

## 20. COMMISSION DES POSITIONS ET DES MOUVEMENTS DES PETITES PLANETES, DES COMETES ET DES SATELLITES

PRÉSIDENT D'HONNEUR: M. LEUSCHNER.

PRÉSIDENT: M. DELPORTE, *Directeur honoraire de l'Observatoire Royal de Belgique, 151  
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VICE-PRÉSIDENT: M. D. BROUWER, *Director of the Yale University Observatory, New  
Haven, Conn., U.S.A.*

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### SOUS-COMMISSION POUR L'ÉTUDE DES COMÈTES PÉRIODIQUES

PRÉSIDENTE: Mlle VINTER HANSEN.

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#### NOTE SUR L'ACTIVITÉ DU PRÉSIDENT E. DELPORTE, PENDANT LA PÉRIODE 1938-47

Après le Congrès de l'U.A.I. Stockholm 1938, M. Delporte, Président de la Commission, s'est mis en rapport avec les membres de la dite Commission élus à Stockholm et avec les membres de pays non adhérents à l'Union et dont la cooptation proposée au meeting de Stockholm avait été acquise par vote. Le déclenchement des hostilités en 1939 a rompu les contacts entre les états. La Belgique encore neutre, a pu servir d'intermédiaire entre le Rechen-Institut de Berlin et la France, l'Angleterre et l'Afrique du Sud pour l'acheminement des éphémérides pour 1940 (*Kleine Planeten*).

Au 10 mai 1940, la Belgique envahie à son tour n'a plus su continuer le rôle d'intermédiaire. Les correspondances avec le Rechen-Institut de Berlin et le Bureau central des Télégrammes astronomiques de Copenhague ont elles-mêmes été coupées pour le reste de l'année 1940 mais ont pu reprendre ensuite, souvent avec des retards très importants. Je tiens à signaler que le Directeur et les membres du Rechen-Institut ont, dans la mesure où cela leur était possible, fait tous leurs efforts pour la continuation des services de petites planètes, intervenant même pour que la fourniture de plaques photographiques soit effectuée.

Les volumes d'éphémérides (*Kleine Planeten*) ont été publiés régulièrement jusqu'en 1944. Le volume contenant les éphémérides pour 1945 a été calculé mais les exemplaires ont été détruits à l'imprimerie même, à la suite de combats de la fin de guerre.

Pendant la période 1938-47, la Commission 20 a perdu plusieurs de ses membres et notamment: le Prof. G. Stracke, décédé en 1943, et dont l'activité au service des petites planètes a été si importante; le Prof. K. Boda, successeur du Prof. Brendel au bureau de calcul de Frankfort; M. le Prof. Neujmin, l'actif observateur de l'Observatoire de Siméïs, qui a eu l'amertume de voir d'abord anéantir l'établissement si renommé par ses travaux; M. de la Villemarqué S.J. qui a continué, jusqu'à la fin de sa vie, ses beaux travaux de perturbations et d'orbites; M. Crommelin, le grand spécialiste des calculs d'orbites cométaires et d'objets spéciaux (astéroïdes); M. le Prof. E. Strömrgren, directeur du bureau des télégrammes; MM. Numerof, Komendantof et Giacobini.

Malgré l'absence d'éphémérides, l'Observatoire d'Uccle pendant le second semestre de 1945 a continué ses prises de clichés en ayant en vue principalement l'observation des planètes trouvées à Uccle. A cet effet le calcul d'éphémérides de celles de ces planètes arrivant en opposition à ce moment, a été effectué. Un calcul identique a été fait pour

l'année 1946 sous la direction de M. Arend par les calculateurs du service: MM. Sanders et Roland. L'Observatoire de Belgrade, à qui nous avons demandé s'il ne possédait pas les *Kleine Planeten* 1945, nous a envoyé les éphémérides d'un certain nombre de planètes arrivant en opposition au cours du dernier trimestre de 1945, ce qui a facilité l'identification d'astéroïdes trouvés sur nos plaques.

L'Observatoire d'Uccle a calculé les éphémérides d'une vingtaine de planètes brillantes pour chacune des années 1946, 1947, et 1948, éphémérides destinées à figurer dans l'annuaire Flammarion de la Société astronomique de France. Le manuscrit du *Kleine Planeten* 1946, remis par M. le Prof. Kopff, a pu être reproduit à un nombre restreint d'exemplaires par la photographie, par le service américain. Le problème du calcul des éphémérides pour l'ensemble des planètes pour 1947 a été posé à la réunion restreinte de l'Union Astronomique Internationale, tenue à Copenhague en mars 1946.

Deux exemplaires des *Kleine Planeten* 1945 avaient pu être retrouvés et se trouvaient à l'Institut théorique d'Astronomie de l'Académie des Sciences de Leningrad, qui en a mis un exemplaire à la disposition du Nautical Almanac Office de Londres.

Grâce à l'obligeance de M. Sadler, Superintendent du Nautical Almanac Office, l'Observatoire d'Uccle a pu se servir de cet exemplaire pour établir une liste d'éléments d'orbites des planètes pour lesquelles ces éléments différaient de ceux des *Kleine Planeten* des années précédentes.

Les correspondances échangées avec le Rechen-Institut, qui s'était fixé à Heidelberg, ayant conclu à l'impossibilité pour ce bureau de se charger du calcul d'éphémérides pour 1947, le travail a été partagé entre un certain nombre d'observatoires européens qui reçurent les éléments de calcul de l'Observatoire d'Uccle qui les avait préparés et qui devait centraliser les résultats.

L'Institut d'Astronomie théorique de l'Académie des Sciences de l'U.R.S.S. s'est chargé du calcul d'un certain nombre d'astéroïdes (1<sup>o</sup> semestre 216, 2<sup>o</sup> semestre 219). Pour le 1<sup>er</sup> semestre, le Président de la Commission 20 a sollicité les concours d'observatoires européens.

Les observatoires d'Alger, Barcelone, Belgrade, Madrid, Nice, San Fernando, Tortosa, Türku et Uccle ont répondu à cet appel.

M. le Prof. Cunningham a réuni en 1 fascicule le résultat de ces travaux, auxquels il a joint les éphémérides d'un petit nombre de planètes calculées à Berkeley.

Les observatoires d'Alger, Belgrade, Nice, Türku et Uccle ont également calculé un nombre restreint d'éphémérides pour le 2<sup>o</sup> semestre 1947. La plus grande partie des éphémérides du second semestre ont été calculées en Amérique au moyen des machines Watson.

C'est grâce aux efforts combinés de M. le Dir. Eckert et de M. le Prof. Cunningham que cette partie importante du travail a pu être menée à bien en un temps assez court. Les observateurs ont donc pu disposer en 1947 de l'entièreté des éphémérides des planètes arrivant en opposition.

D'autre part, le Japon étant coupé encore de relations postales, M. le Prof. Y. Hagihara, Président de l'une des Commissions du Conseil National de recherches de ce pays, a fait calculer les éphémérides de 186 astéroïdes par les soins de cette Commission. Le calcul a été basé sur les éléments d'orbites contenues dans le volume *Kleine Planeten* 1941 qui était le plus récent en main des observateurs.

L'envoi des documents publiés pour 1947 a été fait au Japon pour permettre aux observateurs l'identification des objets observés, et qui ne se seraient pas trouvés dans la liste de M. Hagihara.

Pour l'année 1948 des dispositions ont été prises pour que le travail complet des éphémérides soit assuré par l'Institut d'Astronomie théorique de Leningrad avec le concours du Rechen-Institut. Néanmoins les observatoires d'Alger et de Belgrade, qui avaient déjà commencé leurs calculs, ont fourni déjà un certain nombre d'éphémérides.

E. DELPORTE  
*Président de la Commission*

In March 1947, President Delporte asked to be relieved of some of his duties and requested the Vice-President to take charge of various activities in connection with the work of the Commission, including the preparation of this Report. In September 1947 the following circular was sent to all members of the Commission:

*I. Publication of observations.* For some time the need has been felt for a rapid means of publication such as existed in the Rechen-Institut Circulars before the war. After ample consideration it was decided to issue Minor Planet Circulars under the auspices of the International Astronomical Union. Dr Paul Herget accepted the responsibility for this service. An announcement concerning this step was recently made by the President and the Secretary of the International Astronomical Union.

It should be understood that this has no effect upon the work of the Bureau of Astronomical Telegrams which will remain at Copenhagen.

*II. Publication of Ephemerides.* For the year 1947 the calculation and publication of ephemerides had to be improvised because of insufficient time for adequate preparation.

A volume to be published under the auspices of the Union and containing all of the ephemerides for this year is now being prepared by Dr Paul Herget in cooperation with the U.S. Naval Observatory. This volume is intended primarily for reference purposes: it will appear too late to be of any use in furnishing search ephemerides.

For the year 1948 all of the ephemerides of numbered minor planets will be furnished by the Leningrad Institute. This Institute had originally undertaken a smaller programme but expanded its programme at the request of the President of the Union.

The Rechen-Institut, now at Heidelberg under the direction of Prof. Kopff, has offered to contribute ephemerides of the more recently discovered asteroids for which the Rechen-Institut has data not generally available, as well as ephemerides of asteroids for which it possesses perturbation tables in manuscript form.

It is hoped that for the year 1949 numerous ephemerides based upon improved orbits may be introduced. In this connexion it would be most helpful if members of Commission 20 would communicate what contributions they intend to make. Especially useful would be a listing of those minor planets for which ephemerides based upon perturbed co-ordinates could be contributed. This subject is closely related to that discussed in section IV.

*III. Organization of observations.* On Harvard Announcement Card No. 781 a tentative plan formulated by Prof. Leuschner for dealing with the organization of the observations of asteroids was communicated. The purpose of this plan was to obtain observations of asteroids for which additional observations are urgently needed in order to secure their orbits, and to avoid unnecessary duplication. An attempt has been made to carry out such a programme, but its effectiveness has suffered on account of the fact that many ephemerides for the current year were necessarily of poor quality. A programme of this type cannot be successfully introduced at once. It is necessary to have all ephemerides available well before the beginning of each calendar year, and the ephemerides should be of improved accuracy.

Suggestions concerning this matter will be welcome.

