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

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In the Draft Report for Commission 20, prepared in advance of the Zürich Meeting of 1948, detailed reports of the activities at numerous observatories and computing centres were printed. The membership of the Commission has grown to such a large number that the Draft Report would be prohibitively long if this practice were continued. The numerous reports received have been very useful in preparing the Draft Report which follows. Emphasis has been placed on communications and recommendations that appear to contain material for useful discussion at the forthcoming meeting of the Commission.

MINOR PLANETS

The numerous observations of minor planets published in the *Minor Planet Circulars* and elsewhere indicate that current activity in this field is at a high level. The reports received express general satisfaction with the activities of the Minor Planet Centre at Cincinnati under the direction of Herget. The principal complaints noted are concerned with the delay in receiving the *Minor Planet Circulars* at some observatories.

Owing to co-operation between observers and computers, many of the minor planets of which observations were desirable in order to secure the orbits have been observed in recent oppositions. Dr Herget reports (*M.N* **110**, 167–9, 1950), that 'both the computing and observing phases still have much to accomplish before the current state of minor planet work is put in good order, but this objective should reasonably be achieved within the next few years'

Publications. Important publications of general interest appeared since 1948 in the *Veröffentlichungen des Astronomischen Rechen-Instituts* at Heidelberg:

Nr. 1. Elemente und Grundlagen der Kleinen Planeten, bearbeitet von W. Strobel.

Nr. 2. Nachweis der Beobachtungen und Berechnungen Kleiner Planeten 1939–46, bearbeitet von A. König und K. Reinmuth.

Observations. Systematic observations have been carried out at numerous observatories. Much of the burden of observing minor planets far south of the equator has continued to rest on the Union Observatory in Johannesburg, South Africa. W. H. van den Bos reports that all minor planets of magnitude 14 and brighter from $-15°$ southward at opposition, for which ephemerides are published, are searched for and measured when found. E. L. Johnson, who has been doing this work unassisted, suggests that if the observing of minor planets were allocated according to zones of declination, the Union Observatory might limit itself to observing minor planets south of $-25°$ It would then become possible to make accurate measurements of all the planets found, and possibly follow up more of the new discoveries.

A second southern observatory engaged in systematic observations of minor planets is the observatory at La Plata. According to M. Itzigsohn, the La Plata Observatory

has placed on the programme minor planets of which observations are particularly needed brighter than magnitude 15·5 and south of −10° at opposition. In addition, a list of minor planets of special interest to Dr P Sconzo is observed. In the course of a year, positions of 75 to 100 minor planets are obtained. Unfavourable observing conditions in the months of June to September complicate the programme. Itzigsohn recommends concentration on a list especially prepared by the Commission in accordance with a plan similar to that proposed in *Harvard Announcement Card* 787.

While allocation according to declination has not been found feasible for the entire sky, a combination of the suggestions by Messrs Itzigsohn and Johnson may have merits for the southern sky and lead to more effective coverage.

Computations. At the minor planet centre in Cincinnati special perturbations were computed for 149 minor planets; computations for an additional list of 81 minor planets is now in progress. These computations concern planets for which the elements now available are too uncertain for adequate prediction. The perturbation calculations are to serve as a basis for orbit corrections. While much of this work remains to be done, it has already led to some interesting re-discoveries, for example (1192), (1322), (1362), and (1452) by F. K. Edmondson at the Goethe Link Observatory of Indiana University.

The Astronomisches Rechen-Institut at Heidelberg contributes ephemerides of 687 minor planets to the annual volumes published at Cincinnati, 343 with general, 214 with special perturbations, 130 without perturbations. In addition to this work, orbit corrections of 12 planets without and 22 planets with perturbations were completed.

The Institute of Theoretical Astronomy of the Academy of Sciences of the U.S.S.R. has continued to publish its annual volumes of ephemerides of minor planets. This series began with the year 1946. For the five years 1948–52 ephemerides for all minor planets that came to opposition were furnished.

Since 1947 the computational programme of the Institute has been extended to include more ephemerides based on orbits in which perturbations have been included, especially for planets near Jupiter. Ephemerides without perturbations are calculated by means of punched-card machines. Numerical integration of the equations of motion in rectangular co-ordinates is employed for almost all planets with greater daily motions. For planets with mean daily motion less than 600″, the integration is performed with perturbations by Jupiter and Saturn, by Jupiter only for all other planets. The integration for these planets (about 600 planets of the Hecuba type) is performed on the punched-card machines. In 1949 integrations were made for 265 planets up to the year 1953. Most of these planets are included in the list recommended by Commission No. 20. In 1950, 150 planets were added, the elements of which relate to moments of osculation up to 1941. Integration for the remaining planets of the Hecuba type has been carried out up to the present time. The elements published in *Ephemerides of Minor Planets for* 1948, part 2, were adopted as a basis of integration. Repeated integrations for individual planets were made with new and better elements obtained by the Institute, or taken from publications.

A comparison of integration results with observations has shown that for the majority of planets they are in good agreement, and that there was no need of improving the elements. This made it possible to include 172 ephemerides, calculated on the basis of integration, into the volume of ephemerides for 1951. In the volume for 1952 the number will increase to 300; in that for 1953 it is supposed to give the perturbed ephemerides of almost all the planets of the Hecuba type, with the exception of those (about 15%) the elements of which require improvement.

The elements of the majority of planets of the first group (265 planets) had very remote epochs of osculation. Therefore, for 150 planets the observations of which are satisfactorily represented, new osculatory elements have been calculated for a common moment of osculation: December 20·0 (U.T.), 1951 = J.D. 2434000·5. These elements are to be published in the 1952 volume of ephemerides.

For the last two years vast material has been accumulated at the Institute in the form of tabulated rectangular co-ordinates of planets, in some cases embracing a period of

15–20 years. On the basis of this material a programme of improving the orbits is being undertaken. Improvement of elements of planets with large deviations from the observational data, more than one and even several degrees in geocentric positions, is carried out first. As a rule, for such planets the observations are approximate. Hence the improvement of elements is likewise carried out approximately. The results of the improvements are published in the *Bulletin* of the Institute of Theoretical Astronomy, or in the volume, *Ephemerides of the Minor Planets*, 1948, part 2, 1951 and 1952.

Important contributions are also being made at Nice, by Mme Laugier and M. Patry, at La Plata by P Sconzo, at Madrid by F. M. Torroja and R. Carrasco, and at Tokyo by H. Hirose and collaborators.

Identifications. At Nice, M. Patry, in addition to carrying out systematic observations of minor planets, in co-operation with Mme Laugier, has continued the systematic search for identifications among minor planets discovered between 1900 and 1940, for which the number of observations was insufficient for the determination of orbits. Altogether 735 cases have been studied, from which M. Patry has established 94 identifications. There remain 450 cases to be examined before the programme undertaken by M. Patry is concluded. Minor planets recovered by M. Patry include (450), (650), (1235), (1392), (1432). Dr O. Kippes, Partenstein, Germany, is also giving constant attention to the search for identities. Finally, V V Michkovitch, at the Institute for Theoretical and Applied Astronomy, established in 1949 at Belgrade, intends to undertake extensive calculations in this field.

P Sconzo, La Plata, recommends that, in order to simplify the problem of dealing with identifications, it would be useful to make available a list of all unnumbered orbits that at present are scattered among a large number of publications. The need for the publication of such a list has also been expressed by other members, for different reasons. The compilation of these elements may be undertaken in the near future.

