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 réglement 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^h05^m and + 20°. 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 occuring 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

40-inch reflector at U.S. Naval Observatory, Flagstaff, measures and reduces about 300 plates per year. Miss Roemer comments that the recommendations adopted at Berkeley with respect to the calculation of cometary ephemerides have, in general, been followed, and the improvement is much appreciated.

Candy has continued to calculate preliminary and improved orbits for new cometary discoveries, and reports that the generous help of observers, who have provided accurate positions promptly, has made this work much easier than it would otherwise be. Kresák, on the other hand, comments that the number of accurate measures of position appears to be decreasing, and these positions are not always immediately available to the computer. He therefore suggests the formation of an international centre for the collection of information of this kind, which will then be readily available to computers on demand.

There has been a significant change in the distribution of computing work, caused mainly by the increasing use of digital computers. Ephemerides are readily calculated on these machines, and one result of this has been that the B.A.A. computers have tended to concentrate on the differential correction of orbits, leaving the ephemerides to be computed by machine methods. More precise work is being undertaken in many centres. Marsden reports: 'Preliminary and improved orbits and ephemerides have been calculated for most of the new comets, generally on the IBM 1620 computer at Yale. Investigations have also been made of the orbits of comets Mrkos-Honda (1953 III), and Burnham (1958 III), and in association with G. van Biesbroeck also of comets van Gent-Peltier-Daimaca (1944 I), Abell (1954 V) and Burnham (1960 II). Original orbits have been calculated for comets Bester (1948 I) and Bester-Hoffmeister (1959 III). High-speed computers have also been used to integrate the orbits of a number of short-period comets, in particular that of P/Oterma over its close approach to Jupiter in 1963. Ephemerides have been provided for the seven long-lost comets Neujmin (2), Brorsen, Tempel-Swift, de Vico-Swift, Tempel (1), Biela and Holmes.'

The comets previously being studied by the late A. D. Dubiago (P/Brooks, P/Shajn-Schaldach, P/Westphal) are to be taken over by the Institute of Theoretical Astronomy, Leningrad; and reports have been received of investigations, completed or now in progress, of the orbits of the following comets:

P/Kopff	Kepinski
P/Tuttle-Giacobini-Kresák	Kresák
P/Wolf (1)	Kamienski
P/Halley	Kamienski
P/Grigg-Skjellerup	Sitarski
P/Encke	Makover and Luchich
P/Faye	Khanina
P/Neujmin (3)	Makover
P/Ashbrook-Jackson	Merslyakova
P/Giacobini-Zinner	Evdokimov
P/Wirtanen	Imnadze
P/Johnson	Vorobjev
P/Kulin	Haségawa
P/Reinmuth	Rabe
Wirtanen, 1949 I	Wierzbinski
Bappu-Bok-Newkirk, 1949 IV	Belous
Ryves, 1931 IV	Antishina
Burnham, 1958 III	Vorobjeva and Ananjeva
Abell, 1954 V	Catalá

Mrkos, 1953 II	I.T.A., Leningrad
Johnson, 1950 I	I.T.A., Leningrad
Whipple-Fedtke-Tevzadze, 1943 I	I.T.A., Leningrad
Seki, 1961 f	Haségawa and Seki
Seki-Lines, 1962 c	Haségawa and Seki

There is clearly some duplication in this work, but this is to be welcomed; in modern work a claim to proprietary rights in a comet calculation carries less weight than it did in the past. Miss Roemer quotes cases in which duplication of work has proved valuable in correcting an ephemeris which has not provided sufficient accuracy in making a search with a large telescope.

The use of digital computers in cometary work will become of increasing importance, and might well form a subject for discussion at Hamburg. The following topics have been suggested: (1) Attention must be paid to the careful formation of normal places of comets. In the case of a small number of observations, it is essential to make immediate use of all original observational data which are consistent with each other. This recommendation may be beneficial in linking many appearances of periodic comets. (Kepinski)

(2) It is proposed to discuss the usefulness of organizing an international office for modern computing work on various astronomical problems, e.g., the motion of comets and satellites, as well as to outline general features of activity and the role of actual computers. (Kepinski)

(3) It is proposed to discuss the advantages of establishing an international centre for the positional observations of comets. Observers would be asked to send all observations of good accuracy, whether published or not, to this centre, which would then supply complete data on individual application by those undertaking the calculations. (Kresák)

REPORT ON THE WORK IN THE U.S.S.R. ON MINOR PLANETS, COMETS, AND SATELLITES FROM THE END OF 1960 TO JULY 1963.

(prepared by Prof. N. S. Yakhontova)

A very noticeable reduction in the observations of these small bodies of the solar system must be noted. In the U.S.S.R. the observations of Minor Planets have been carried out at the Central Astronomical Observatory of the U.S.S.R. (Pulkova), at the Main Astronomical Observatory of the Ukrainian SSR (Goloseevo near Kiev), at the Tashkent Observatory, and at the University Observatories in Moscow (Sternberg Astronomical Institute), and in Tartu.

Observations of the ten bright planets nos. 1, 2, 3, 4, 6, 7, 11, 18, 39, and 40, selected for the determination of systematic errors of the Catalog of Faint Stars, have been carried out at Pulkova, Moscow, Kiev and Tashkent. Some foreign observatories also take part in this work: Bucharest, Cape, Copenhagen, Leiden, Madrid, Nanking, San Fernando, Sydney, Shanghai (Zo-Se), and Tsingtao. The plates from the Cape have been sent to Pulkova, where they have been measured and reduced. All computations for the determination of the precise star positions were performed on an electronic calculator. It requires only a few seconds for all the computations for each plate.

