}{2}\dfrac{d^2\alpha}{dT^2} = 50v_\alpha \quad$ and $\quad \dfrac{1}{2}\dfrac{d^2\delta}{dT^2} = 50v_\delta$

"In *Precession Tables for the Equinox* 1950·0, Table 2 (Veröffentlichung Nr. 50 des Astronomischen Rechen-Instituts), the second term of the precession already appears in the form here proposed. If, moreover, instead of the annual precession the centennial precession is given, the three terms of the precession would be defined uniformly as the coefficients of T, T^2 and T^3 in the series development of the precession in powers of time."

Opinion on this proposal appears to be divided. It is hoped that it may be discussed with Commission 8 (Meridian Astronomy). If the resolution is carried, the question of notation will arise, and will be discussed with Commissions 8 and 3 (Notation).

(5) The following proposal by Dr. Robertson: "That at any observatory where an occultation of a star is observed for which a reliable position is not available, or whose proper motion is not well determined, the star shall also be observed by a transit instrument to determine its position; or if no such instrument is available, that some other observatory be requested to observe the star's position."

The views of Commission 17 (Moon) on this proposal are being sought.

(6) The publication of trigonometrical tables. The printing of the 7-figure table of the natural values of the trigonometrical functions for every second of time prepared by Comrie is now in hand. Unfortunately, although the need for them in astronomical, optical and surveying circles is great, the 7- and 8-figure tables for every second of arc prepared by Peters and Comrie are still unprinted. Peters is now engaged on the calculation of a 10-figure table of the six trigonometrical functions for every $0^s{\cdot}001$, since the use of the centesimal degree is tending to oust that of the nonagesimal degree and its sexagesimal division in many quarters. A 6-figure table for every $0°{\cdot}01$, prepared by Peters, was published in 1937. An 8-figure table for every $0°{\cdot}001$ has also been prepared by Peters, and is awaiting publication.

(7) A discussion on air almanacs. A departure from the usual method of tabulation was put forward by Weems in 1928; it consists of the tabulation of the Greenwich hour angle in arc instead of right ascension in time. This has been taken up in the American *Nautical Almanac* for use at sea and in the air. It was followed in 1935 by the French *Éphémérides Aéronautiques*, in which the Greenwich hour angle is found by the uniform and elegant process of adding the Greenwich sidereal time and the versed ascension ($= 360° -$ R.A.) of the heavenly body, both in arc. Finally, a new British *Air Almanac* utilises the American principle for the Sun, Moon and planets, and the French principle for the stars.

Recent tables for the solution of the navigational spherical triangle will be exhibited.

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

American Nautical Almanac Office, Washington (Dr. A. J. Robertson). The latest volumes of the *American Ephemeris and Nautical Almanac* have been subjected to the following changes:

(a) In the 1940 volume the mean and apparent places of the 887 standard stars have been computed on the FK3 system.

(b) The 1941 volume will contain only the 164 navigational stars. The complete list will appear in the international volume, edited by the British Nautical Almanac Office. The computation of the 162 stars previously made by this office will be continued as our contribution to the international volume.

(c) The position angle of the terminator and the fraction of the Moon's disk illuminated, for each day of the year, are added to the Physical Ephemeris of the Moon.

(d) The list of observatories has been separated into two groups, one containing the active, and the other the inactive observatories.

(e) Corrections to the Moon's mean longitude and to its latitude have been derived from the reduction and discussion of occultations observed during the years 1935–36. These corrections were utilised to correct the times and positions of the total solar eclipse of 1937 June 8, and in the computation of the elements and circumstances of the eclipses of 1939 and 1940.

(f) The new zodiacal catalogue is so far advanced that it has been found practicable to take the positions of the 509 occulted stars for 1941 from the catalogue computation sheets. The complete catalogue will be ready for the printer in a few months.

Astronomisches Rechen-Institut, Berlin (Prof. A. Kopff). Der *erste* Teil (Die Auwers-Sterne) der Arbeiten über den Dritten Fundamentalkatalog des Berliner Astronomischen Jahrbuches (FK3) ist im Druck erschienen als Veröffentlichung Nr. 54.