Unusual Orbits. At the Lick Observatory, the 20-inch Carnegie astrograph has produced several discoveries of minor planets in the inner fringe of the ring. Examples of these are given by P Herget, *M.N* **110,** 168 (1950). Most of these discoveries were made by Mr Wirtanen who examines the programme plates and notes the minor planets that stand out by unusual motion. Such planets were followed by H. M. Jeffers, usually with the Crossley reflector.

The observatories at Heidelberg, Nice, and Uccle have also made new discoveries of planets with orbits of this type. Among these is the interesting planet 1949 CA jointly discovered by Arend at Uccle and Patry at Nice. This planet was found to be identical with 1927 CR. Two new Trojan planets were discovered at Heidelberg, one at Uccle.

Theoretical Work. At the Institute for Theoretical Astronomy of the Academy of Sciences of the U.S.S.R. precise calculation of minor planets 1, 3, 6, and 39, selected for the determination of the systematic corrections to the *Catalogue of Faint Stars* is in progress. For these planets, general theories that include the perturbations by all principal planets are being constructed by Hill's method. The terms of the first order as to the perturbing masses have already been completed.

In the field of general perturbations, investigations related to the application of Bohlin's method are being made. Simplified tables have been compiled for the calculation of approximate perturbations by this method of planets of the Hestia type, and new tables are being constructed for planets of the Juno type ($\mu \approx 800''$). Tables for mean daily motions 800″ to 820″ have already been completed.

Other investigations in progress include the numerical integration of the orbit of Hidalgo with the inclusion of perturbations by all the principal planets.

At Kiev University, investigations of many years' duration are being carried out on the motion of (1036) Ganymed and other planets that have close approaches to Jupiter.

The Institute of Mathematics and Physics of the Academy of Sciences of the Latvian S.S.R. has taken an active part in the annual calculation of ephemerides. It has taken upon itself the calculation of perturbations by Brendel's method of numerous planets with unusual elements, Nos. 183, 1177, 1373, 1390, and some others.

At the Astronomical Institute of Tokyo University, T. Takenouchi obtained the period of 190 years for the libration of Thule, *Publ. Astr. Soc. Japan*, **1**, 159, 1950. In collaboration with T Ura he is continuing the study of the motion of Thule, while K. Akiyama is studying the motion of Hilda, both by a method of special perturbations.

W H. Heinrich, Prague, reports on theoretical papers in celestial mechanics, *Publ. Inst. Astr. Univ. Charles, Prague*, ser. 2, nos. 21–5, and he makes the following remarks and suggestions:

> Many authors have failed to take into account the fact that a small change in the mean motion may produce a large change in the motion of a planet or satellite. For practical purposes many of the existing orbits are satisfactory for 50–80 years, but beyond that time it may be dangerous to draw theoretical conclusions from the material available. In most cases the observations are not sufficiently extensive to decide definitely on many important questions relative to the distant past and future of planetary and satellite systems, often even to decide between libration and rotation of the perihelia.
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> Theoretical workers should be advised to give up exact conclusions on these matters or else give them with all possible reserve and base them on reliable mean elements. In the case of satellites conditions are more favourable. Accurate observations have been available for the last fifty years, corresponding to more than twenty-five centuries in the system of the inner planets.
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> The suggestion would therefore be to impress on observers the necessity of procuring the most careful observations, especially of satellite systems with the aid of large reflectors.

H. G. Hertz has completed a numerical theory for the members of the Trojan group with the application to (659) Nestor. The work is being prepared for publication. Oppositions 1908–48 are represented with 3′

H. Roure, at Marseille, has extended the Hill-Brown method used in the lunar theory to the development of group theories of minor planets, following the principle first introduced by Bohlin. It is possible to construct tables for the computation of series for different commensurabilities with Jupiter and Saturn. He comments that the method is easy to use, the calculations are purely algebraical, the results may be obtained in rectangular or polar co-ordinates as preferred.

M. Roure proposes that the subject of developing group theories for minor planets be placed on the agenda of the next meeting of the Commission, with the view of simplifying the calculations and diminishing the time that must be devoted to individual planets.

G. Fayet published a memoir entitled 'Contribution à l'étude des proximités d'orbites dans le système solaire', *Ann. Bur. Longitudes*, Tome **12**. This study deals with the orbits of 800 minor planets.

D. Brouwer and A. J. J. van Woerkom have completed a new development of the secular variations of the principal planets, published in *Astr. Papers Amer. Eph.* Vol. **12**, part 2, 1950; an article by D. Brouwer dealing with applications to the orbits of minor planets appeared in *Astr. J* **56**, 1951.

Planetary Co-ordinates. The British Nautical Almanac Office reports that work is in progress on the third volume of *Planetary Co-ordinates* for the equinox of 1950.0, and that it hopes to publish this volume before 1955.

Accurate Ephemerides. The British Nautical Almanac Office has also been computing accurate geocentric ephemerides of Ceres, Pallas, Juno, and Vesta from 1951 onward. These calculations are based on rectangular co-ordinates published in *Astr. Papers Amer. Eph.* Vol. **11**, part 4. They were derived from numerical integrations carried out at the Cincinnati Observatory, and orbit corrections made at the United States Naval Observatory. At the Copenhagen Observatory the motion of (51) Nemausa is being investigated.

Magnitudes. In accordance with a decision reached at the Zürich meeting, a subcommittee was appointed to prepare the subject of magnitudes of minor planets for

discussion at the next meeting. Prof. A. Kopff kindly consented to act as chairman of this committee. His report is as follows:

Das Sub-Committee ist Mitte 1950 gebildet worden, als Chairman hat der Unterzeichnete den Auftrag übernommen, die ersten Vorschläge einzuholen, die als Grundlage für eine weitere Diskussion dienen sollen.

Photometrische Messungen von Kleinen Planeten sind bisher nur in geringem Umfang ausgeführt worden, vor allem bei einzelnen hellen Planeten oder solchen, deren Helligkeitsschwankungen von besonderem Interesse sind (z.B. Eros). Die grosse Zahl der Planetenhelligkeiten beruht auf Schätzungen meist sogenannter visueller Helligkeiten (z.B. Königstuhl-Sternwarte), wobei die Skala empirisch zu immer schwächeren Grössenklassen ausgedehnt wurde. Neuerdings werden auch photographische Helligkeiten gegeben (z.B. Turku, Goethe Link Observatory). Diese letzteren sind, so weit als möglich, in den Veröffentlichungen and Mitteilungen (auch in dem *Jahresheft 'Kleine Planeten'*) des Astronomischen Rechen-Instituts in Heidelberg zur Unterscheidung durch kursiven Druck hervorgehoben, und es wird dringend empfohlen, *um Verwirrungen zu vermeiden*, dass diese Unterscheidung durch die Wahl der Typen oder in anderer Weise auch in Zukunft beibehalten und von anderer Seite verwendet wird.

In der Zukunft wird es notwendig sein, für die Kleinen Planeten zu einer einheitlichen Helligkeitsskala überzugehen und für möglichst viele Objekte photometrische Grössen zu ermitteln; aber bis dieses Programm durchgeführt ist, müssen visuelle und photographische Helligkeiten deutlich unterscheidbar von einander gegeben werden.