*IV. Need for orbit and perturbation calculations.* The minor planets that will need particular attention are those that have been observed in fewer than four oppositions. Numerical integrations for a large number of these minor planets, with the aid of high speed calculating machines, are planned by Dr Herget in Cincinnati and possibly elsewhere. The task of making differential orbit corrections by comparing these perturbed orbits with observations cannot be performed so readily by these machines. It is therefore proposed that a co-operative plan be formulated in which the onerous routine calculations would be performed by the automatic machines and provided to the computers who wish to complete the computation of the differential corrections. At least some of the perturbations should be available some time between January and March of 1948. Members of the commission are requested to communicate to what extent they would wish to participate in undertaking a share of this work. It is believed that in this manner useful contributions can be made in numerous centres of research, and that this type of co-operation may grow to a successful international undertaking of considerable scope.

It has been emphasized in previous years by Leuschner that increased activity in the field of providing general perturbations is particularly desirable. On the other hand, in order to obtain accurate osculating elements to be used as the basis of general perturbations, it is necessary to link at least four oppositions by means of special perturbations. Much of this preparatory work remains to be done in the near future.

In response to the request for reports from members, numerous communications have been received. These are summarized by countries. It was found necessary to omit extensive bibliographies, and reduce the extent of detailed tabulations. In view of the impossibility of obtaining reports from all members at a sufficiently early date, the President of the Commission has on previous meetings omitted these reports from the Draft Reports. Since this year the reports contain information on work in progress that may be particularly useful in the discussions at Zürich, it appeared desirable to have these available in advance. It was evidently impossible to achieve completeness. Reports that may be received later will be presented at a meeting of the Commission.

#### ARGENTINE REPUBLIC

B. H. Dawson at La Plata and J. Bobone at Córdoba have contributed extensive series of observations of comets, published in the *Astronomical Journal*. The latter has also made observations of minor planets and of Jupiter's sixth satellite.

Captain Guillermo O. Wallbrecher, director of the La Plata Observatory, has expressed the intention of the observatory to take an active part in a programme of observation of minor planets.

#### BELGIUM

A report by E. Delporte and S. Arend on the activity of the Observatoire Royal de Belgique for the period July 1938 to 15 December 1947 reads in part:

L'astrographe double de Zeiss, de 400 mm. de diamètre et 2 mètres de longueur focale a été consacré pendant toute la période à la recherche et l'observation des petites planètes et à l'observation de comètes. La difficulté de se procurer des plaques pendant la guerre et dans la période qui a suivi celle-ci, a fait que l'emploi simultané des 2 chambres a été très rare.

La méthode d'observation à double pose (barre-point), sans modification de centre, a été moins employée. On lui a substitué très souvent la méthode à doubles poses (barre-point) mais avec décalage du centre pour la 2<sup>e</sup> pose. Cette méthode donne des plaques plus chargées puisque chaque étoile a deux images, mais pour les mesures précises elle a l'avantage que les secondes poses (point) ont la même durée pour les étoiles et l'astéroïde; les images sont donc mieux comparables.

La méthode Trépied-Metcalf a été beaucoup plus employée en raison de la moins grande sensibilité des émulsions photographiques dont on a pu disposer et qui obligeait donc à concentrer la pose sur un objet faible en tenant compte de son mouvement par les déplacements micrométriques.

Le rendement en nombre d'objets mesurables a donc été moindre pour cette raison.

Deux autres causes ont grandement influencé le rendement du service, c'est d'abord le fait que les conditions du ciel ont été très mauvaises; le trouble de l'atmosphère allant en augmentant jusqu'à la fin de la période (1947); d'autre part les opérations de guerre ont contrecarré l'observation, soit qu'il s'agisse des tirs contre avions ou contre engins V1 ou V2 obligeant à fermer les coupoles, soit en raison des restrictions dans l'éclairage commandées par l'occupant.

Pendant la plus grande partie de l'année 1940, le personnel a été plus réduit, M. Arend étant absent pour raisons militaires. Les autres années le service d'observation a comporté trois observateurs: MM. E. Delporte, S. Arend, F. Rigaux.

*Relevé statistique: 1938 Juillet—1947 Décembre*

Nombre de centres, 795  
Nombre total de positions, 1697  
Planètes nouvelles découvertes, 101  
Planètes anciennes observées, 822  
Nombre de positions approchées, 867:  
Planètes connues, 788; Planètes nouvelles, 79  
Nombre de positions précises, 830:  
Planètes connues, 688; Planètes nouvelles, 142.

*Résultats: 1938–47.* Planètes numérotées au profit de l'observatoire d'Uccle et dénominations:

E. Delporte	1937 UC 1433 Geremina
	1936 FD <sub>1</sub> 1434 Margot
	1936 RA 1476
	1938 QA 1486 Marilyn
	1938 QB 1493 Sigrid
	1941 SI 1543
	1942 XB 1560
P. Bourgeois	1929 CZ 1547
S. Arend	1943 EQ 1563 Noël
F. Rigaux	1937 RC 1458 Mineura
	1941 SA 1555 Dejan

En plus les planètes découvertes à Uccle:

E. Delporte 1938 CB 1463 a été numérotée au profit de l'Observatoire de Türku qui en avait la priorité de découverte,

de même S. Arend 1935 CD a été numérotée au profit de l'Observatoire d'Heidelberg à la suite de la redécouverte 1938 WB. Elle a reçu le nom 'Arenda'.

Calculations of orbits of planets discovered at Uccle in which S. Arend, J. Biezemans, J. Hunaerts, F. Rigaux, and P. Sanders participated, have been published in the *Bulletin Astronomique de l'Observatoire Royal de Belgique*, Vols. 2 and 3.

J. Delvosal and J. Warzée published photographic observations of Eros with the Carte du Ciel instrument.

Numerous articles on subjects related to minor planets by members of the observatory staff appeared, principally in *B.A.B.* and in *Ciel et Terre*. Among these may be listed: J. F. Cox et H. Jehle, 'Éléments canoniques des petites planètes nos. 1 à 1183', *B.A.B.* 3, 248–65, 1944; P. Bourgeois et J. F. Cox, 'Probabilité de la découverte et nombre de petites planètes', *A.N.* 265, 1–20 (nos. 6338–9), 1938; various articles by S. Arend on the method of reduction of astronomical photographs; two articles by S. Arend et P. Sanders, 'Application du calcul des matrices à l'amélioration de l'orbite de l'astéroïde 1938 QB=1493', *B.A.B.* 3, 60–4, 1939; 'Application du calcul des Cracoviens à l'amélioration des orbites', *B.A.B.* 3, 101–4, 1940.

#### CZECHOSLOVAKIA

Dr V. NECHVÍLE, of the National Observatory at Prague, reports:

Before the war, eleven accurate positions of the comet 1939*d* Jurlov-Achmarov-Hassel were obtained with the double Zeiss astrographic equatorial of the Stefánik Observatory at Prague, with the collaboration of Prof. E. Buchar. During and after the war 42 accurate astrographic positions of the planet Eros, obtained during the opposition 1930–31, were newly reduced on the basis of the new and definitive positions of the reference stars, given in the Catalogue by Dr H. Spencer Jones and P. J. Melotte in the *Memoirs of the Royal Astronomical Society*, Vol. LXV, part IV, 1937. Both publications are in the Press in the *Annales de l'Observatoire National de Prague*.



## DENMARK

Julie M. Vinter Hansen reports on the activities at the University Observatory at Copenhagen:

*Comets.* Preliminary orbits and ephemerides for numerous comets have been computed, particularly by the late Mr Jens P. Möller, in connection with the activities of the I.A.U. Bureau of Astronomical Telegrams.

Elis Strömngren and H. Q. Rasmusen published a paper 'On the original orbits of comets 1925 I, 1920 III, and 1897 I' (*Publikationer og Mindre Meddelelser fra Københavns Observatorium*, No. 114).

Definitive orbits for comets 1929 I and 1941 VII were computed by H. Q. Rasmusen and P. Naur, respectively (*Pub. Kopenhagen Obs.* Nos. 128 and 141).

Unpublished investigations are: by H. Q. Rasmusen on the prediction for the return of comet Olbers (finished) and by J. M. Vinter Hansen on periodic comet Comas Solá (in progress).

*Minor Planets.* Observations of the brighter minor planets at the Copenhagen Observatory, principally by J. M. Vinter Hansen and J. P. Möller, were continued (*Pub. Kopenhagen Obs.* Nos. 117 and 123). While at the Lick Observatory and at Berkeley, California, Miss Vinter Hansen's activities included 'Observations of Eros and of 51 Nemausa' (*Lick Obs. Bull.* Nos. 512, 516) and, with A. O. Leuschner, 'The calculation of ephemerides of Watson Asteroids for 1942' (*Lick Obs. Bull.* No. 509).

Prof. Bengt Strömngren reports on an investigation of the motion of 51 Nemausa:

The aim of the investigation is to derive, ultimately, systematic corrections of the fundamental system in the equator zone. This asteroid, which at opposition is always close to the equator, is suitable for such a study. Most of the computational work involved has been carried out by Mr Ole Möller, part of it by Messrs Ole Hesselberg, Erik Sinding, and Peter Naur.

Using preliminary improved elements derived from observations 1927-39 the motion has been calculated 1927-47 taking account of the perturbations by all the major planets. The observations of the asteroid in this period are being re-reduced and compared with the resulting ephemeris using improved positions of the comparison stars. The positions of 120 comparison stars have been determined by Dr Anders Reiz from meridian observations made by him at the Lund Observatory. The improved elements resulting from this discussion will presumably be available within a year, and will then form the basis of a repeated numerical integration of the equations of motion. From a comparison of the resulting ephemeris with observations of high accuracy in a well-defined system it will be possible to derive the required systematic corrections in the equatorial zone. It is planned to base the final solution on twelve oppositions of high-accuracy observations. It will be possible, however, to derive rather accurate preliminary values already from three accurately determined oppositions.

Tables published in *Pub. Kopenhagen Obs.* are:

H. Q. Rasmusen, *Äquatoriale Uranus- und Neptun-Koordinaten für den Zeitraum 1800-1903, bezogen auf das Äquinoktium 1950.0* (No. 121).