Die Zusatzsterne sind zur Zeit noch in Arbeit. Die Örter und Eigenbewegungen für 1900·0 sind fertiggestellt und im Druck erschienen (*Astr. Nachr.* 264, Nr. 6324). Die trigonometrische Übertragung auf 1950·0 ist ebenfalls beendet. Für die nördlichen und südlichen Zusatzpolsterne des FK3 sind Örter und EB für 1900 und 1950 in *A.N.* 265, Nr. 6341 veröffentlicht worden. Zur Zeit sind die weiteren Präzessionsrechnungen im Gange. Die gesamte Arbeit für die Zusatzsterne war auf drei Jahre angesetzt worden (vergl. *Transactions I.A.U.* 5, 287). Es ist zu erwarten, dass bis zum Sommer 1938 die mittleren Örter für 1941 und für die folgenden Jahre zur Verfügung gestellt werden können.

Der Plan zur Schaffung eines Fundamentalkatalogs schwächerer Sterne (7. bis 9. Grösse) wurde weiterhin zurückgestellt.

[While this report was in press, the mean positions and proper motions for 1940·0–1943·0 of the FK3 supplementary stars have appeared as an appendix to the *Berliner Jahrbuch* for 1940. Prof. Kopff directs particular attention to the inclusion of the places for 1940·0.—L. J. C.]

Dr. D. Brouwer, Yale University Observatory. I have undertaken the development of new general theories for the planets Uranus and Neptune. A complete discussion of all available observations and an attempt at a new determination of the mass of Pluto will be made.

I have edited and completed an article: "On the system of Astronomical Con-

stants" that Prof. de Sitter left unfinished. This will be printed in the *B.A.N.* in the very near future.

Dr. L. J. Comrie, Scientific Computing Service Limited, London. A new institution has been established for the purpose of doing mechanical calculation for the scientific public. Astronomical contacts have been maintained in the reduction of numerous star observations for latitude and longitude, and in the preparation of a volume of *Tables for Sea and Air Navigation*, to facilitate the use of position line methods.

Connaissance des Temps, Paris (Prof. G. Fayet). Les volumes de la *Connaissance des Temps* pour 1938 et 1939 ne présentent aucune modification nouvelle. Depuis 1935, le Bureau des Longitudes assure les calculs du volume nouveau *Éphémérides Aéronautiques*.

Dr. W. J. Eckert, Columbia University, New York. A new astronomical Hollerith computing bureau has been brought into existence. It is a scientific, non-profit-making organisation whose purpose is to make the punched-card method of computation available to astronomers. It is a joint enterprise of the American Astronomical Society, Columbia University and the International Business Machines Corporation.

The bureau maintains for the use of astronomers a complete set of computing machines of the punched-card type, skilled operators, and extensive card files of astronomical data. The card files are available for use at the bureau or for duplication and distribution. The plan of organisation is given in *Publications of the Astronomical Society of the Pacific*, **49,** 249.

H.M. Nautical Almanac Office, London (Dr. L. J. Comrie, 1935–36). Various points covered by Mr. Sadler's report (which follows) need not be repeated. Every effort was made early in 1936 to arrange for the first volume of apparent places of 1535 stars to be for the year 1940, rather than 1941. It was also planned that the volume of *Planetary Co-ordinates for the Equinox of* 1950·0 covering the years 1940–59 should be published before the end of 1937.

H.M. Nautical Almanac Office, London (Mr. D. H. Sadler). The new occultation machine has enabled the programme of prediction of occultations to be greatly extended. For 1936 predictions were made for 10 stations and published for 4 stations in the *Nautical Almanac*; for 1939 these numbers have been increased to 59 and 12 respectively. The predictions now made cover the greater portion of the observing world, with the exception of the United States. Occultation reduction elements, containing all relevant material connected with the positions of the Moon and occulted star, have been given in the *Almanac* since 1938 (those for 1937 and 1938 were published in the 1938 edition), for all stars brighter than magnitude 7·5 that can be occulted from some place on the Earth. These elements, which are based on the new method of reduction of occultations by Dr. L. J. Comrie,* enable a reduction to be completed in 10 minutes. A full description of the method of reduction, with a complete account of the occultation machine and the work of prediction, was given in a supplement to the *Nautical Almanac* for 1938, published separately as *The Prediction and Reduction of Occultations*.