Von den Mitgliedern des *Sub-Committee* sind ausführliche Berichte eingegangen, aus denen das Wesentliche mitgeteilt sei: Dr E. L. Johnson, Union Observatory, Johannesburg, schreibt (12. x. 1950):

'All magnitude determinations made by me have been by comparisons of stars on the photographic plates in the blink microscope.

'Generally speaking, the magnitudes given for the minor planets in the *Opposition Ephemerides* are good and I seldom find one which differs by more than 1/2 mag. At the same time I am inclined to estimate the magnitudes of both comets and minor planets a little on the bright side because we have always used the C.P.D. magnitudes for comparison.

'Quite recently I photographed a selected region of the Mount Wilson series giving the same exposure that I use for the minor planets search (10 min.) and using the same plates (103*a*-O) and development. I enlarged and identified the stars on a print and then mounted the original negative in a tube which could be screwed into one arm of the blink microscope. I could then get an accurate estimate of any minor planet on my negatives by comparing the minor planet with the identified images on the chart. A correction of 0·8 mag. was made (equal to G5) in order to obtain the visual magnitude. This method is good enough for stars which are on or near the centre of a plate, but is not reliable for minor planets which are near the edge of the plate.

'With short-focus instruments, such as ours, bad seeing, light skies, etc., do not interfere very much and need not be considered when estimating to about 0·2 mag. which I consider possible by this method.

'Remember, I am only giving the views of the hard-working observer of minor planets who has not the time or facilities to try and make very accurate determinations of magnitudes. At the same time I do think that experienced observers should try and give an estimate of all minor planets observed, as this will give a good indication of the accuracy of the predicted magnitudes.

'My suggestions are as follows:

1. That the magnitudes of minor planets published in the *Opposition Ephemerides* are fairly reliable and that where an observer finds an estimated difference of 0·5 mag. or larger the fact should be reported and a revised magnitude should be made.
2. That each observer should have some fairly reliable method (such as the one mentioned above) for determining the brightness of any particular minor planet whose mag. differs from that given in the Ephemeris.

3. That especial care be taken when reporting the discovery of new planets to get that most reliable magnitude possible. (This, of course, only applies to those planets which the observer intends to follow up and calculate an orbit—the others need only be estimated.)'

Dr Johnson und ebenso Dr Reinmuth weisen noch darauf hin, dass die vom Goethe Link Observatory gegebenen Helligkeiten um wenigstens zwei Grössenklassen schwächer als die eigenen visuellen Angaben sind. Einzelheiten über die Helligkeitsbestimmungen an diesem Observatorium sind hier nicht bekannt.

Dr G. P. Kuiper schreibt vom McDonald Observatory, Texas, über das neue Beobachtungsprogramm (1. ix. 1950):

'The McDonald programme is carried out with the Cook Observatory Telescope, a 10-inch Ross F/7 four component lens similar to the Lick 20-inch except that all dimensions are half. The instrument is on loan for a period of five years; it was left open whether this period might be extended. The plates used are 8 × 10, 103*a*-O (blue sensitive plates); a 10-minute exposure shows stars down to 17·2 photographic according to tests on Selected Areas; 16·5 is regarded as giving a measurable image. During each dark-of-the-Moon an area of 40 × 40 degrees centred on the opposition point at New Moon is photographed which comprises 6 × 8 = 48 fields. These fields have about 3/4° overlap on the edges since the plates are about 6·5 × 8·1 degrees in size and are about 5° by 6·5° apart, centre to centre, in the two co-ordinates. Each of the forty-eight fields is photographed twice with one hour interval between the exposures. This is done by making runs on the fields as follows: 1, 2, 3; 1, 2, 3 or 1, 2, 3, 4; 1, 2, 3, 4. In this manner in two hours three or four fields are completed. The plates are blinked and all asteroids are noted. The photographic magnitudes are determined on the international scale by means of 10-minute exposures on Selected Areas, and the velocity vectors are measured. In this manner complete information is derived for all asteroids down to 16·5 in a 40° belt along the ecliptic. The overlap between consecutive months is ample for all except the fastest asteroids. It is intended to continue this programme for about eighteen months which will insure a sufficient overlap at the ends since the average synodic period of the asteroids is about fifteen months. The amount of work involved is, of course, very considerable but from the experience gained to date it appears that we can handle it.'

Dr Väisälä teilt vom Observatorium der Universität Turku (17. x. 1950) unter Hinweis auf *Astronomische Nachrichten*, **268**, 7, 1939, und Informo Nr. 6 (Minor Planet work at the Astronomical Observatory of the Turku University) mit:

'Alle unsere Planetenbeobachtungen sind mit dem anastigmatischen Spiegelteleskop mit 500 mm. Öffnung und 1031 mm. Brennweite oder mit einem gleichartigen kleineren (340/688) gemacht worden. Die Bilder der Planeten sind praktisch punktformig, was das Vergleichen mit den Fixsternen sicherer macht. Die Helligkeitsbestimmungen sind durch Schätzungen mit einer Lupe (Apparat für das Aufsuchen von kleinen Planeten) gemacht worden und als Vergleichsfolgen werden die Mount Wilson photographischen Grössen in den Kapteynschen Eichfeldern gebraucht. Wir haben bestrebt an jedem Beobachtungsabend wenigstens ein Eichfeld auf dieselbe Weise wie die Planetenaufnahmen zu photographieren, und nach Möglichkeit in derselben Höhe. Bei längeren systematischen Serien kommen ohnehin 1–2 Kapteynsche Felder mit in der Beobachtungsserie.'

Unsere Grössen sind also photographische, obgleich wir meistens panchromatische Platten verwenden. Wegen der panchromatischen Platten würden wir gern in die visuelle Skala übergehen, bisher sind aber keine visuellen (photovisuellen) Grössen für die Sterne der Eichfelder bekannt. Es wäre gut zu wissen, *ob visuelle Grössen* (in Amerika?) *in der nahen Zukunft veröffentlicht werden.*

Meistens haben wir Grössenschätzungen aus den für die Positionsbestimmungen aufgenommenen Platten gemacht. Wenn ein Eichfeld aus derselben Platte sich nicht befindet, so wird der zufällige Fehler der Helligkeit wegen der Verschiedenheit der Platten usw. vergrössert. Wir haben vor einigen Jahren Beobachtungen speziell für den Zweck der Helligkeitsbestimmungen begonnen, aus Mangel von Hilfskräften sind die Arbeiten aber nun im Stillstand. Wir machten damals Aufnahmen aus blauempfindlichen Platten, und der Zweck

war auch möglichst gleichzeitig panchromatische Platten in Verbindung mit einem Gelbglas zu verwenden. Wir dachten zuerst hellere Planeten bis zu *ca.* 14^m (phot.) zu bestimmen.

Da die Bilder mit unserem Instrument sehr klein werden, empfehlen sich unsere gewöhnlichen Aufnahmen nicht gut zur Bestimmung der Helligkeit mit grösster möglicher Genauigkeit. Für diesen Zweck haben wir eine besondere extrafokale Methode ausgedacht (Artikel des Untergez.: Une Modification de la méthode extrafocale dans la photométrie stellaire (*Veröffentlichungen des Finnischen Geodätischen Institutes*, Nr. 36; Helsinki, 1949), auch als 'Informo 4' erschienen) und auch in kleinem Masstab erprobt. Diese Aufnahmemethode haben wir auf die Bestimmung der Helligkeit von hellsten Planeten (bis etwa zu der 12. Grösse) zu verwenden gedacht.