Jens P. Möller, *Tafeln zur Reduktion gemessener Differenzen in Rektaszension und Deklination auf Differenzen der mittleren Örter bezogen auf das Äquinoktium des Jahresanfangs* (No. 123).

## FRANCE

M. G. Fayet, directeur de l'Observatoire de Nice reports:

Sauf pendant 1944 et 1945, où l'on a dû interrompre, faute de plaques et aussi d'éphémérides, le grand astrographe double, que possède notre observatoire, a été utilisé, depuis 1935, à la recherche photographique des astéroïdes. Ce service a toujours été confié à Madame Laugier et à M. Patry.

Voici le résumé des résultats obtenus :

Obsr	Nombre de clichés	Nombre d'astéroïdes	Planètes nouvelles ou non identifiées
I—1937-43			
Mme Laugier	654	1108	121
M. Patry	363	981	39
II—1946-fin oct. 1947			
Mme Laugier	118	143	5
M. Patry	77	163	15

D'autre part, Mme Laugier a calculé 42 orbites et M. Patry 12.

En 1946, mes deux collaborateurs ont calculé et adressé à M. Delporte, une centaine d'éphémérides pour l'opposition de 1947.

En appliquant la méthode qu'il a exposée dans le *Journal des Observateurs* (Vol. 29, Nos. 5-6), M. Patry a entrepris une recherche systématique en vue d'identifier les petites planètes insuffisamment observées pour qu'il soit possible d'en déterminer l'orbite. Parmi les 416 objets examinés jusqu'à présent, M. Patry a réussi à établir 56 identités parmi lesquelles il convient de citer particulièrement celles qui intéressent les astéroïdes 459, 650, et 750 perdus depuis longtemps.

Enfin je vous signalerai que j'ai achevé, depuis déjà plusieurs années, un mémoire assez étendu consacré à l'étude générale des proximités dans le système solaire, mais qui n'a pu encore être imprimé faute de crédits. J'espère toutefois qu'il pourra paraître, dans un avenir assez proche, dans le prochain volume des *Annales du Bureau des Longitudes*.

M. A. Schaumasse, astronome, Observatoire de Nice reports :

Jusqu'en juillet 1942 j'ai pu continuer à l'équatorial coudé de 40 cm. de l'Observatoire de Nice, mes travaux sur les recherches de comètes, l'observation des petites planètes et les calculs d'orbites et d'éphémérides.

Mon activité a été interrompue jusqu'en 1947, les objectifs des instruments ayant été enlevés, mais depuis le mois de mai Monsieur Fayet vient de me charger du chercheur de comètes de 25 cm. d'ouverture de Zeiss, qui après quelques modifications, va sans doute me permettre de recommencer mes recherches.

A report received from L. Boyer, Observatoire d'Alger, Bouzaréah, reads in part :

Pendant la période 1938-47 le service des petites planètes et comètes a eu une activité réduite et à certaines époques complètement arrêtée par suite de la guerre.

*Observations.* L'instrument employé est l'Equatorial Photographique de la Carte du Ciel. Les observations sont faites par la méthode Trépied-Metcalf.

J'ai pris environ 1200 clichés et obtenu les positions de 1150 planètes et de 100 comètes, ainsi que 5 positions de Pluton.

Cinq planètes nouvelles ont été découvertes; une seule a pu être suivie assez longtemps pour être numérotée: 1511.

Sur la demande de divers calculateurs des séries d'observations s'étendant sur un intervalle de 4 à 6 mois ont été faites: notamment pour 1 Cérés, 2 Pallas, 3 Juno, 4 Vesta, 433 Eros, et 1036 Ganymed.

En 1946-47 13 comètes différentes ont été observées. Elles sont suivies le plus longtemps possible.

*Travaux de calcul:* 1° Positions précises de planètes et de comètes: 950 environ.

2° Calcul d'orbites des planètes découvertes à Alger.

3° Calcul des perturbations par Jupiter et Saturne et amélioration des éléments de quelques planètes découvertes à Alger, en particulier de 1177, 1301, 1339, 1377.

4° Continuation du calcul des perturbations de 173 Ino par toutes les grosses planètes. Ce travail entrepris par M. P. Caubet, astronome à Toulouse, a été poursuivi ici. Les éléments de

cette planète ont été améliorés pour la dernière fois avec des observations de 1924. Depuis cette date jusqu'en 1944 les observations, à chaque opposition, sont représentées d'une façon très satisfaisante. Pour les observations des 16 oppositions qui ont eu lieu pendant cette période, les moyennes des valeurs absolues des écarts entre les observations et le calcul sont de 0<sup>s</sup>.05 en  $\alpha$  et de 0<sup>s</sup>.6 en  $\delta$ . Actuellement je continue les calculs de façon à combler le retard et à publier une année à l'avance les éléments de cette planète pour l'opposition à venir, comme cela était fait avant la guerre.

Les résultats des calculs qui précèdent sont ou seront publiés au *Journal des Observateurs*. Les positions des comètes et de quelques planètes sont publiées aux Circulaires de l'U.A.I.

5° Contribution au calcul des éphémérides pour les années 1947 et 1948 avec la collaboration de M. Reiss.

6° D'autre part M. A. Schmitt et M<sup>me</sup> Schmitt-Bancilhon ont obtenu visuellement à l'Equatorial Coudé environ 200 positions de comètes. M. A. Schmitt a calculé les orbites et les éphémérides de 3 comètes.

*Remarques.* L'Observatoire d'Alger a demandé à collaborer aux observations systématiques de certaines petites planètes (Cir. U.A.I. No. 1071). Aucun plan d'observation n'est parvenu à ce jour.

Les circulaires de l'U.A.I. parviennent à Alger 10 à 15 jours après leur départ de Copenhague. Par suite de ce retard il est parfois impossible d'utiliser les éphémérides publiées par ces circulaires. Il y aurait intérêt à les expédier parfois par avion.

#### GREAT BRITAIN

Mr D. H. Sadler, Superintendent of H.M. Nautical Almanac Office, reports:

The second volume of Planetary Co-ordinates referred to the equinox of 1950.0, covering the years 1940–60 (and including spherical co-ordinates of Uranus and Neptune for 1800–1900) was published in September 1939. It followed closely the plan of the first volume, with minor improvements, such as the use of a smaller interval of tabulation for Saturn and the retention of an extra figure in the attractions on the Sun. Owing to the war, distribution was much restricted. The type, plates and stock were destroyed in November 1940; a reprint was unfortunately impossible until after the war, but it was possible to meet the most urgent requirements by loan copies. A photographic reprint has now been issued.

It is proposed to issue a similar volume covering the years 1960–80 in about 1955.

Dr J. G. Porter, Director of the Computing Section of the British Astronomical Association, reports:

The work of the Computing Section in connection with Minor Planets, Comets and Satellites since the last I.A.U. meeting has been as follows:

*Minor Planets.* An ephemeris of Vesta from Leveau's tables was prepared by B. F. Bawtree up to the year 1943, but was discontinued after that date.

*Comets.* Regular predictions of the return of all periodic comets have been made and published annually in the *Handbook of the British Astronomical Association*. Work is now in progress on the comets due to return in 1949 and 1950. Investigations have been made as to the degree of accuracy of predictions based on Crommelin's tables (*Memoirs R.A.S.* 64, 149); and methods of correcting a Cowell or Encke scheme for observations are also being tried.

*Satellites.* No predictions of mutual eclipses, etc., of Jupiter's satellites were possible. Predictions of phenomena for Saturn's satellites in 1948 will appear shortly, and this work is being continued. Mutual phenomena of Jupiter's satellites in 1949 are being investigated.

Dr G. Merton, University Observatory, Oxford, reports:

The only observations of position of sufficient accuracy for orbit determinations, made in the British Isles, are those of comets by Dr W. H. Steavenson at Cambridge (30-inch reflector) and those from photographs, obtained with small cameras of relatively short focus, which are measured when required by Dr G. Merton at Oxford, where two such cameras are now mounted



and in use on photometric work. Since such observations of position are generally not of the high order of accuracy required for definitive computations of orbits, they are not made except for checking or computing preliminary orbits.

Occasional computations of cometary orbits have been made in this country chiefly by Dr Martin Davidson, and the regular work on periodic comets (reported under the Sub-Commission for periodic comets) is carried on by members of the Computing Section of the B.A.A.; and recently Dr G. Merton has returned to join in both types of work. Generally speaking the calculation of preliminary orbits, and of improved orbits, cannot at present be usefully undertaken here because reliable observations are not received sufficiently quickly. In fact recently the first-class elements for orbits which Dr L. E. Cunningham computes, and which are telegraphed from the United States, are usually received through the I.A.U. Bureau before the three accurate observations necessary for an orbit determination become available. Ephemerides are, however, computed as needed and published in the B.A.A. Circulars and elsewhere.

The inclusion in the annual Council Notes of the Royal Astronomical Society of information on Minor Planets was discontinued after the death of Dr A. C. D. Crommelin, and that for comets has not been so complete as before. In the Council Notes for 1947, however, an attempt has been made to bring the information on cometary orbits up to date, and details of 70 orbits are given there.

#### ITALY

Prof. E. L. Martin, Direttore dell' Osservatorio Astronomico, Trieste, reports that owing to damage suffered during the war, the observatory has no instruments that can be utilized for observations of minor planets, comets, and satellites. The director and the observatory staff are anxious to take an active part in the calculation of ephemerides and in the differential correction of orbits. For the present, the scarcity of competent personnel and of calculating machines will limit the extent to which such contributions can be made.

#### POLAND

Prof. M. Kamiński, Cracow, reports that he is continuing his work on the motion of periodic comet Wolf I, a summary of which appeared in *Monthly Notices R.A.S.* **106**, 267-73, 1946. In connection with investigations on the motion of Halley's comet (see recommendation no. 7), investigations have been in progress on the co-ordinates of the principal planets in the remote past. These include: Tables of the Sun for the Period from 10,000 to 4000 B.C., by M. Kamiński; and Tables of Uranus and Neptune from 4000 B.C. to 3000 A.D., by M. Kamiński and R. Walter. These publications are in print in *Bulletins of the Polish Academy of Sciences*.