The interpolation tables in the *Nautical Almanac* for 1937 were extended to include formulae and tables for mechanical integration and differencing, while a new method† of inverse interpolation developed by the late Superintendent was incorporated. These tables, with the appropriate explanation, were reprinted as *Interpolation and Allied Tables*.

* *A.J.* No. 1062, 1937.
† *Supplement to the Journal of the Royal Statistical Society*, **3,** 87, 1936.

As a result of opinions expressed at the Paris meeting, it has been decided to retain in the *Almanac* the Sun's co-ordinates *X, Y, Z* referred to the beginning of the year. The heliocentric ephemeris of Mercury has been retained to a low degree of accuracy for use in the analysis of meridian observations. From 1941 onwards the log distance of the planets will be replaced by natural values; this has been done for Mercury since 1935.

In 1941 the resolution passed at the Paris meeting relating to the publication of a separate volume containing the apparent places of 1535 stars will be implemented. Arrangements have already been made for the redistribution of the calculations between the almanac offices of France, Germany, Spain and the United States, and the approval of the British Admiralty has been given to the printing of this volume. The separate volume of stars for 1941 will be issued at the latest about the middle of 1940, and consequently the *Nautical Almanac* for 1941 and subsequent years will contain the apparent places of about 200 of the brighter stars required for navigation and surveying. From 1941 onwards the FK3 will be adopted as the fundamental catalogue for the apparent places of all stars; a list of the definitive corrections FK3—Eichelberger will be given as an appendix to the *Nautical Almanac* for 1940.

The copy for the second volume of *Planetary Co-ordinates for the Equinox of* 1950·0 is completed, and it is anticipated that publication will take place at the beginning of 1939. Comet 1933*f* (Whipple) is being used for purposes of illustration of various methods of computing perturbations.

Copy for the 7-figure trigonometrical tables with argument in time has been sent to the printer. The completion of the copy for the 7- and 8-figure trigonometrical tables for every second of arc is in hand, though no avenue for publication has yet been found.

At the request of the British Air Ministry a special *Air Almanac* for the purpose of astronomical navigation by aircraft has been produced. The first issue covered the last quarter of 1937. Work is in active progress for the compilation of altitude and azimuth tables, designed to solve the navigational spherical triangle with the minimum of labour on the part of the user. The first of the twelve volumes is to be issued shortly.

The Nautical Almanac Office has been made a branch of the Royal Observatory, and placed under the direction of the Astronomer Royal. Dr. L. J. Comrie vacated the post of Superintendent on 1936 August 26, and was succeeded by Mr. D. H. Sadler.

Instituto y Observatorio de Marina, San Fernando, Spain (Don Leon Herrero). Owing to the circumstances of the war that is being waged in the peninsula, it has been necessary to allow most of the staff of the Observatory to take up other duties, retaining only those essential for the maintenance of the equipment and certain special services. Consequently the activities of the Observatory are suspended until the staff returns to renew them.

Dr. J. Peters, Astronomisches Rechen-Institut, Berlin. In dem Katalog von rund 14000 am Meridiankreis beobachteten Anhaltsternen für die photographische Neubeobachtung der A-G-Kataloge sind die Präzessionsgrössen in der neuen Form angesetzt. Auf jeder Seite werden am Fuss die Formeln stehen:

$$\alpha_T = \alpha_{1950\cdot0} + I_\alpha T + II_\alpha T^2 + III_\alpha T^3$$
$$\delta_T = \delta_{1950\cdot0} + I_\delta T + II_\delta T^2 + III_\delta T^3$$

T (Einheit 100 Jahre) gezählt ab 1950·0.

24

Damit ist jede Unklarheit über die Bedeutung der Koeffizienten von T, T^2 und T^3 ausgeschlossen. Auch der A-G-Katalog für 1950·0 wird die Präzessionsgrössen in der gleichen Form bringen.

Zur Zeit bin ich mit der Berechnung einer zehnstelligen Tafel der sechs trigonometrischen Funktionen von Tausendstel zu Tausendstel jedes Neugrades (400^g auf den Umkreis) beschäftigt. Die Tafel wird in wenigen Monaten fertig berechnet vorliegen.

L. J. COMRIE
President of the Commission