

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

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COMITÉ D'ORGANISATION: S. Arend, D. Brouwer, F. K. Edmondson, W. Fricke, H. Hirose.

MEMBRES: Ahmed, Bohme, Boyer, Bruwer, Candy, Clemence, Cunningham, Fayet, Gehrels, Gennaro, Giclas, Gutierrez-Moreno, Heinrich, Herrick, Hertz, Hirst, Itzigsohn, Jeffers, Kahrstedt, Kamienski, Kepinski, König, Kresák, Kuiper, Laugier, Makover, Michkovitch, Missana, Orlov (A. A.), Pels, Popovic, Porter, Protitch, Rabe, Rasmusen, Reinmuth, Rigaux, Robertson, Roemer, Schmitt, Schrutka-Rechtenstamm, Schubart, Spigl†, Strobel, Subbotin, Torroja, Väisälä, van Biesbroeck, Wilkins, Wood (H. W.).

INTRODUCTION

From the vantage point of the Minor Planet Center, it is easy to see that the amount of activity in the area of minor planets continues gradually to diminish. Among the obvious reasons are: the retirement of K. Reinmuth, an indefatigable observer; the death of A. Patry, who was eminently successful in establishing identities; the removal of L. Boyer, an excellent observer, from the observatory at Bouzareah, Algeria; and the demands of other duties upon the observers at Turku. Replies to the President's notification of 20 September 1963 were received from Arend, Fricke, Heinrich, Hirose, Michkovitch, Popovic, Porter, Protitch, Rabe, Miss Roemer, Schubart, van Houten, Wilkins, Wood, and Mme Yakhontova. No formal report has been received from the U.S.S.R., so that the extent of activities there is not fully known. In the area of comets, the draft report has been prepared separately by Dr J. G. Porter.

OBSERVATIONS

Observations with the 10-inch Cooke triplet at the Goethe Link Observatory continue at the same pace as in recent years. This has accounted for about one-fourth of all minor planet observing during the last decade. Usually only approximate positions are reported; but recently several hundred accurate positions have been required for orbit improvements at Leningrad and Cincinnati. At Uccle, observations of asteroids and comets with the double astrograph ($f/5$, two meters focal length) have been continued along the same lines as previously. Observers: Arend, Dommanget, Rigaux, Roland. At Heidelberg, the flow of minor planet observations has dwindled. Hirose indicates the possibility of observations being made with the new 36-inch reflector at Mt. Dodaira. Belgrade regularly observes (51) Nemausa, the planets of the Washington and Pulkova lists, and other planets brighter than magn. 12. At Flagstaff, Miss Roemer observes primarily faint minor planets and satellites at the rate of about 100 plates per year, including 12 Trojans within the past two years, (1011), (1362), (1580), (1620), (1627), etc. Jup. VIII has been well observed from an ephemeris by Kovalevsky, and Jup. IX and XII from ephemerides by Herrick. Sydney, Australia, observes the even numbered planets which are south of the equator, leaving the odd numbered ones for La Plata. Special attention is also given to certain planets which are of special interest—e.g. (6, 7, 11, 18, 39, 40, 433). Observations have not come from Algiers during the last year.

Van Houten reports the present status of the Palomar 48-inch Schmidt minor planet survey. An area $18^\circ \times 12^\circ$, centered at $0^h, 0^\circ$, was photographed on eight nights during September and October 1960. C. J. van Houten and I. van Houten-Groeneveld blinked the plates at

Heidelberg, and measured them at Groningen. There are 19 numbered planets, 732 new objects found in both months, 970 found on four plates in one month, 458 found on three plates. The photometry of these objects, made at the Leiden Observatory, is one-third complete. The faintest asteroids found have a brightness of about 20.4^m , and the material is practically complete down to 20.0^m . The Cincinnati Observatory will reduce the plates (one plate has been completed as a test), and then will compute orbits for all the determinate cases. This is a joint program of the Leiden and Cincinnati Observatories and the Lunar and Planetary Laboratory, Tucson; it was initiated by G. P. Kuiper.

ORBITS, EPHEMERIDES, IDENTITIES, ETC.

The Institute of Theoretical Astronomy continues to publish the annual ephemeris volume in the same style and format that has proved satisfactory in former years. In 1961 the Institute reported that: (a) 696 planets computed at Leningrad have entirely reliable ephemerides; (b) 363 planets have ephemerides of lesser quality (mainly because of inadequate distribution of observations, or because orbit improvements have not yet been undertaken); (c) 308 planets have ephemerides provided by collaborators (Cincinnati, Tokyo, etc.); (d) 238 planets have ephemerides computed only from elliptic elements. The count from the 1964 volume shows 1332 S-planets, 179 A-planets, and 139 without perturbations, an obvious improvement in the last category.