Prof. F. Kępiński, Warsaw, reports that he is continuing his work on the periodic comet 1906 IV. An account of work done during the war was published in *Publications of the Polytechnic Astronomical Institute* at Warsaw, No. 23. In this same number he published an account of the cruel effects of the war on the Institute and its staff.

#### SOUTH AFRICA

Dr W. H. van den Bos, Union Astronomer, Johannesburg, reports that the Union Observatory tries to cover the southern half of the ecliptic every year for minor planets, and observes all comets in the southern hemisphere as far as possible. The regular programme was interrupted in 1940 when Mr C. Jackson, who concentrated on minor planets, and Mr E. L. Johnson, who concentrated on comets, left the Observatory on account of military service. After the war Mr Jackson became observer in charge at the Yale (now Yale-Columbia) Southern Station in Johannesburg. Mr Johnson has since early in 1946 been in charge of the observing of both minor planets and comets. Observations from 1938 to early in 1941 were published in *Union Observatory Circular*, Nos. 101-4. During the war years some work was carried on by Dr van den Bos, Mr J. A. Bruwer and Dr H. van

Gent. The observations during this period will appear in *U.O. Circular*, No. 105, now in print. Van Gent's observations of minor planets in 1940 were published in *B.A.N.* 9, 1942.

#### SPAIN

A report has been received from Prof. R. Carrasco, Director del Observatorio Astronómico de Madrid. The civil war caused total suspension of the work, and partial suspension afterward. The astrograph of the Madrid Observatory and its building were damaged, and were out of operation until 1946. During the world war difficulties similar to those in other countries were experienced, especially caused by lack of ephemerides, photographic plates, etc. These difficulties have now been overcome, and the work is normal. Active co-operation with the San Fernando Observatory will stimulate work in Spain in the field of minor planets, comets and satellites. The observatories took an active part in the calculation of ephemerides for the year 1947. A total of 144 ephemerides were computed: 51 at the Observatorio de Fabra (Barcelona), 22 at San Fernando, 15 at Ebro, and 56 at Madrid.

The number of positions of minor planets and comets obtained during the period 1938 July to 1947 July are

	Minor Planets		Comets	
	1938-44	1946-47	1938-44	1946-47
Fabra	283	67	36	6
San Fernando	12	52	2	1
Madrid	—	58	82	21

A large part of these observations was published in the R.I. circulars, I.A.U. circulars and, for Madrid, in the *Boletín Astr. del Obs. de Madrid*, Vols. 2 and 3.

A definitive orbit of comet Carrasco (1931 V) was published by R. Carrasco, *Bol. Astr. del Obs. Madrid*, 3, No. 5.

Articles by Ortez Farnaguera on a comparative study of different methods of orbit calculation with calculating machines and by Febrer on a statistical study of the distribution of asteroids are in print.

#### SWITZERLAND

A report has been received from Prof. S. Mauderli, Astronomisches Institut der Universität Bern.

Since 1939 orbit determinations have been made for the minor planets 1531, 1551, 1554 and 1556. Accurate special perturbations by Jupiter in the elements have been continued for 1009 Sirene, 1134 Kepler, 1308 Halleria, 1313 Berna, and 1435 Garlena. For Sirene occasional perturbations by Mars have been included. Dr Max Schürer took charge of the work on minor planets on April 1, 1946, when Professor Mauderli retired; Schürer has contributed numerous orbit corrections by approximate methods.

During the war, Mauderli maintained an extensive exchange of observations and circulars between the Observatories at Algiers, Cape of Good Hope, Córdoba, Johannesburg, La Plata and Nice with the Astronomisches Rechen-Institut. This exchange included the mailing of R.I. circulars Nos. 2103-2567 to these observatories, and in return of communications of observations to the Rechen-Institut.

#### UNITED STATES OF AMERICA

At the University of California, Berkeley, Dr Sophia Levy McDonald, of the mathematics department, has continued her development of general perturbations and the determinations of mean elements of minor planets of the Hecuba group on the basis of the Berkeley Tables. A summary of the highly satisfactory results on a total of 35 planets of

the group was reported by her at the December, 1947, meeting of the American Astronomical Society at Columbus, Ohio. A manuscript on the results of the individual planets is ready for publication.

Research Surveys for 1091 planets were published by Leuschner late in 1935 as Vol. 19 of the *Publications of the Lick Observatory*, and embody all available material published to June 30, 1929. Afterwards, these surveys were extended to include material published since that date, and surveys have been completed for additional planets up to and including planet 1489. This continuation is in manuscript and contains all available material published to June 30, 1938. It was carried out with the aid of the Works Progress Administration of the United States Government with Dr Katherine Prescott Tinker as supervisor of workers made available by that agency. No provision has yet been made for the publication and further continuation.

In a report received from H. M. Jeffers, covering the activity at the Lick Observatory, it is stated that a certain amount of the observing time with all the major instruments is available for the observation of comets and minor planets. The bulk of this work is carried on by means of the Crossley 36-inch reflector, and the 20-inch Carnegie astrograph. The principal observers are, on the Crossley, Dr H. M. Jeffers, and on the 20-inch astrograph, Dr C. D. Shane. The observational work on the comets and planets is to a large degree co-ordinated with investigations being carried on at Berkeley, principally by Dr L. E. Cunningham. An attempt is made to obtain observations of currently visible comets each month, and more often than this if the positions are needed. The minor planets that are observed are mainly those of special interest for one reason or another. (It has not been found practicable to devote much of the 20-inch time to the routine observation of the known minor planets.) Satellites are observed occasionally, for one reason or another. During the years 1942-45 few comet and minor planet observations were made, since during these years several members of the Observatory staff were away.

General observational programmes of minor planets and comets have been in progress at the Yerkes and McDonald Observatories, principally by Van Biesbroeck; at the United States Naval Observatory, Washington, D.C., in recent years principally by Sharpless and Reuning; and at the Lowell Observatory, Flagstaff, Arizona, principally by Giclas. Most of the observations obtained have been published in the *Astronomical Journal*.

Miscellaneous investigations of the motions of minor planets and comets have been pursued, particularly at the University of California, Berkeley, at the Cincinnati Observatory and at the United States Naval Observatory. Cunningham's numerous preliminary orbits and ephemerides of newly discovered comets, and his calculation and distribution of ephemerides of minor planets in the early months of 1947 were most significant contributions. In the latter part of 1947, an installation of punch-card calculating machines was made at the Cincinnati Observatory. With this equipment Herget intends to make extensive studies of the motions of minor planets. Since the work has only recently been started, no details are as yet available. Herget made significant contributions by undertaking the publication of minor planet circulars and by editing a compilation of all the minor planet ephemerides for the year 1947.

At the United States Naval Observatory, G. M. Clemence has initiated a programme of observation of thirteen minor planets which were selected by G. W. Hill, *Coll. Math. Works*, 1, 105-7, as particularly suitable for an accurate determination of Jupiter's mass. The periods of the principal terms of long period for these planets range from 61 to 121 years. By 1955, for all but two of these planets a complete period of the principal inequality will have elapsed since discovery. The current series of observations is intended to serve for the determination of accurate osculating elements which may be used as the basis of the computations of the perturbations.

As reported to Commission 4 by G. M. Clemence, work on the improvement of the orbits of the first four minor planets is in progress at the United States Nautical Almanac Office, at the Cincinnati Observatory, and at the Yale Observatory with the purpose of obtaining orbits that may be used for the calculation of precise ephemerides.

The Yale programme of observations of 16 selected minor planets for deriving systematic corrections to fundamental star catalogues has been continued, the series of observations to end in the summer of 1948. In 1938 G. van Herk at the Observatory at Leiden, Netherlands, began a series of observations with the 13-inch photographic refractor in support of this programme. Leiden observations for the years 1938–44 were published in the *Bulletin of the Astronomical Institutes of the Netherlands*, Vols. 9 and 10. Plates for this programme obtained at the Allegheny Observatory, at the Yale-Columbia Southern Station, and at the Yale Observatory are being measured at the Yale Observatory. Since 1941 this work has been carried out by G. Land and assistants. The computational work for the programme at the Thomas J. Watson Astronomical Computing Bureau at Columbia University came to a complete standstill in 1941. It was resumed in 1947 at the Watson Scientific Computing Laboratory, New York, through the co-operation of its director, W. J. Eckert. This includes both the plate reductions and the numerical integrations of the orbits.

At the Mount Wilson Observatory, Nicholson's photographic survey of the region around Jupiter led to the discovery of two new satellites in 1938, the motions of which were well established by a series of photographic observations with the 60-inch and 100-inch reflectors in subsequent years. Other important contributions to the study of the motions of faint satellites were made by Van Biesbroeck and by Sharpless. With the Yale telescope at Johannesburg H. L. Alden made an extensive series of observations (1939–42) of the satellite of Neptune and obtained an improved value of the ratio between the mass of the satellite and the primary,  $m_s/(m_p + m_s) = 0.0128 \pm 0.00023$  (*Astr. Journal*, 50, 110, 1943).

At the United States Naval Observatory, F. H. Hollander has undertaken the measurement of Saturn's satellites on photographic plates taken at the Allegheny Observatory and at the Yale-Columbia Southern Station. The principal immediate purpose of this work is the determination of the mass of Saturn.

At the Yale Observatory an investigation of the motions of Jupiter's Galilean satellites has been undertaken. A collection of eclipses since the middle of the seventeenth century has been made by J. Ashbrook. Various phases of the theory have been examined by Brouwer. It is hoped that a discussion of the eclipse material will throw new light upon the discordances found by the late Prof. W. de Sitter between the mean motions obtained from observations since 1890 and the average mean motions during the past three centuries.

The Watson Scientific Computing Laboratory at New York, with W. J. Eckert, director, has already demonstrated the capacity of its equipment and staff by the rapid calculation of ephemerides of 783 minor planets for 1947. With powerful additional equipment the Laboratory will be even better prepared to undertake important computational projects in the future. Several projects dealing with motions of minor planets, in addition to the Yale programme, are being considered.

#### UNION OF SOVIET SOCIALIST REPUBLICS

A report received from G. Shajn covers the activity at the Crimean Astrophysical Observatory at Simeis. The observations of minor planets were interrupted in September, 1941, two weeks before the invasion by German troops. The observatory was ruined, but is being rebuilt. Two 120 mm. cameras were preserved, and observation of minor planets was resumed in August, 1947. It is hoped that the observational work in this field can be developed to the same level as before the war.