Die letztgenannte Methode verspricht eine ziemlich hohe Genauigkeit (m.F unter $0^m.1$ auch mit der Schätzungsmethode), aber es wäre wichtig die Platten mit einem objektiven Photometer zu messen. Wir waren auch bestrebt ein derartiges Instrument zu schaffen, und nun haben wir einige Hoffnungen ein derartiges Instrument von L. C. Eichner in Clifton, New Jersey, mit den sogenannten 'Truman-Geldern' zu bekommen. (Das Photometer wurde inzwischen genehmigt.) Wenn dies wirklich gelingt, könnten wir in unser Beobachtungsprogramm genaue Grössenbestimmungen der helleren kleinen Planeten aufnehmen. Diese Bestimmungen würden wir wie bei den photometrischen Vergleichungen üblich anstellen, also u.a. den Planeten und das Vergleichfeld auf derselben Platte photographieren usw. Für die Bestimmung auch der (photo) visuellen Grösse wären die visuellen Helligkeiten in mindestens zwei Eichfeldern dringend nötig. Ich würde besonders empfehlen, ein Feld für Herbst- und eins für Frühlingsbeobachtungen, z.B.

$$\text{No. 68 } 0^h.2 + 15° \quad \text{und} \quad \text{No. 80 } 12^h.2 + 15°$$

Könnten Sie einwirken, dass die Amerikaner (Mt Wilson?) visuelle Grössen für diese Felder oder für nahe liegende im Voraus zur Verfügung stellen wollten, wenn die Veröffentlichung von allen Beobachtungen noch eine längere Zeit beanspruchen wird? Die Vergleichungen mit der Polsequenz sind zu zeitraubend und aus naheliegenden Grunden nicht so zuverlässig wie Vergleichungen mit Eichfeldern in der Nachbarschaft des Planeten.

Bisher habe ich auf unsere eigenen ausgeführten und geplanten Arbeiten mich beschränkt, nun einige Bemerkungen von allgemeinerer Natur.

Bisher sind nur selten systematische Spezialmessungen betr. die Helligkeiten der kleinen Planeten ausgeführt worden. Aber schon für die Identifizierung der kleinen Planeten ist die Kenntnis ihrer Helligkeit mit gewisser Genauigkeit notwendig. Die an unserer Sternwarte bestimmten Grössen sind im Mittel etwas mehr als eine Grössenklasse schwächer als die anderswo bestimmten Grössen. Dies scheint anzudeuten, dass diese im Mittel nahezu visuell sind, weil unsere nach der photographischen Skala bestimmt worden sind. Zwar haben wir in einzelnen Fällen merkliche Abweichungen auch nach der entgegengesetzten Richtung angetroffen, so dass die in der Ephemeride mitgeteilte Grösse zwei Grössenklassen und noch mehr schwächer als die wirkliche visuelle Grösse gewesen ist.

Vorschläge. Da die Bestimmung der Grössen von allen kleinen Planeten eine sehr lange Arbeit sein wird, müsste man möglichst bald wenigstens die grössten Fehler korrigieren, die die Identifizierung erschweren. Die Beobachter müssten die Grundlagen mitteilen, nach welchen sie die Helligkeiten bestimmen, insbesondere die gebrauchte Skala (visuell, photographisch). Das Astronomische Rechen-Institut hat schon seit langer Zeit die auf die Mt Wilson-Skala bezogenen Grössen kursiv gedruckt. Es wäre wichtig, dass das auch in der jährlichen Veröffentlichung *Minor Planets* (Herget) in gleicher Weise gemacht würde. Es wäre gut, dass die Beobachter, falls die beobachtete Grösse des Planeten merklich von der Ephemeridengrösse abweicht, sogleich dies an der Zentralstelle, am besten an die Subkommission zu Heidelberg mitteilen wurden. Die groben Fehler müsste man in der nächsten Ephemeride verbessern.

Allmählich müsste man danach streben die Planetengrössen, von den hellsten Planeten beginnend, systematisch zu bestimmen. So könnte man vielleicht veränderliche kleine Planeten entdecken und, wenn sowohl die visuellen als die photographischen Grössen bestimmt würden, könnte man in bezug auf den Farbenindex interessante Planeten entdecken. Wir

haben bei einem Planeten einen Farbenindex getroffen der bedeutend von dem üblichen abwich. Es wäre ein interessantes Spezialproblem die Grössenbestimmungen von helleren Planeten möglichst weit ausserhalb der Opposition auszuführen. Für diesen Zweck wären Ephemeriden für hellere Planeten (z.B. für etwa 30 Stück) für das ganze Jahr nötig. Auf diesem Gebiete könnten auch ernstere Amateurastronomen nützliche Beschäftigung finden.

Einige Worte betr. die Kapteynschen Vergleichsfelder (Mt Wilson Katalog): Für den Gebrauch in unserer Sternwarte sind (als Übungsarbeiten der Studenten) Karten von den Kapteynschen Eichfeldern gezeichnet worden. In die Karten sind die Sterne und die betr. Grösse bis auf die Grösse $17^{m}{\cdot}99$ bezeichnet worden. Vielleicht das Fehlen derartiger Karten hat eingewirkt dass der Gebrauch der Eichfelder nicht allgemein angenommen ist.

In einiger Hinsicht sind die Kapteynschen Eichfelder zu unserem Zweck mangelhaft. In der Mitte des Eichfeldes befindet sich gewöhnlich ein Stern von 8.–9. Grösse, aber wegen der Kleinheit des Feldes sind die nächsten Sterne gewöhnlich nur von der 11.–12. Grösse. Es gibt hier also eine Lücke in den Grössen. Auch für die Bestimmung der Grösse aller hellsten, zwar wenigen Planeten, können die Eichfelder nicht unmittelbar verwendet werden. Seit Jahren haben wir einen Plan für die Bestimmung der Planetengrössen gemacht. Für gewisse volle Rektaszensionsstunden und für Deklinationen 0°, ±5°, ±10° usw. werden vergrösserte photographische Karten in der Grösse 1° × 1° gemacht und nahe der Mitte des Feldes eine kontinuierliche Sternfolge gewählt, so dass der Unterschied in der Grösse der nachfolgenden Sterne nicht gern mehr als eine halbe Grossenklasse beträgt. Beispielsweise haben wir solche Photographien mit folgenden Zentren gemacht:

$$\text{R.A. } 0^{h}\,0^{m},\ \text{Dekl. } 0°,\ +5°,\ +10° \ldots +30°$$

Als Skala haben wir 1° = 120 mm. genommen. Hätte man solche Sternfolgen z.B. fur jede zweite Rekt. stunde in der Umgebung der Ekliptik, so hätte man eine sichere und praktische Grundlage fur die Bestimmung der Planetengrossen. Soeweit Dr Väisälä.

Schliesslich ist noch hervorzuheben, dass, nach Mitteilung von Dr Brouwer, die *Mitglieder der Commission* 20 *der American Astronomical Society* auf der Tagung im Juni 1950 folgende Resolution gefasst haben:

'In order to obtain a more uniform system of magnitudes of minor planets, observers of minor planets are urged to measure and make available photographic magnitudes based on the north polar sequence. The observer should further state whether round images or trails were used.'