Since 1961, the Cincinnati Observatory has improved the orbits of 202 numbered planets and produced all the ephemerides (from quadrature to quadrature, see MPC2117) on microfilm until 2000 AD. More work of this kind is under way. Dr O. Kippes, Miss Mitrovnich and some others continue to make identifications. About 50 objects with tentative identifications have new ephemerides computed at Cincinnati, and if they can be recovered and well observed in one more opposition, they can be numbered.

The *Identifizierungsnachweis der Kleinen Planeten* was published by W. Strobel (*Veröff. astr. Rechen-Inst. Heidelberg*, no. 9, 1963). This is the fifth edition of an index of identifications of Minor Planets compiled at the Astronomisches Rechen-Institut, the first one appeared in the year 1901. The index contains a chronological list of all discoveries including identities and their sources. In another list the identities of all numbered Minor Planets are given in numerical order. Incorporated in the 'Identifizierungsnachweis' are all data which became available up to 1961, November 15.

At the Astronomisches Rechen-Institut the card-files have been continued containing: (a) the sources of all observations and computations, (b) the O-C of all numbered Minor Planets, and (c) the elements of all Minor Planets in the order of Ω .

The Cincinnati Observatory maintains an Index (now exceeding 80 000 cards) of one punched card for each minor planet observation since 1939, the contents of Heidelberg 16 and 17, and older observations which have been required for orbit improvements. The format since 1961 is described in MPC2033. Also, a project is under way to remeasure (at Nice) and reduce (at Cincinnati) 6000 observations made at Nice by Mme Laugier since 1940, but there has been no progress during the last year.

GENERAL

W. W. Heinrich is studying the general planetary problem with a view to eliminating the reciprocal distances, not from the potential, but from the righthand members of the equations of motion by means of an 'operation' previously defined in *Acta Mathematica*, **88**, Stockholm, 1951, *Časopis pro pěstování matematiky a fyziky*, Praha, 1913.

The 'operation' leads to an integral equation for a simple linear coupling of the major axes. The said integral equation allows in general a complete resolution. In case of eccentric

anomalies, one is dealing nearly within the scope of finite polynomials, thus avoiding entirely the calamity of small divisors of the classical theory.

The author looks chiefly for problems (hitherto inaccessible to the classical ways of Laplace—Lagrange) which could be approached from the purely analytical functional way of calculus. His chief aim is the lunar problem (*Acta Math.* **88**, the problem of Trojans, the problem of orbits linked together as the rings of a chain (Gauss), the problem Thule, Chicago, and Hyperion-Titan. In press: *An Integral Equation for the Major Axes in the Problem of Three and n Bodies*, Academy of Prague.

V. V. Michkovitch has calculated the mean periods of the quasi-identical oppositions of all numbered planets. Attempted identifications of (155), (473), and (719) have been unsuccessful. In press is a study of some peculiarities of quasi-coplanar asteroids. Two theses have been completed: J. Simovljevic—*Generalization of the vectorial elements of Keplerian motion*; and J. Lazovic—*On some interesting peculiarities in the motion of quasi-coplanar asteroids*.

B. Popovic reports: 'Dans le travail "Kalkulado de planed – kaj kometefemeridoj senpere el iliaj pozicio kaj rapido" (*Bull. astr. Obs. Beograd*, **24**, no. 1-2, 13, 1959) j'ai proposé un procédé pour un calcul rapide des éphémérides (resp. des f , g dans $r_t = fr + gv$), sans qu'il soit besoin de trouver les éléments de l'orbite. Le procédé est donné sous la forme de formules fermées et sous la forme de séries en degrés des petites quantités.

'Je prépare une méthode générale pour la détermination des orbites, valable pour tous les cas d'orbites et aussi pour chaque technique de calcul. J'ai préparé aussi une méthode pratique de détermination des perturbations planétaires, absolument valable pour toutes les inclinaisons et toutes les excentricités. J'aimerais décrire ces deux méthodes au cours des séances des Commissions 20 et 7.'

At Belgrade, Miss Mitrinovich computes circular orbits for all objects with two observations, as part of a continuous program to establish identifications.