For many years Prof. Shajn has not personally participated in this work and for this reason he wishes to resign from the membership of Commission 20. In the near future it will be cleared up who, from the staff of the observatory, will be engaged in the work so successfully carried on by the late Dr G. Neujmin before the war.

Although no report was received from the Institute for Theoretical Astronomy at Leningrad, reference should be made to the significant contributions by this Institute.

Recent publications show an intensive activity in the field of perturbation calculation and orbit correction of minor planets, both by special and general perturbations. The Institute issued printed ephemerides for 435 minor planets for the year 1947, and undertook the calculation of the ephemerides of all numbered minor planets that will be in opposition during the year 1948.

#### YUGOSLAVIA

A report has been received from Prof. V. V. Michkovitch, Secretary General of the Serbian Academy of Sciences.

A list of all insufficiently observed minor planets for which there are no orbits has been prepared by Prof. Michkovitch with the co-operation of others at the University Observatory at Belgrade. The list contains about 3600 observed objects, and furnishes: date of observation, observed position, daily motion if determined, apparent magnitude, and approximate date of opposition. For some objects approximate node and inclination have been computed. This compilation, which was begun before the war, has been completed, and it is hoped that it can be made available to astronomers and observatories as a publication by the Serbian Academy of Sciences. It is expected that this publication will be useful for the identification of minor planets even if all the records of the Rechen-Institut have been preserved.

The Astronomical Division of the Mathematical Institute of the Serbian Academy of Sciences has decided to initiate research on problems concerning minor planets, and contemplates taking an active part in the work of this Commission.

Communications were also invited from Prof. A. Kopff at Heidelberg, Germany, and from Prof. Y. Hagihara, Tokyo, Japan.

#### GERMANY

Prof. A. Kopff, director of the Astronomisches Rechen-Institut at Heidelberg and director of the Königstuhl Observatory, writes:

*Observations.* The Königstuhl Observatory intends to observe minor planets in the same way as before the war; at the moment it is not possible to obtain special plates for astronomical purposes so that the programme had to be nearly stopped.

*Calculations.* The Astronomisches Rechen-Institut in Heidelberg intends to do as much work on minor planets as possible. A special list of minor planets for which the perturbations and corrections of elements will be calculated in future has already been sent to Dr Brouwer and Dr Herget. Ephemerides for 1948 are being calculated for this programme. In the future ephemerides will be calculated according to a special plan. We also wish to extend this programme and to take part in the co-operative plan for the correction of elements of planets in connection with the work by high-speed calculating machines.

For all planets discovered at Heidelberg or elsewhere in Germany we wish to calculate the first orbits and ephemerides necessary to secure these bodies.

*Publications.* The observations and results of calculation will be published as quickly as possible by our publications here. But we also wish to send this material to all other authorities which need it. All ephemerides for 1948 are published in the *Veröffentlichungen* of the Observatory. The publication (first part) is now being printed.

#### JAPAN

Prof. Y. Hagihara, Director of the Tokyo Astronomical Observatory, Mitaka near Tokyo, reports that in 1946 he was appointed chairman of a research commission for asteroids and comets, created on his recommendation by the Japanese National Research Council. Under the auspices of this commission, several hundred ephemerides of minor planets for the year 1947 were computed. These were mostly on the basis of elements furnished in *Kleine Planeten* 1941. Perturbations were computed and included for only



a small number. These ephemerides were received by Dr Herget about the middle of 1947. For the year 1948 ephemeris calculations of about 300 minor planets have been made. The results were ready for mailing in November 1947. Approximate Jupiter perturbations are included for 49 minor planets (for 153 Hilda approximate Saturn perturbations are also included); approximate general perturbations are included for 40 minor planets. The remaining ephemerides were computed without perturbations, but improved elements were used for 1232 Cortusu and empirical corrections to the mean anomalies in 63 cases.

For the year 1949 Prof. Hagihara proposes to compute ephemerides for the same minor planets, increasing the number of orbits for which perturbations are to be taken into account, but this cannot be accomplished for more than about 100 minor planets. He stresses his desire to participate in co-operative work in orbit and ephemeris computations and in observations.

Work on comets in Japan has concerned principally the calculation of perturbed orbits of periodic comets that are expected to be observable in 1948 and 1949.

Several papers of theoretical content were published by Prof. Hagihara, including: 'A Proof of Poisson's Theorem on the Invariability of the Major Axes of Planetary Orbits', *Jap. J. Astr. Geophys.* **21**, 9-27, 1944; 'On the General Theory of Libration', *ibid.* 29-43, 1944.

With the help of two assistants Hagihara is computing the perturbations of Thule over a complete period of its libration. This work is similar to that on Hilda by K. Hirayama and K. Akiyama (*Jap. J. Astr. Geophys.* **15**, 137-48, 1937), which is being extended by Akiyama to its complete period of libration. For this purpose the Tokyo Observatory has completed the calculation of Jupiter's heliocentric positions with a ten-day interval from 1961.0 to 2060.0, based on Hill's tables.

The research commission encourages observations of asteroids and comets. The 8-inch Brashear camera at the Tokyo Observatory and the 12-inch Cooke telescope of the Kwasan Observatory are being used for this purpose, although it is difficult to obtain photographic plates. The Azabu Observatory was completely destroyed during the war. The larger Mitaka Observatory lost its main building with books and measuring equipment. The larger instruments of the Tokyo Observatory are not in working order.

#### RECOMMENDATIONS

The following recommendations have been received:

1. The interval of minor planet ephemerides in the annual volumes shall be changed to 10 days beginning with the ephemerides for the year 1950, the number of ephemeris dates remaining six.

For comet ephemerides the recommended intervals remain 2, 4 or 8 days, depending upon the motion. An interval of 10 days is acceptable for comet ephemerides computed so many years in advance that national ephemerides giving the solar co-ordinates for every day are not yet available.

2. The variation shall be published as a fraction,  $d\delta/d\alpha$ , so that the numerator and the denominator indicate the ephemeris correction in each co-ordinate corresponding to an advance of the object in its orbit by the amount of motion during one ephemeris interval. The quotient would be the variation as it had been given in the past. The advantage is that an estimate of the error in the mean anomaly may be converted directly into an ephemeris correction.

3. It is recommended that all observations be published to the full accuracy with which they have been measured and reduced. Accurate observations are to be encouraged especially for minor planets that have been observed in fewer than four oppositions and for the minor planets the motions of which are so accurately known that approximate positions cannot add significantly to the knowledge of the orbit.

4. Permanent numbers shall as a rule be assigned to new planets after they have been observed in two oppositions, and after a satisfactory orbit based upon accurate special perturbations has been obtained. In the case of planets that approach the earth within

the orbit of Mars a permanent number may be assigned after a single opposition, provided that the planet was well observed and that a satisfactory orbit was obtained.

5. Each annual volume of minor planet ephemerides shall contain an appendix giving the basis of all elements. The first year in which new elements are introduced it shall state the number and the extent in time of the observations upon which the orbit is based, the kind of perturbations employed, the range of the residuals, and a reference to the publication of the orbit correction. If the data have not been published, the name of the institution or computer responsible for the orbit shall be given. In succeeding years it shall give the year of the annual ephemeris volume in which this information was published, together with references to new relevant information that has become available.

6. Observers are urged to provide more observations of cometary brightness, especially precise observations. There is need for improved methods; experimentation with the application of photoelectric techniques to this field is desirable.

7. It is desirable to extend the investigation by Cowell and Crommelin of the motion of Halley's comet as far back into the past as possible.

Recommendations 1 to 6 were prepared by a group of American members. Recommendation 7 is made by Kamiński who adds the following comments:

The orbit of this comet was investigated only to 240 B.C. It is feasible to extend this work, at least approximately, for 2000 years or more. The computed apparitions of the comet may then be compared with the records found in S. Lubienietzki's work.

In addition to the consideration of these recommendations, the principal business for the meetings of the Commission is that of bringing more definite order to various phases of the work on minor planets that require international co-operation. The following items will deserve particular attention:

- (a) Division of the work of computing ephemerides.
- (b) Arrangements for the publication of annual volumes of ephemerides.
- (c) Arrangements for the prompt distribution of the results of observations.
- (d) Arrangements for assigning temporary designations and permanent numbers to newly discovered minor planets.
- (e) Arrangements for improving the planning of observations, possibly along lines suggested by Leuschner in Harvard Announcement Card, No. 781.
- (f) Plans for the recovery of minor planets that have not been observed in recent years, especially those that have been observed in fewer than four oppositions.
- (g) Division of the work of improving the quality of ephemerides by deriving adequate orbit corrections, with and without special or general perturbations.
- (h) In connection with recommendation No. 3, consideration of the question whether some provision can be made to guide observers in deciding whether accurate or approximate positions are desired for specific minor planets.

January 8, 1948

DIRK BROUWER  
*Vice-President of the Commission*

## REPORT FROM THE SUB-COMMISSION ON SHORT-PERIOD COMETS

The activities of the Sub-Commission have proceeded along the same lines as those outlined in *Transactions of the I.A.U.* 6, 387, although greatly hampered by the sad death of its president Dr A. C. D. Crommelin and by the war. At the Copenhagen meeting in March 1946, Miss J. M. Vinter Hansen of the Copenhagen Observatory was entrusted with acting as president of the Sub-Commission.

The main work of the Sub-Commission is to arrange for the calculation of orbits and ephemerides of short-period comets so as to avoid—as far as possible—the duplication of work. This—never an easy task—has been made further difficult by the present uncertain mail conditions; it has often been impossible for the President to get in touch with some of the astronomers who previous to the war had announced their intention of computing a definitive orbit for a short-period comet. In the following table of short-period comets

for which reservations are known to the President more than one computer have therefore sometimes been listed, the name in brackets denoting the computer who primarily has made no reservation through our Sub-Committee but has come nobly to our rescue when it seemed probable that no prediction for the next apparition of a comet would be forthcoming from the listed computer. We are greatly indebted in this respect to several astronomers, particularly to the computers in the Comet Section of the British Astronomical Association and to Dr Leland E. Cunningham of the Students' Observatory, Berkeley, who have often published search-ephemerides which led to the recovery of a comet that might otherwise have been lost. A question mark after the name of a listed computer means that either no results to our knowledge have materialized or that it has been impossible to contact the computer.