Es wird sich also in erster Linie darum handeln, das photometrische System festzulegen, in welchem in Zukunft die Helligkeiten der Kleinen Planeten angegeben werden sollen.

Dr Reinmuth und ebenso der Unterzeichnete geben, ähnlich wie Dr Johnson und wohl auch Dr Väisälä den visuellen Helligkeiten den Vorzug, da sich auf diese die Angaben der weitaus grössten Anzahl der numerierten Objekte beziehen. Fast alle Beobachter geben die Helligkeit in einer visuellen Skala. Es dürfte sich empfehlen, für die Kleinen Planeten in Zukunft die genaue Bestimmung visueller und photographischer Helligkeiten anzustreben, um daraus auch den Farbenindex herzuleiten. Auf keinen Fall dürfen die jetzt bekannten visuellen Helligkeiten durch Benutzung eines mittleren Farbenindex auf photographische umgerechnet werden; das wertvolle Material der visuellen Helligkeitsschätzungen ginge dadurch verloren.

A. KOPFF

Future Work on Minor Planets. In accordance with a decision of the Commission at its Zürich Meeting, a committee was appointed to study the purpose and direction of future work on minor planets. Prof. Fred L. Whipple consented to act as chairman of this Committee. His report follows:

At your request I have collected the viewpoints of certain members of Commission 20 concerning the problem of limiting the addition of minor planets to the 'Kleine Planeten' S. Arend, A. Kopff and N. Yakhontova have expressed themselves in some detail concerning this subject, and I shall attempt to present their reports briefly.

The expression by S. Arend is based also upon the judgment of E. Delporte and is signed by both. They state, with regard to an astrometric programme, in contrast to a special research programme, that:

1. An astrometric programme consists in obtaining the positions of catalogue asteroids
   (*a*) which are of especial interest to celestial mechanics, and
   (*b*) whose orbits require improvement.

In the course of such a programme new asteroids are found and should be followed because they add to our understanding of the asteroid ring and give new information concerning a number of important problems.

2. It seems necessary for a long time to determine orbits for the newly discovered asteroids because:
   (*a*) the new ones influence the statistics of the orbital distribution, and
   (*b*) if no orbits or ephemerides are determined the observer will waste time in following objects unnecessarily.
3. It seems most important to observe the already numbered asteroids whose orbits are uncertain before pursuing new asteroids.

An observer with a powerful instrument will discover more new objects than he is capable of following. At Uccle, for example, only the exceptional new asteroids are usually followed. Hence, on the average, only about three new ones per year are followed.

A priori it seems that the most powerful instruments, particularly large reflectors, should concentrate on other programmes than routine astrometric observation. Nevertheless, they should follow the newly discovered objects of exceptional characteristics.

4. It does not appear that the maintenance of the *Asteroid Catalogue* for good orbits and ephemerides will be too great a task for perhaps as many as 3000 objects if:
   (*a*) each observer follows the practices above;
   (*b*) ephemerides are published for all objects with reasonably well determined orbits;
   (*c*) perturbations are calculated with properly approximate methods as done e.g. by G. Stracke, rather than with highly precise but lengthy methods.

Other comments by Drs Arend and Delporte will be included below in a discussion of some specific suggestions.

In June 1950, Dr A. Kopff wrote:

'Naturally most of the asteroids are "useless" in a general sense. We had discussed what to do in the future many years ago. I remember the time, before 1914, when there were lengthy discussions also with Max Wolf and Brendel. But, if we had then stopped to calculate perturbations and ephemerides for the known objects, it would have been impossible to look for new objects and therefore impossible to extend our knowledge about the system of asteroids. If you consider the interesting objects discovered since that time, you may believe that the decision to continue the work was a right one.

'We have again discussed the same question with those who are working on minor planets. If we withhold numbers and ephemerides, or even ephemerides alone, for useless planets we must end observations of minor planets altogether or only observe in future a selected number of interesting objects. It is only by a rare chance that we find new and interesting objects. Dr Reinmuth, for example, thinks that it is useless to continue with the observations here in Heidelberg. Indeed, there is no purpose in observing in future any planets, other than the selected numbers.

'I feel that the situation is the same as it was forty years ago. To continue the work on the calculation of elements and perturbations is not so great as is generally thought. Formerly, we could do a great part of the work at Dahlem alone. But now the work is divided and Cincinnati is prepared to do the greater part of perturbations with the machines, so that, for example, Heidelberg with a reduced staff has to do corrections of the elements and ephemeris work for only one-third of the known asteroids. At the moment by far the greater part of newly found asteroids is lost again, so that the selection is self-regulating.

'Naturally your special programme, which you give on page 1 of your letter, is not touched upon and it will be necessary to fix the details of this work by Commission 20 to avoid double work. I would, also, be interested in the results of Miss Marrison's discussion.'

In February 1951, he wrote Dr Brouwer a letter of which I translate freely the following:

From long consideration and recent discussions I have come to the conviction that a decision must be made now, either

1. To continue the minor-planet programme as hitherto, or
2. To change the programme radically, confine the *Catalogue* to a selected and limited number of objects, and to compute neither orbit improvements, perturbations, or ephemerides for the "useless" planets.'

In a recent letter Dr N. Yakhontova presents the viewpoint of the Institute of Theoretical Astronomy of the Academy of Sciences of the U.S.S.R. A free translation by Dr S. Gaposchkin follows:

'It seems to us that it is quite legitimate to limit the list of the minor planets in the *Catalogue*, and we think that the Centre of Planets in Cincinnati stands on a quite reasonable ground by making strict demands which ought to be fulfilled for the newly discovered planets. The small number of planets which received numbers in the last few years (in all four planets) speaks for the fact that these demands are truly strict.

'We agree that the planets belonging to your classes (Trojans, planets with unusual orbits, etc.) must be entered in the *Catalogue* in the first category, possibly with very little changes.

'With respect to removing the "average" planets from the *Catalogue*, according to your expression as "useless", the idea seems to us not rational because the removing out of the *Catalogue* is equal to refusal of publication of the ephemerides. Consequently, if such a removed planet be on a plate, the observer will not be able to know whether it is a new or an old one and will try to obtain if possible new observations and to determine the orbit. Meanwhile the observation of the planets appears now to be the most difficult process in the work on the minor planets. The process has not changed since the discovery of photography, while at the same time the computation of ephemerides is going on in the present time rather simply and the computation of 100 additional ephemerides is not so difficult.

'I do not speak certainly about those ten or twenty planets which could be considered as entirely lost, and for which the ephemerides are truly useless. The list of such planets should be established.

'The most real possibility of reducing the work of maintaining the ephemerides appears to us the maximum rationalization of the computational processes. Entirely different is the situation with the observations. Endless observations of minor planets with very well determined elements (this refers chiefly to bright minor planets) do not appear rational. It is necessary to publish the list of the planets which are in special need of observation so that the observatories can observe them. The observations should be given as a rule approximately, aiming in doubtful cases at not less than two observations in the opposition.

'Finally, it is necessary to draw attention of astronomers to the physical observations of the minor planets and to propose a programme of photometric, spectroscopic and spectrophotometric observations.'