E. K. Rabe's work in the area of Trojans and the Restricted Problem is reported in detail under Commission 7.

J. Schubart and P. Stumpff report the development of a Siemens 2002 computer program to integrate simultaneously the motion of up to ten bodies with a fixed interval size. However, the interval size can be changed without stopping the computer. Several minor planets can be run concurrently together with the major planets, provided the starting values are all for a common epoch. The program was successfully tested on a recomputation of the work done in Vol. XII of the *Astronomical Papers of the American Ephemeris*, and on a computation for (1221) Amor. J. Schubart is also engaged in theoretical studies of orbits of the Hecuba-, Hilda-, and similar types.

G. A. Wilkins reports: 'We have picked up again the work on the satellites of Mars that I started in 1957, and I am hoping that I shall have reached some conclusions about the secular accelerations of the satellites before the meeting next year.'

Herget has completed a program for the IBM 1620 to integrate the equations of motion of the outer satellites of Jupiter, and simultaneously to integrate all the partial differential coefficients required to represent the displacement vector with respect to the starting values and the mass of Jupiter. It is planned to prepare a differential correction program, an ephemeris program, and to analyze fully the orbits of all of the satellites of Jupiter except the first five.

PROPOSALS

Mme Yakhontova proposes that the list of elements in the annual ephemeris volume be changed by removing the 'S' for special perturbations, retaining the 'A' for absolute perturba-

tions, and introducing 'E' for elliptic elements when there are no perturbations. At present a large majority of all planets have 'S'.

Prof. Hirose proposes the re-instatement of some symbol to designate those planets for which observations are urgently needed.

G. A. Wilkins proposes omitting from *The Astronomical Ephemeris* the rectangular Solar Co-ordinates referred to the equinox of the beginning of the year. This is supported by J. G. Porter.

M. B. Protitch proposes: 'Vu les difficultés que je viens de signaler plus haut, il me paraît raisonnable de vous proposer la mise à l'ordre du jour de la session de notre Commission, d'une discussion sur la possibilité d'établir un Service spécial, responsable devant la Commission 9 par exemple, qui s'occuperait de fournir les données astronomiques courantes nécessaires. Ce Service, qui aurait un règlement intérieur semblable à celui du Bureau des Télégrammes, et travaillerait sur la base des abonnements souscrits, pourrait même intervenir dans bien d'autres questions, communes à l'astronomie pratique quotidienne.'

En vous suggérant une telle idée, dont les modalités doivent être encore précisées, je pars de la conviction qu'un bon nombre d'astronomes, nos collègues, se trouvent dans une situation identique, dès qu'il s'agit pour eux de se procurer des données, nécessaires à la réalisation de leur programme astronomique.'

In view of the success of Kuiper's minor planet survey in 1951-52, and the gradual decline of observing, Herget is investigating the possibility of a comprehensive and co-operative observing program of continuous sky coverage. The NASA Minitrack stations each has a 40-inch focal length, $f/5$, aerial camera, equatorially mounted, at its center, and equipped for 8×10 -inch plates. Since at least one of these would be available at any time, as required, experiments are now under way to study the feasibility of photographing a band 45° wide along the ecliptic, so as to encompass nearly all minor planets over a period of about 18 months. The positional accuracy would be one second of arc.

As an appendix to this report, the report of the working committee for orbits and ephemerides of comets, prepared by Dr J. G. Porter, its chairman, is printed hereafter.

The following was inadvertently omitted by the President: T. Gehrels reports that fifteen asteroids were observed photometrically at McDonald. Iris was observed nearly pole-on, at $8^h 05^m$ and $+20^\circ$. Large obliquities often occur, and there is apparently some alignment of the poles. The ecliptic longitudes of eight asteroid poles were determined between 104° (284°) and 194° (14°), with none occurring between 14° and 104° or between 194° and 284° (Gehrels, T., Owings, D., *Astrophys. J.*, **135**, 906, 1962).

The report of the work in the U.S.S.R. was not received in time for printing in the Draft Reports, but it is now printed in page 246 of this volume.

PAUL HERGET
President of the Commission

APPENDIX. REPORT OF THE WORKING COMMITTEE ON ORBITS AND EPHEMERIDES OF COMETS

CHAIRMAN: J. G. Porter.

MEMBERS: Candy, Kepinski, Kresák, Makover, Roemer.

There has been a noticeable increase in the amount of computational work, but reports of consistent measurements of positions of comets are still far too few. Antal makes positional observations regularly with the 60-cm reflector at Skalnaté Pleso, while Miss Roemer, using the