Name of comet	Period (years)	Last apparition observed	Next apparition	Computer
1. Encke	3.3	1947	1951	Matkiewicz
2. Grigg-Skellerup	4.9	1947	1952	Cripps
3. Tuttle-Giacobini	5.-	1907	?	Stephens (?)
4. Tempel 2	5.2	1946	1951	Ramensky
5. Neujmin 2	5.4	1926	1953 (?)	Poulkovo Observatory
6. Schwassmann-Wachmann 3	5.4 (?)	1930	1952 (?)	Parfenow (?), (Cripps)
7. du Toit (1945 c)	5.5	1945	1949	Cunningham
8. du Toit-Neujmin-Delporte	5.5	1941	1952	Naur
9. Tempel 1	6.0 (?)	1879	?	v. Schrutka-Rechtenstamm
10. Pons-Winnecke	6.1	1945	1951	Guth (?), Porter
11. Kopff	6.2	1945	1951	Kepiński
12. Forbes	6.4	1942	1948	Makarow (?), (Cripps)
13. Schwassmann-Wachmann 2	6.5	1948	1954	Rasmusen
14. Reinmuth 2	6.6	1947	1954	Rabe
15. Giacobini-Zinner	6.6	1946	1953	Cripps, Cunningham
16. d'Arrest	6.6	1943	1950	Recht
17. Daniel	6.8	1943	1950	Hirose (?), (Cripps)
18. Finlay	6.9	1926	1953	Cimino (?)
19. Borrelly	6.9	1932	1953	Cunningham
20. Brooks 2	6.9	1946	1953	Cunningham, Cripps
21. Holmes	7.-	1906	?	Koebecke
22. Reinmuth 1	7.2	1935	1950	Kanda (?)
23. Faye	7.3	1947	1955	Zseverzsev (?), (Cunningham)
24. Whipple	7.4	1947	1954	Cunningham
25. Wolf 2	7.5	1924	1954	Kanda (?)
26. Jackson-Neujmin	8.-	1936	1952	Poulkovo Observatory, Cunningham
27. Oterma (1942 VII)	8.0	Observed every year		Oterma, Herget
28. Schaumasse	8.2	1943	1952	Kanda (?) (B.A.A.)
29. Wolf 1	8.3	1942	1950	Kamieński
30. Comas Solá	8.5	1944	1952	Vinter Hansen
31. Swift	8.9 (?)	1889	?	Stephens (?)
32. Väisälä	10.-	1939	1949	Oterma
33. Gale	11.0	1938	1949	Cunningham, Cripps
34. Tuttle 1	13.6	1939	1953	B.A.A.
35. Schwassmann-Wachmann 1	16.3	Observed every year		Behrens, Cunningham, Herget
36. Neujmin 1	17.7	1931	1948	Poulkovo Observatory, (Cunningham)
37. Stephen-Oterma	38	1942	1980	Oterma
38. Westphal	61.7	1913	1975	Koebecke
39. Olbers	69.6	1887	1956	Rasmusen
40. Pons-Brooks	71.6	1884	1956	Herget
41. Halley	76.0	1910	1986	Bobone
42. Herschel-Rigollet	156.-	1939	2095	Maxwell + Kaster, Rigollet

The comet Pons-Coggia-Winnecke-Forbes on which Dr Crommelin did such a splendid work needs a computer. Its next apparition is due in 1956.

Astronomers who may wish to compute definitive orbits for short-period comets are urgently requested to consult the president of the Sub-Commission before starting work.

From a few members of the Sub-Commission reports have been received, the most extensive being that of Dr G. Merton. As it contains some valuable suggestions it is quoted here in full:

Since the last Report British work on comets has sustained a very severe loss in the death of Dr A. C. D. Crommelin, then President of this Sub-Commission. The predictions for the returns of periodic comets have always constituted one of the most important sections of work in the British Astronomical Association's annual *Handbook*, for which the Director of the Computing Section has been responsible. The death in 1939 of Dr Crommelin, who so greatly contributed to these predictions, left many problems unsolved, and a tribute must be paid to Dr J. G. Porter, appointed Director of that Section in 1940, for the able and energetic leadership he then brought to the whole organization of the work. In the midst of the duties of a professional career outside astronomy, and working under the great difficulties and anxieties of the war period he was able, with the assistance of a few amateur computers similarly overburdened by war-time duties, to continue the predictions in each annual *Handbook*. Recently Dr G. Merton, working in close collaboration with Dr Porter, has taken over the responsibility for organizing the work on these predictions.

As our first purpose must be to prevent the periodic comets from becoming lost, the B.A.A. aims to give predictions close enough to ensure the comets being recovered, that is to give  $T$  within, say, one day. When more accurate orbits are available from other computers these are used but, unfortunately, in many cases those who carry out the more thorough investigations do not complete, or do not communicate, their predictions in sufficient time for their inclusion in the *Handbook*. It has to be remembered that the *Handbook* has to go to press in August of the year previous to that for which the ephemerides are required; in some cases this means two years or more before the predicted perihelion. Some unnecessary duplication of effort has thus resulted, and steps to avoid this in future should be considered.

Of the perturbation methods that have been used in the B.A.A. work, the modified Cowell-Crommelin method of integrating the perturbed rectangular co-ordinates, and Encke's method, have yielded most of the best results. Their employment is limited, however, by the small number of our computers who can borrow, or afford to buy, the calculating machines necessary. The perturbation of elements method employing Crommelin's tables (*Mem. R.A.S.* 64, 149-207) is designed for logarithmic calculation but has not always proved successful because of the manner in which it was employed. Investigations are proceeding on the techniques to be adopted to reach a higher standard of accuracy in future predictions. One important need is for computers who are able to undertake the preliminary correction of orbits. Another is that other workers who are carrying on accurate investigations of orbits should communicate their results to the B.A.A. workers in advance of publication, especially their revised starting orbits for the prediction computations, in order that the use of inferior starting orbits may be avoided.

In the case of the orbits of periodic comets observed for the first time, attention is still rarely given by their computers to the need for indicating the range of uncertainty in the elements, particularly in the period. Experience has shown that the probable error in the mean motion deduced from a least squares' solution is not a good indication of the range of values for the period which the observations will tolerate, or of the reliability of a prediction based on the solution found. It is worth repeating the remark in Prof. Leuschner's report to the I.A.U. meeting at Rome in 1922 (*Trans. I.A.U.* 1, 57, item 6) that an orbit deduced from three first-class normal places will prove more valuable for predicting a finding ephemeris at the next return than the usual so-called definitive orbit, provided the extreme range of possible period and eccentricity is determined. It is now suggested that, if a 'definitive' determination is made, the residuals of the normal places should be expressed to show the effect of small changes in the mean motion adopted, and from them also the sum of the squares of the residuals for different assumed values of the mean motion. This will enable an estimate of the

range of uncertainty in the prediction to be made. Examples of this will be found in the cases of the periodic comets Grigg-Skjellerup (*Mem. R.A.S.* 64, 94–6) and Schaumasse (*M.N.* 87, 566–7), and it will be noted that although this demands that the computer shall make his solution in a certain way, it does not involve any great amount of extra work. It is also desirable in stating the elements that the corrections to them for a small change in the adopted mean motion should be given, in order to facilitate correction when an improved value is obtained as the result of re-observation at a subsequent apparition. It is admitted that none of these processes is accurate for any but small changes in the mean motion, since the differential factors on which the solutions depend themselves change with the alteration of the assumed elements. Nevertheless, this does not destroy their value for the purposes we have mentioned.

Work on the revision of orbits is sometimes delayed because the observations are not published for a long time, and it is not known what material is available. It is therefore suggested that observers of periodic comets should be requested to send to the I.A.U. Bureau (and the Chairman of this Sub-Commission), *immediately* after the apparition of each comet, a list of the dates of their observations and their nature, that is whether of accurate position or of physical details. Those investigating the orbits and physical changes of these comets could then be put into correspondence with the observers and obtain from them, in advance of publication, the extracts giving the essential data required.

The comparative lack of cometary observations from the southern hemisphere, especially when the object is faint, sometimes affects the work. It seems highly desirable that means should be found to ensure at least the minimum of essential observations when a comet in southern declination is out of reach of northern observatories, even if no extended programme of cometary observations is considered justified by the better equipped southern observatories. At some returns a comet does not come within reach of a northern observatory and the only hope of recovering it lies in searches by southern observatories, e.g. in the case of Encke in 1944 and Schwassmann-Wachmann (3) in 1946. It will have been noted that the record of observation at every return since 1819 of Encke's comet was broken in 1944 when no observation was recorded. Yet during the whole of October that year, a few weeks after perihelion, the comet was over 50° from the Sun and, though faint, could probably have been recorded if searches with a suitable instrument had been made in the southern hemisphere. If it is considered impracticable to deflect larger instruments from their programmes to this occasional work, thought might be given to the possibility of providing on loan to amateurs in the south two or three Schmidt cameras of moderate size to meet this need.

Dr Van Biesbroeck has sent the following interesting remarks:

At present two periodic comets with small eccentricity have been followed through aphelion and are therefore observable like an asteroid at each successive opposition. They are 1925 II (Schwassmann-Wachmann) and 1942 VII (Oterma). In the latter object the brightness changes normally with the distances, while the first one behaves in the most erratic way as far as light-intensity is concerned. Sometimes it has changed between magnitudes 9th and 18th in the course of a few days; sometimes it hardly changes for several months. Upon investigation there is no indication of deviations from normal motion connected with this unusual behaviour.

Further, the attention is drawn to Prof. Kamiński's proposal, found elsewhere in the general report of Commission 20, that the computation of the orbit of comet Halley should be carried as far back as possible and even extended, approximately, two or more millennia back.

JULIE M. VINTER HANSEN  
*President of the Sub-Commission*



## Report of meetings

ACTING PRESIDENT: Dr D. BROUWER.

SECRETARIES: Dr S. AREND, Dr G. MERTON.