From a study of these views it appears to the writer that, as Arend and Delporte point out explicitly, there are two problems involved, which must be studied separately, viz.:

1. Special research programmes on asteroids.
2. Routine astrometric programmes.

I shall first touch lightly on (1) which is not the primary task assigned to us, and then dwell more at length on (2) which concerns more intimately the maintenance of the annual *Asteroid Catalogue*.

Arend, Delporte, and Yakhontova agree that a homogeneous magnitude system for the asteroids is of vital importance. I believe that this matter has been considered elsewhere by Commission 20 and need not be pursued further by us. Furthermore, many special research programmes, such as spectroscopic, spectrophotometric and other programmes for larger telescopes will unquestionably lead to extremely important results concerning the nature and origin of the asteroids. It is obvious that the continued production of an annual catalogue and ephemeris for the asteroids will be of vital importance to many of their programmes. Our assigned problem, however, really concerns the routine astrometric programmes and the

general problem of the observer, limited by the problem of maintaining an ever-growing annual catalogue and ephemeris.

It appears that all of the members of this Sub-Committee are in agreement that the long-range purposes of the annual catalogue and ephemeris include furtherance of the following objectives:

1. Enhanced physical knowledge of the minor planets, such as spectra, brightness, size, rotation, composition, etc. (form and duplicity especially stressed by Arend and Delporte), and orbital statistics certainly are of great importance in evolutionary studies to determine the nature and origin of the minor planets themselves.
2. Orbital studies of minor planets provide an excellent means for testing and applying theories of celestial mechanics.
3. The minor planets can serve as tools for ulterior investigations, such as corrections to star catalogues, establishing masses of the principal planets, etc.

Also, all appear to be in agreement that the asteroids of greatest general interest are:

1. The Trojans.
2. Planets with unusual orbits including those having close approaches to the Earth or other planets, or those having perihelia within the Earth's orbit or aphelia beyond Jupiter.
3. Planets brighter than 9 (or 10?) absolute magnitude.
4. All planets within some inner zone (proposal by Brouwer).
5. Planets whose periods are near to resonance with Jupiter (proposal by Brouwer).

One would naturally add to this list planets that show unusual variations in brightness, colour, etc.

Furthermore, there seems to be no disagreement that homogeneous statistics of the orbits and other characteristics of the asteroids are of prime importance. It follows then that special effort should be made to complete the statistics to as faint a practical limit of absolute magnitudes as possible (item 3, above).

There is, however, a divergence of opinion with regard to the definition or to the existence of what I termed 'useless' asteroids. I admit that I used this term intentionally because of its provocative nature. Obviously there are no 'useless' asteroids in the statistical sense and possibly no 'useful' asteroids in a very practical sense. By 'useless' I had in mind those asteroids that are too numerous for cataloguing in detail and so average in character that they add relatively little to the furtherance of the three general objectives listed above. The addition of any 'average' asteroid of absolute magnitude 7 or 8 to the catalogue would obviously be useful. The addition of an 'average' asteroid of faint absolute magnitude would add too little to justify the effort unless it were one of a homogeneous statistical collection.

Another point of interest emerges from the discussion, particularly that of Arend and Delporte, that it is hopeless to search for a strong correlation between the discovery position and motion of a new asteroid and its orbital elements. Hence, an actual orbit calculation is needed to determine much about the orbit except for very exceptional asteroids.

From the above discussion, representing the opinions of a number of asteroid investigators, one can probably find general agreement on the following points:

1. That there is some practical upper limit to the number of asteroids that should be followed and for which ephemerides should be presented in an annual ephemeris. Perhaps 3000 asteroids represent a reasonable upper limit.
2. That far more asteroids can be found with modern telescopic equipment than can be followed by the number of astronomers who are active or apt to become active in astrometric studies of asteroids.
3. That in practice there is a definite limitation or censorship with regard to the addition of new asteroids. There is individual selection of bodies that are apparently intrinsically brighter and of bodies that may be termed more 'interesting'
4. That the recently stiffened requirements for the inclusion of an asteroid in the annual catalogue probably provide a sufficient limitation at the moment to prevent the catalogue from growing at an impossibly rapid pace.

5. That no further formal limitations as to the inclusion of asteroids in the catalogue are needed.
6. That there is fairly good agreement in practice as to what types of objects constitute interesting or 'useful' asteroids for future inclusion in the catalogue but that it might be advisable to obtain a more general expression of opinion from the members of Commission 20 with regard to what criteria define the most 'useful' objects for inclusion in the catalogue. A wide distribution of this set of criteria might be advisable.
7. That special attention should be given to the addition of asteroids of brighter absolute magnitudes, particularly in the range from 7 to 10. The selection of faint asteroids in the present catalogue must be far from random or typical.
8. That it might be desirable to consider the possibility of a second Asteroid Catalogue, comparable to the catalogues of comet orbits, in which orbits insufficiently well determined for inclusion in the general catalogue might be included for statistical purposes. This last possibility requires more thought and probably should be considered by the whole Commission.

FRED L. WHIPPLE

COMETS

Limitation of space makes it necessary to limit this Report to a selection of some highlights. There has been a great deal of activity during the past three years on problems concerning the origin and the nature of comets, as the following publications testify:

A. J. J. van Woerkom: On the origin of comets, *B.A.N.* **10**, 445, 1948.
J. H. Oort: The structure of the cloud of comets surrounding the solar system, and a hypothesis concerning its origin, *B.A.N.* **11**, 91, 1950.
Fred L. Whipple: A comet model, *Ap. J.* **111**, 375, 1950; **113**, 464, 1951.
M. Schmidt: The variation of the total brightness of comets with heliocentric distance, *B.A.N.* **11**, 253, 1951.
J. H. Oort and M. Schmidt: Differences between new and old comets, *B.A.N.* **11**, 259, 1951.

Prof. Oort makes the following recommendations:

The attention of computers of comet orbits is drawn to the interest of knowing, beside the *osculating* elements, also the eccentricities of the *original* orbits of those comets for which the orbital major axes exceed 500 astronomical units.

While some of these researches obviously go beyond the field of activity of this commission, it is impossible to draw a strict boundary between the provinces of Commissions 15 and 20.

A Report by Prof. A. D. Dubyago, Kasan University, on research on comets in the U.S.S.R. calls attention to a publication by E. I. Kazimirchak-Polonskaya entitled *Close approaches of comets and planets and the planetocentric motion of comets*. This publication gives an historical review of the motions of 36 short-period comets which had close approaches to planets from Mercury to Jupiter; of 110 approaches investigated, 69 pertained to Jupiter.

Prof. Dubyago investigated the secular acceleration and retardation of a number of periodic comets. He established the existence of a secular retardation of Pons-Winnecke's comet between the years 1858 and 1886. He showed that progressive variations of the mean daily motion of periodic comets may be explained by the loss of parts of their matter. He has also calculated the possible amount of this loss of mass near the perihelia of their orbits. This process is offered as an explanation of the secular accelerations of periodic comets (*A.J U.S.S.R.* **25**, 361, 1948).

In view of the fact that the question of investigating the motion of Halley's comet in ancient times was raised at the Zürich Meeting, Prof. Dubyago calls attention to a publication by M. H. Vilyev (*Transaction of the Russian Society of Amateurs of the Knowledge of the Universe*, **6**, 215, 1917), containing results of the calculation of perturbations on Halley's comet by Jupiter and Saturn extending from the year 451 to −622. The earliest perihelion passage determined by Vilyev is dated −622.04.