As in previous years, the Institute of Theoretical Astronomy (Leningrad) has published every year the Ephemerides of Minor Planets. The volumes for 1962, 1963, and 1964 have been issued and the one for 1965 is in preparation. As usual, various centers took part in the Ephemeris calculations: the Riga Branch of the Astronomical-Geodetic Society of the U.S.S.R., Kharkov State University, Astronomisches Rechen-Institut in Heidelberg, the observatories in Cincinnati, Nanking, Tokyo, Shanghai (Zo-Se), and the University of California.

The number of search ephemerides calculated without perturbations is decreasing each year. For more than 1000 planets, the perturbation calculations are performed with the aid of electronic computers at the Institute of Theoretical Astronomy (Leningrad).

In 1962 numerical integrations have been performed for nearly all the planets for which the ephemerides were formerly calculated by Brendel's method; and the elements have been improved. In this way more than 200 improved sets of elements have been introduced into the Ephemeris volume, and still others are in progress. The electronic computer programs (**1, 2**) have been improved and three are now in use: (1) Numerical integration with perturbations by Jupiter and Saturn, and automatic comparison with observations (including aberration and parallax, with an accuracy within $0''.1$; (2). Element improvements on the basis of (O–C) obtained under (1) above; (3) Numerical integration and calculation of search ephemerides from the improved elements. The elements of more than 160 planets have been improved in this way. There are 500 sets of elements for which only rectangular coordinates were available from the electronic calculator Ural 1. Search ephemerides of these planets will be performed by program 3) above.

The preliminary improvements of elements of planets for the evolution of systematic errors of the Catalog of Faint Stars and the selection of observations are going on. Although the observations of these planets are planned to be finished by the end of 1965, more than 3000 precise observations are already available.

Theoretical Work.

O. N. Barteneva (**3**) published auxiliary tables for integration by means of Cowell's method; the Tables give the values of the function

$$f = \frac{(wk)^2 (1 + \Sigma m)}{r^3} \cdot 10^{10}$$

with the argument r^2 for different intervals of integration. V. A. Isvekov (**2**) published a summary of his asteroid investigations carried out of the electronic calculator of the Academy of Sciences of the U.S.S.R. in Moscow during 1954–59. M. J. Shmakova (**7**) described the program of numerical integration on the electronic computer "Ural". L. J. Pius (**4**) investigated the possibility of application of the method of periodic orbits to the Hecuba-type planets. Although numerical integration is a powerful means of investigation of the motion of heavenly bodies, theories of general perturbations have not lost their significance and the electronic calculators can lend a valuable aid in this field.

N. G. Polosova (**1**) worked out a program for the calculation of general perturbations of minor planets and applied it in the calculation of perturbations of Ceres by Saturn. W. F. Proskurin (**12**) continued his work on Ceres and constructed a theory of absolute perturbations of the second order of the masses.

Satellites

The efforts of many astronomers in the U.S.S.R. have been directed to the investigation of the motion of artificial satellites, consequently only a few papers deal with the motions of natural satellites. V. A. Shor (**6, 9**) continued his work on the use of high-speed computers for the solution of the restricted Three-Body problem by the method of Hill-Brown, as applied to the development of an analytical theory of the satellite VII of Jupiter. E. N. Lemekhova (**5**) published a new system of elements and tables of the motion of Jup X, according to the theory of Delaunay. V. F. Proskurin and L. A. Isacovitch (**10**) assembled all the observations of Jup VI and constructed normal places.

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Comets

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Comet Observations

Observations of positions have been carried out at Alma-Ata, Ashkhabad, Pulkovo, Tartu, and Zvenigorod; photometric observations at Alma-Ata, Ashkhabad, Dushanbe, and Kiev (**5** to **11**).

Theoretical Work

I. W. Galibina investigated the original and future orbits of comets with eccentricity near unity. Including her previous work, she investigated 48 original and future orbits. The computations are based on a method proposed by Dr S. G. Makover, according to which the true anomaly is taken as independent variable. The majority of original orbits have been found

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to be elliptic, while only about half of the future orbits are elliptic, the others being hyperbolic (**15**).

H. I. Kazimircak-Polonskaya, continuing her work on the motion of comets in the vicinity of planets, investigated the possibility of an application of the method of numerical integration in special rectangular coordinates to the planetocentric motion of comets. She also worked out differential methods of small corrections for different factors, such as perturbations due to some inner planets and satellites, systematic effects of high order terms, etc. (**13, 14**).

F. H. Perlin (**12**) investigated the method of variation of arbitrary constants with the eccentric anomaly as independent variable. She derived exact formulas for the Lagrange and Herrick form of the equations. K. A. Steins published a series of papers dealing with problems of the capture theory of periodic comets and of the theory of diffusion of comets.

V. G. Fessenkov stated that the great Tungus meteorite fall might be the result of an encounter of the Earth with a small comet. He proved also that short-period comets probably originated from non-periodic comets as a result of single and multiple perturbations due to the major planets.

B. Ju. Levin suggested a hypothesis, that in icy cometary nuclei the stony substances are present in the form of separate atoms and molecules embedded in the amorphous, non-coherent condensate of different volatile substances (**16**).

L. S. Marochnik investigated the nature of the cometary head, and made an attempt to prove that heads of comets may be considered as composed of plasma with a high degree of ionization.

S. K. Vsekhsvyatsky published a Catalog of Absolute Magnitudes and Photometric Parameters of 62 Comets observed in 1954–60 (**18**).

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