The appointments of the Vice-President, Dr D. Brouwer, to take the chair during this meeting, and of the secretaries, Dr S. Arend and Dr G. Merton, were agreed by the members of the Commission present.

The chairman read greetings to the members and best wishes for the success of the meeting received from the President, Prof. E. Delporte, who was unable to be present. Both the Chairman and the new President of the Sub-Commission on periodic comets, Miss J. M. Vinter Hansen, referred to the serious loss the Commission had sustained in the death of Dr A. C. D. Crommelin, the late President of the Sub-Commission.

Dealing with the report of the Sub-Commission on periodic comets, Miss Vinter Hansen said she had little to add to the printed report. The task of the Sub-Commission was to arrange for the computation of the orbits of periodic comets so as to avoid duplication of work. This has not always been possible as will be seen from the list (p. 230). It was partly due to the bad communications that existed during the war. Moreover, it had been difficult, she said, to do anything about it because it is also our work to see that ephemerides appear in good time, and, as we have not always been able to rely on those who have promised predictions, we have sometimes been very grateful to others who, although unannounced, have provided us with orbits.

It was remarked that the list was not complete, and it was suggested that it would be useful if a list of periodic comets for which computers were needed could also be published.

The suggestion was made by Mr Merton that the name of the periodic comet Pons-Coggia-Winnecke-Forbes was very cumbersome and that the present occasion offered a fitting opportunity to honour the name of the past President of the Sub-Commission, who had done so much for cometary astronomy, by naming the comet 'Crommelin's comet'. This was not a new idea as, when Dr Crommelin had submitted to the late Prof. Kobold his proofs of the identification, Kobold had not only accepted them but had from that time always referred to this comet in the *Astronomische Nachrichten* and elsewhere as 'der Crommelinischer Komet'. After a short discussion the following resolution was unanimously agreed:

*Resolution 1.* The Commission recommends that the periodic comet Pons-Coggia-Winnecke-Forbes should in future be called Crommelin's comet.

The announcement by Prof. F. Kepiński that he would continue his investigations of the periodic comet Kopff was welcomed. The records of his computations, he said, had been lost in the war, but he had saved the accurate ephemerides for the 1939 and 1945 apparitions. These he had compared with observations. A note of these results (residuals about 0'·5 in 1945) was presented by him for members to see.

Prof. A. A. Mikhailov referred to the work on periodic comets being done in the U.S.S.R., and mentioned in particular the work on the motion of Encke's comet that was begun at the end of 1944 at the Institute for Theoretical Astronomy of the Academy of Science of the U.S.S.R. This is a continuation of the well-known investigation by Matkevitch, and is being carried out under his supervision. While the Institute will carry forward this study it also intends to undertake the study of the motions of some other periodic comets.

Mr Merton drew attention to the need of preventing confusion in the naming of comets now that it frequently happened that one observer discovered several. He suggested that numbering after the name of a discoverer should be used only to clarify the identity of the comet and not to denote the number of comets discovered by any one observer. The following resolution which, it was pointed out, conformed to previous custom, was then carried:

*Resolution 2.* The Commission recommends that the addition of numbers after the names of comets should be made only for the purpose of distinguishing between cases of periodic

comets bearing the same name (or combination of names) as a previous comet, and that other periodic comets, and all 'non-periodic' comets, should be distinguished simply by the year and letter (or year and Roman numeral) in conjunction with the name of the discoverer. For example, the du Toit Comets, in their order of discovery are thus designated: 1941 VII P/du Toit-Neujmin-Delporte, 1944 III P/du Toit (1), 1945c P/du Toit (2), 1945d du Toit, and 1945g du Toit (where P/ indicates a periodic comet).

Attention was drawn to the importance of having immediate notification by telegram of the recovery of periodic comets on their returns, and of having early information after the apparition of the observational data which would be available. It was agreed that the observer should notify the I.A.U. Bureau through the appropriate official channels, immediately upon securing the recovery observation. This would be unnecessary in the case of comets under more or less continuous observation such as Schwassmann-Wachmann (1) and Oterma, which were not given annual letter designations.

It was also agreed that observers should be requested to notify the President of the Sub-Commission, after the apparition of every periodic comet, of the extent and nature of their observations of it (positional and physical), without waiting to complete the reductions. Computers and others requiring the use of the observational material could then ascertain from the President of the Sub-Commission what would be available to them and, if necessary, could request advance copies of this information.

The Commission then considered the recommendations listed in the Draft Report. The first proposal was passed in amended form as follows:

*Resolution 3.* The Commission recommends that, beginning with the ephemerides for the year 1950, the interval of minor planet ephemerides shall be changed to 10 days, chosen to conform with the rule for the standard 40-day dates, the number of ephemeris dates remaining six.

The second part of the original proposal, advocating 8-, 4-, or 2-day ephemerides for comets, was not agreed. The desirability of achieving uniformity with the preceding resolution concerning minor planets was urged, and Dr Comrie suggested for discussion that the intervals might be made 10, 5, or 2 days. Dr Jeffers, seconded by Miss Vinter Hansen, objected to the suggestion of these intervals as compared with the 8-, 4-, or 2-day basis on the general ground that an ephemeris with a 5-day interval does not lend itself to rapid and convenient subdivision. Observers frequently find it desirable to reduce the published ephemeris intervals of comets by interpolation to halves, in order to be able to obtain the position and rate of motion from the ephemeris without having to consider higher differences.

It was agreed, however, that cases for which a 5-day ephemeris would be troublesome from this point of view did not occur very frequently. These objections would be met if the computers would in such cases give ephemerides for shorter intervals than has been their previous practice.

Dr F. L. Whipple urged that it was important to avoid the confusion that would result if the choice of one of these systems were left optional. After some further discussion the following resolution was passed:

*Resolution 4.* The Commission recommends that the interval normally employed in comet ephemerides should, from the beginning of the year 1950, be 10 days or 5 days, the dates being chosen to fit the standard 40-day dates. But that in all cases in which a high rate of motion or a rapid change of motion occurs, such as is likely to make the interpolation of position or of the instantaneous rates of motion troublesome to the observer, the computer should give the ephemeris for 2-day or 1-day intervals.

The attention of Commission 4 was drawn to Resolutions 3 and 4 with the suggestion that it would be of value if the national ephemerides distinguished in some way the standard 10-day dates in the tables of solar co-ordinates.

The Commission considered and approved the next proposals in the Draft Report, subject to a few slight modifications. The resolutions were carried in the following terms:

*Resolution 5.* The Commission recommends that, in ephemerides of minor planets, the variation shall be given in two ways, the one in the form which has been customary, and the other in the form of the ratio  $\Delta\delta (r^\circ)/\Delta\alpha (r^\circ)$ , the numerator and the denominator denoting the changes in the declination and in the right ascension, respectively, for an alteration of  $+1^\circ$  in the mean anomaly.

*Resolution 6.* The Commission recommends that all observations should be published to the full accuracy to which they have been measured and reduced. And further, that the ephemerides of planets for which accurate observations are desired should be marked to indicate the fact to observers who, in such cases, should not be content to obtain approximate positions only.

*Resolution 7.* The Commission recommends that permanent numbers shall, as a rule, be assigned to a new minor planet after it has been observed in two oppositions and a satisfactory orbit has been obtained. In the case of a planet that approaches the Earth within the orbit of Mars, a permanent number may be assigned after a single opposition provided that the planet was well observed and that a satisfactory orbit was obtained.

*Resolution 8.* The Commission recommends that each annual volume of minor planet ephemerides shall contain an appendix giving the basis of each set of elements. The first year in which new elements are introduced it shall state the number and the extent in time of the observations upon which the orbit is based, the kind of perturbations employed, the range of residuals, and a reference to the publication of the orbit correction. If the data have not been published, the name of the institution or computer responsible for the orbit shall be given. In succeeding years it shall give the year of the annual ephemeris volume in which this information was published, together with references to new relevant information that has become available.

Consideration was then given to the sixth proposal of the Draft Report requesting more observations of cometary brightness. After discussion it was decided that this matter should first be referred to Commission 15. Subsequently the Commission unanimously voted the following resolution:

*Resolution 9.* The Commission recommends that observers should be urged to provide more observations of cometary brightness, especially more reliable determinations of it. Further, the details of the methods used should be reported in the final publication of the observations.

The chairman then asked Prof. A. A. Mikhailov to report on the work on minor planets which was being done in the U.S.S.R. His report gave the following information:

Until 1941, the Institute for Theoretical Astronomy of the Academy of Science of the U.S.S.R. (formerly Leningrad Astronomical Institute) performed the following work:

(1) Investigation of the motions of the planets near Jupiter (Trojan planets and planets of the Hilda and Hecuba types), about 100 planets in all. Numerical integrations of the equations of motion, taking into account the attractions by Jupiter and Saturn, were performed. For the majority of these planets the orbital elements were corrected, using several (4 to 8) oppositions. The results of this work were published in *Bulletins of the Institute and in the Russian Astronomical Journal*.

(2) For the planets of the Minerva type (mean daily motion near  $750''$ ) the perturbations were computed by the method of Bohlín. For 40 planets tables of perturbations were computed. For 20 of these the elements were improved, using several oppositions, and the mean elements determined. These results were published in nos. 53 and 55 of the *Bulletin of the Institute*.

(3) For all of the above-mentioned planets, ephemerides in which perturbations by Jupiter and Saturn had been taken into account were computed annually.

The work which almost stopped during the war was resumed in 1945. For 1946 ephemerides of 219 bright planets (not fainter than 12.5) were computed, 55 with perturbations and 164 without perturbations. These ephemerides were computed and distributed in mimeographed form to all Soviet and certain foreign observatories.

For 1947, 435 ephemerides were computed. Of these, 175 were with perturbations. These ephemerides were published in two parts, in April and in June.

In a letter of August 29, 1946, the President of the International Astronomical Union, Sir Harold Spencer Jones, asked the Institute for Theoretical Astronomy to undertake the computation of search ephemerides of all minor planets. Accordingly, the Institute undertook the computation of ephemerides of all numbered minor planets, beginning with the year 1948.