Prof. M. Kamienski ('Researches on the Periodicity of Halley's Comet', part 1, *Bull. Acad. Polon. des Sciences et des Lettres, Cracovie*, 1949; and report of meeting of January 21, 1951) finds an average period of Halley's comet $76^{y}\cdot903 \pm {}^{y}\cdot008$ (Julian years). An empirical formula with four periodic terms is used to represent recorded apparitions of the comet back to 2315 B.C.

The following recommendations were submitted by Prof. Dubyago:

1. It is recommended that a detailed index be published of all the observations of the positions of each comet in the I.A.U. Circulars.

2. It is recommended that the British Astronomical Association publish ephemerides of the periodic comets from two to three years in advance of their next apparition.

3. It is recommended that the British Astronomical Association publish a catalogue of comet orbits.

Report of the Sub-Commission on Short-period Comets

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 computation. This is not always an easy task. It happens off and on that astronomers, who have informed the Sub-Commission that they will compute a revised orbit for a periodic comet, give up the computation *without* advising the Sub-Commission that they are not able to fulfil their obligations, and this may imperil the recovery of the comet at its next apparition. Computers are, therefore, urgently requested to tell the Sub-Commission well in advance of any change in their plans regarding the orbits and predictions that they have undertaken to provide. The computers of the British Astronomical Association have been of great help in supplying predictions when such were not provided by the proper computers. The following table lists the comets for which the Sub-Commission has the information that revised orbits or predictions are under preparation. In doubtful cases the name of the computer has been placed in parentheses:

Name of comet	Period (years)	Last apparition observed	Next apparition	Computer
1. Encke	3·3	1951	1954	Leningrad Astr. Inst.
2. Honda-Mrkos-Pajdusakova	4·8	1948	1953	Schmitt
3. Grigg-Skjellerup	4·9	1947	1952	Dinwoodie
4. Tuttle-Giacobini-Kresak	(5)?	1951	?	(Stephens), Cunningham, Kresak
5. Tempel 2	5·2	1946	1951	Ramensky, Goodchild
6. Neujmin 2	5·4	1926	1953	Poulkovo Obs.
7. Schwassmann-Wachmann 3	5·4	1930	1952	Parfenow, Cripps
8. du Toit (1945*c*)	5·5	1945	1956	(Cunningham)
9. du Toit-Neujmin-Delporte	5·5	1941	1952	(Naur), Voyeva, B.A.A.
10. Tempel 1	6·0	1879	?	V Schrutka-Rechtenstamm
11. Pons-Winnecke	6·1	1945	1951	Guth, Porter
12. Kopff	6·2	1945	1951	Kepinski, Beart and Julian
13. Tempel-Swift	6·3	1908	1957	Ramensky, Kanda
14. Forbes	6·4	1948	1955	Cripps
15. Schwassmann-Wachmann 2	6·5	1948	1954	Rasmusen
16. Reinmuth 2	6·6	1947	1954	Rabe
17. Giacobini-Zinner	6·6	1946	1953	(Cunningham), Cripps
18. d'Arrest	6·6	1950	1957	Recht
19. Daniel	6·8	1950	1957	Cripps
20. Finlay	6·9	1926	1953	Cimmino
21. Borelly	6·9	1932	1953	Cunningham
22. Brooks 2	6·9	1946	1953	Cunningham, Cripps
23. Holmes	7·0	1906	?	Koebcke
24. Faye	7·3	1947	1955	Zseverzsev, (Cunningham)

Name of comet	Period (years)	Last apparition observed	Next apparition	Computer
25. Wolf 2	7·5	1924	1954	Kanda
26. Reinmuth 1	7·7	1950	1958	Cripps (Kanda)
27 Jackson-Neujmin	8·0	1936	1952	Poulkova Obs.
28. Oterma (1942 VII)	8·0	Observed every year		Oterma, Herget
29. Schaumasse	8·2	1943	1952	Sumner (Kanda)
30. Wolf 1	8·3	1950	1959	Kamienski
31. Comas Solá	8·5	1944	1952	Vinter Hansen
32. Swift	8·9	1889	?	(Stephens)
33. Väisälä	10·5	1949	1960	Oterma
34. Gale	10·8	1938	1960	Dinwoodie
35. Neujmin 3	10·9	1929	1951	Julian, Higami
36. Tuttle 1	13·6	1939	1953	B.A.A.
37. Schwassmann-Wachmann 1	16·3	Observed every year		Herget
38. Neujmin 1	17·7	1931	1966	Poulkova Obs.
39. Crommelin	27·8	1928	1956	B.A.A.
40. Stephan-Oterma	38·0	1942	1980	Oterma
41. Westphal	61·7	1913	1975	Koebcke
42. Olbers	69·6	1887	1956	Rasmusen
43. Pons-Brooks	71·6	1884	1956	Herget
44. Halley	76·0	1910	1986	Bobone
45. Herschel-Rigollet	156·0	1939	2096	Rigollet

The following periodic comets are particularly in need of computers:

Johnson (1949*d*)	6·2	1949	1954
Wirtanen (1948*b*)	7·3	1948	1955
Whipple (1947*g*)	7·4	1947	1954
Ashbrook-Jackson (1948*i*)	7·5	1948	1956
Shajn-Schaldach (1949*e*)	7·8	1949	1957

Astronomers who wish to provide predictions for these five comets, or any other periodic comets not yet taken care of, are kindly requested to make their intentions known to the President of the Sub-Commission.

J. M. VINTER HANSEN
President of the Sub-Commission

SATELLITES

Studies of satellite systems are in progress at various observatories, but few completed investigations can be reported. The most recent addition to the known satellites in the solar system is Nereid, satellite of Neptune, discovered by G. P Kuiper at the McDonald Observatory on May 1, 1949.

The motion of Jupiter's eighth satellite has again been the subject of several investigations. The Institute for Theoretical Astronomy of the Academy of Sciences of the U.S.S.R. reports on two studies of this satellite. Cowell's method was used for numerical integration from its discovery in 1908 to 1947. The orbit was improved by comparing with observations from 1930 to 1946. The mass of Jupiter, determined from this comparison, was $1/m_4 = 1047{\cdot}411$. An attempt was also made to apply the general theory developed by E. W Brown and D. Brouwer. This investigation 'showed a number of defects in the theory which rendered it useless for the construction of tables of the satellite's motion' The nature of these defects is not given. In defence of the authors of the theory it may be said that they were aware of the very approximate character of the constants used and that the theory might at best be adequate for prediction purposes.

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A numerical integration of this orbit was also undertaken by H. R. J. Grosch. A summary of his work was published in *Astr J* **53**, 180–7, 1948. Grosch used the same interval as the Leningrad astronomers, 1930–46, for comparison with observations.

A. J. J. van Woerkom published a discussion of all available observations of Jupiter's fifth satellite, *Papers Amer. Ephem.* Vol. **13**, part 1, 1950. A secular acceleration in the mean longitude of this satellite is indicated. The determination depends strongly on observations in 1949 made by H. M. Jeffers at the Lick Observatory. Additional observations of this satellite are needed to strengthen the solution.

A discussion of observations of Saturn's satellites is in progress at the United States Naval Observatory. Plans for further work, probably in co-operation with the Yerkes Observatory, are being considered.