The ephemerides of 677 minor planets whose oppositions occurred during the first six months of 1948 were published by the Institute at the end of 1947. The ephemerides of the remaining 556 planets with oppositions during the second half of 1948 were distributed in July, 1948. This second part also contains the elements of all 1563 numbered minor planets.

The number of minor planets that have oppositions in 1948 is 1233. For 276 of these, ephemerides were computed with perturbations (numerical integration was used for 96 planets, Bohlin's method for 50 planets, and Brendel's method for 138).

The following institutions participated in the computation of the ephemerides for 1948: the Sternberg Astronomical Institute in Moscow, the Institute of Mathematics and Physics of the Latvian Academy of Science, the Kiev Observatory, the Odessa Observatory, and schools of astronomy of the Universities of Kazan, Kharkov and Rostov, and of the Kherson Pedagogical Institute.

For 1949 for the first time the ephemerides of minor planets will be published in one volume for the whole year. This issue will contain the ephemerides of 1199 planets that will have oppositions in 1949. The computation of all unperturbed ephemerides was performed with the aid of punched-card machines. The number of planets for which perturbations are taken into account has been increased only slightly as compared with that in 1948. All these computations are based on the elements published in the circular *Ephemerides of minor planets for 1948, Part two*. The computations have been completed, the manuscript went to press in June, 1948, and it is hoped that the volume will be published in November, 1948.

Plans for future work include:

(1) The publication of ephemerides as early as possible. The ephemeris computations for 1950 are being carried out on the same basis as those for 1949. The work is almost finished; the manuscript will go to press in November, and will be printed during the first half of 1949. The volume will be distributed promptly.

(2) Simultaneously with the computation of ephemerides for 1950, numerical integrations in rectangular co-ordinates are being performed for 375 planets of the Hecuba type. Perturbations by Jupiter only are taken into account. This work, which is being done with punched-card machines, has just been started. The results will be available for the first time for the computation of the ephemerides for 1951.

(3) At the end of 1948 it is proposed to begin the systematic improvement of the elements of the orbits of planets for which there are observations in at least four oppositions during recent years.

(4) It is planned to continue the systematic study of the motions of planets with unusual orbits: 887 Alinda, 944 Hidalgo, 1221 Amor, and some others.

(5) The ephemerides of the planets Ceres, Pallas and Juno are computed by the method of numerical integration with perturbations by Jupiter and Saturn. The ephemeris of Vesta is computed with the tables of Leveau. It would be possible to compute these ephemerides for a long period of time.

The chairman expressed appreciation of the great amount of work done by the Institute for Theoretical Astronomy of the Academy of Science of the U.S.S.R. He regretted that, notwithstanding the excellent efforts of this Institute, there had been a considerable

amount of duplication of calculation on account of unavoidable delays in receiving ephemerides from Leningrad. For 1949 there would again be duplicate publication of ephemerides. He reminded the members of the Commission that the arrangement made in 1946 was on a temporary basis, and suggested that, beginning with the ephemerides for 1950, it might be possible to return to the original plan whereby there would be truly international co-operation and a single publication of ephemerides of minor planets under the auspices of the International Astronomical Union.

The chairman stated that so many minor planets are urgently in need of perturbation calculations and orbit corrections that rapid improvement in the average quality of the ephemerides will be possible only if the work can be shared by all the institutions interested in contributing. He then outlined how the work might be divided between the Institute for Theoretical Astronomy of the U.S.S.R., the Rechen-Institut at Heidelberg, and other centres elsewhere, all working in collaboration in a general scheme.

In the first part of the publication of the ephemerides computed by the Rechen-Institut for 1948 (*Veröff. d. Badischen Landessternwarte zu Heidelberg (Königstuhl)*, Band 15, No. 4, p. 42) a list is appended of 631 minor planets, or about 40% of the total number, for which the Rechen-Institut has adequate data for the calculation of ephemerides. It would be unnecessary, he said, to duplicate work on any of these planets elsewhere as long as so much remains to be done on the remaining 60% of the numbered planets. This remainder might well be divided about equally between the Institute for Theoretical Astronomy of the U.S.S.R. and institutions elsewhere. Among work by the latter, he referred to a large project undertaken by Dr P. Herget at the Minor Planet Centre at Cincinnati in co-operation with other institutions. This concerns especially numerical integrations and orbit corrections of minor planets observed in only two or three oppositions and also some other planets that have shown very large deviations from their ephemerides in recent years.

Mr Mikhailov agreed that it would be possible to avoid duplication of publication after 1950, but that in the U.S.S.R. the ephemeris material up to then was either already in the press or in the process of completion. Following some further discussion, the chairman remarked that he wished it recorded that he (Brouwer) had made repeated efforts during the past two years to achieve a proper division of the work. Would the Institute for Theoretical Astronomy, he asked, now be prepared to transmit a selected list of those minor planets for which it had adequate data and for which it could furnish ephemerides for the ephemeris volumes to be published by the I.A.U. for 1950 and subsequent years? Mr Mikhailov replied that he thought it would.

The Commission approved unanimously the outline of the future plan of work presented by the chairman, and after some discussion the following three resolutions were passed unanimously:

*Resolution 10.* The Commission recommends that the Minor Planet Centre at Cincinnati be maintained, that it continue the publication of the Minor Planet Circulars, and that, beginning with the ephemerides for the year 1950, the Centre publish the annual volumes of ephemerides under the auspices of the International Astronomical Union.

*Resolution 11.* The Commission recommends that an annual grant of one thousand dollars be given to the Minor Planet Centre for the publication of its circulars and ephemerides.

*Resolution 12.* The Commission recommends that the Minor Planet Centre at Cincinnati be authorized to assign provisional designations and permanent numbers to minor planets and to approve and assign the names proposed for them by their respective discoverers.

With regard to the responsibilities of the Minor Planet Centre stated in Resolution 12, the chairman proposed and the Commission approved that there would be a small committee to assist Dr P. Herget, in charge of the Centre, in the decisions.

Attention was drawn by Mr Merton to the lack of observations of faint comets by



observatories in the southern hemisphere, and the delays in their communication. He moved the following resolution, supported by Miss Vinter Hansen, and this was agreed:

*Resolution 13.* The Commission draws attention to the lack of observations of faint comets by observatories in the southern hemisphere, and recommends that steps be taken by observatories suitably equipped to obtain, especially in the case of periodic comets, at any rate the essential minimum of observations of position and magnitude when the comets are out of reach of active observatories in the northern hemisphere, and to communicate such observations without delay to the I.A.U. Bureau.

Prof. Th. Banachiewicz spoke in favour of the proposal made in the Draft Report by Prof. M. Kamiński, that the orbit of Halley's comet should be traced backward as far as possible and comparison made with S. Lubienietki's work. The Commission recognized the desirability of this work and expressed the view that the undertaking should be encouraged.

Prof. G. Fayet informed the meeting of the work being carried on at Nice by M. Patry in the identification of minor planets with provisional designations for which the number of published observations has been insufficient for the determination of an orbit. Out of 400 cases in the period 1900–30 M. Patry has been able to find 70 identifications. After the chairman had pointed out the great value of this work, the Commission unanimously passed the following resolution:

*Resolution 14.* The Commission expresses the wish that the research undertaken by the observatory at Nice, in identifying those minor planets discovered after 1900 for which only two observations were obtained, be continued.

The chairman referred to the Research Surveys of minor planets, carried on under Prof. A. O. Leuschner, and to their great value. He proposed a resolution, warmly supported by Prof. G. Fayet and Prof. A. Kopff, which was carried as follows:

*Resolution 15.* The Commission reaffirms its high opinion of the usefulness of the *Research Surveys of Minor Planets* prepared and published under the direction of its honorary president, Prof. A. O. Leuschner, and recommends that they be continued. It expresses the hope that ways and means may be found for this purpose.

Turning then to the subject of planning of observations, the chairman referred to the minor planet work at the Union Observatory, done in recent years by Mr E. L. Johnson. The limiting magnitude is 14. In order to be able to cover the sky it was desirable to limit the observations there to declinations south of  $-15^\circ$  during the months March to September. This would enable them to obtain two positions, or more, for planets requiring this attention. Dr G. Meyer and M. A. Schmitt of Algiers stated that they could co-operate with the Union Observatory to secure adequate coverage of the sky, and that the equipment at Algiers could reach a limiting magnitude 16. Mr Kopff said that a division of the sky according to declination might be acceptable for the southern sky, but that attempts by the Rechen-Institut to arrange this for the northern sky had not proved successful. It was decided that a quarterly publication in the Minor Planet Circulars of lists of minor planets that were in urgent need of observation would be most useful. The Minor Planet Centre could further give individual attention to special minor planets.

The chairman also reported two recommendations by Mr Johnson: that planets differing 3 minutes of time or more in right ascension from their ephemeris positions should be followed more closely, with two or more observations; and further, that if a planet searched for was not found, this fact should be reported. He thought that these were good suggestions.

As to the planning of computations, the chairman stated that the programme for the immediate future should be: (a) the orbit correction, with or without perturbations, of all planets differing 3 minutes of time or more of right ascension from their ephemerides, and (b) the orbit correction, with or without perturbations, of all planets observed in

2 or 3 oppositions. For planets observed in only one opposition, it would as a rule be impossible to improve the orbital elements. He suggested that all astronomers interested in taking part in the project should communicate with him or Dr Herget concerning the work they might wish to undertake, and give a list of the planets in which they were interested.

The subject of the magnitudes of minor planets was discussed briefly, Mr Kopff pointing out that he had found as much as two magnitudes difference between the two systems used.

The chairman also reported that Mr Whipple, not present at this session, had hoped to speak on the purpose and direction of future work on minor planets.

It was decided that two committees be appointed by the chairman to study each of these two problems, and to report to the Commission at the next meeting of the Union.

The Commission had such a crowded agenda that there was no time left during any of its four sessions to have scientific papers presented to it. Among the papers considered, read by title, were: a communication by Prof. W. W. Heinrich on a suitable transformation found by him for the treatment of proximity and collision problems in planetary motion, and a communication by T. Ura and T. Takenouchi on numerical integration. The latter had been received by the chairman from Prof. Y. Hagihara. Dr E. Sevin had asked time to speak on the prediction of trans-Uranian planets. He subsequently presented this subject at a time not scheduled for a session of the Commission.