DIRK BROUWER
President of the Commission

20. ADDITIONAL REPORT OF THE SUB-COMMITTEE ON PERIODIC COMETS

The following astronomers have been announced as computers of orbits of periodic comets:

Number in Draft Report	Name of comet	Computer
1	Encke	Makover
38	Neujmin 1	Mitrofanova

Furthermore Professor Dubyago, Kazan, states that he, too, has established the identity of comet Kresák (1951*f*) with P/comet Tuttle-Giacobini.

J. M. VINTER HANSEN

February 1952

Report of meetings

PRÉSIDENT: Prof. D. BROUWER.

SECRÉTAIRE: Dr S. AREND.

The first meeting of the Commission took place on Friday, 5 September. The meeting was opened by the President. On his nomination, the members present approved the appointment of S. Arend to serve as Secretary.

Messages from Honorary President A. O. Leuschner and from E. L. Martin and P Herget were communicated. The President was instructed to acknowledge them. On motion by G. Merton the Draft Report was approved as printed. A tentative agenda proposed by the Chair was adopted.

Minor planets

Ephemerides. The change in the form of publication of ephemerides was discussed. Beginning with the year 1952, no complete volume of ephemerides was published by the Minor Planet Centre in Cincinnati. Instead, the Leningrad volume was adopted for general use, supplemented by corrections published by the Minor Planet Centre for planets for which more reliable data were available at other centres. As a result of correspondence between the President and M. Subbotin, the Institute for Theoretical Astronomy at Leningrad will be prepared to publish in future volumes, along with ephemerides computed by its own staff and collaborators, also ephemerides computed by other institutions, with mention of author and source. The plan cannot be made fully effective at once since it will necessitate earlier preparation of ephemerides than was

previously necessary. Within a few years the new policy should reduce materially the number of minor planets for which corrections to the Leningrad volume must be furnished. A statement on this subject by the President was confirmed by a communication by D. J. Martynov on behalf of N. S. Yakhontova, chief of the department of minor planets of the Institute for Theoretical Astronomy of the Academy of Sciences of the U.S.S.R. The Commission voted its approval in the resolutions:

The Commission approves the policy adopted by the Minor Planet Centre in Cincinnati of publishing for the year 1952 corrections to ephemerides published in the ephemeris volume issued by the Institute for Theoretical Astronomy of the Academy of Sciences of the U.S.S.R. for planets for which more accurate data were available elsewhere, instead of publishing a complete volume of ephemerides by the Minor Planet Centre. The Commission recommends that this policy be continued.

The Commission regards with satisfaction the intention of the Institute for Theoretical Astronomy at Leningrad to publish along with ephemerides computed by its own staff and collaborators ephemerides computed by other institutions, with mention of author and source.

Charts. The desirability of continuing the publication of charts giving the paths of minor planets near opposition was discussed. The opinion of the members present appeared divided. The President was instructed to explore the matter further.

Minor Planet Circulars. While the *Circulars* serve their purpose as a record of observations, newly computed orbits, etc., complaints have been received concerning their distribution by surface mail at long intervals. The following resolution was passed:

The Commission expresses the wish that *Minor Planet Circulars* be issued at shorter intervals and distributed by air mail outside North America.

Minor Planet Centre. A communication by P Herget on the operation of the Minor Planet Centre was read. This dealt especially with problems concerning the naming of newly discovered planets and the designation of the rightful discoverer. The Report reads in part:

It has always been recognized that the discoverer alone has the right to choose the name, but it has been the established practice in former years that the name must be approved by the Minor Planet Centre before it is accepted for common usage. There are several good reasons for the exercise of such a controlling authority. This will avoid the existence of names which are so similar to each other as to be easily confused. There are already too many such cases, e.g. (1045) Michela, (1348) Michel, (1376) Michelle; and we propose to avoid such occurrences in the future. Names which differ from others by only one letter will surely be unacceptable.

In the past, names have been rejected on grounds of political connotations. This policy appears to be of doubtful validity. We propose to reject names only on the grounds of being deliberately offensive or in bad taste.

Circumstances which formerly did not exist, now make it possible for disputes to arise as to who is the rightful discoverer One kind is due to the establishment of identities with planets observed in former years but not numbered. If the identification is based upon the similarity of elements computed separately in each year, then the first observer is the discoverer. If the identity is derived only from elements based upon observations in a later year, then this observer is the discoverer. If a planet is numbered on the basis of an identification and the rightful discoverer is deceased, then the right to assign a name shall fall to the identifier. This seems to be a fair way to reward these valuable contributions.

A more delicate situation can arise in the case of independent discoveries made nearly at the same time. If both reports are received at the Minor Planet Centre before either is printed and distributed in the *Minor Planet Circulars*, then the earliest observation determines the discoverer. If the second report is received after the first one is distributed, then the second one loses its claim, even though it may be an earlier observation. Such disputes will be avoided if observers follow the practice recommended by the Minor Planet Centre concerning

the assignment of provisional designations. The provisional designation will be assigned (and the observer will be notified by return air mail, when requested) upon receipt of the following data: time, place, magnitude, and approximate right ascension and declination.

On a motion by G. van Biesbroeck, amended by Sir Harold Spencer Jones, it was voted that:

The Commission expresses its great satisfaction with the very good work done by the Minor Planet Centre in Cincinnati, and recommends that the same financial support as was given during the past four years be again granted for its continued operation.

Recommendation by P. Sconzo. This recommendation, printed in the Draft Report, concerns the desirability of publishing a list of elements of all unnumbered orbits of minor planets, now scattered in numerous publications. A. Kopff stated that a card catalogue of such orbits is being kept up to date in the Astronomisches Rechen-Institut at Heidelberg. W Strobel explained that a first instalment has been forwarded for publication in the *Minor Planet Circulars*. The list as a whole, to be completed by further instalments, will occupy relatively few numbers of *Minor Planet Circulars*. At first, planets discovered at Heidelberg and at Uccle are included in the lists, later on planets discovered elsewhere will be taken up. The chairman stressed the importance for the systematic search for identities for which the listing of unnumbered orbits will be useful. This was referred to in the Draft Report.

Magnitudes. A. Kopff gave a brief review of the report of the Committee on magnitudes, of which he was chairman (see Draft Report). G. P Kuiper described the present status of the observing programme dealing with magnitudes of minor planets carried out at the MacDonald Observatory. F. K. Edmonson gave a description of the method of observing of minor planets used at the Goethe Link Observatory. He employs the Trépied-Metcalf method, and obtains photographic magnitudes by comparison with a polar sequence plate. A. Kopff urged that a clear distinction be maintained between visual and photographic magnitudes. He encouraged the work on magnitudes of minor planets, as this should lead to an improved system, but recommended that no changes be introduced prior to the completion of the survey at the MacDonald Observatory.

Future of the Minor Planet Work. F. L. Whipple reviewed the report written by him as chairman of the committee (see Draft Report). The consensus of opinion among those present was that no change in policy is necessary at the present time. In part on account of the strict rules for numbering of newly discovered planets, now in force, the number of additions to the list of numbered planets has not been very large in recent years.

Publication of Elements. The members present agreed that publication of complete lists of elements at an interval of five years is adequate, provided that changes in elements be published in an appendix to the ephemeris volume in which the change is introduced.

Names of Planets in the Leningrad Volumes. S. Arend expressed his concern with the use of Russian characters for the names of minor planets in the ephemeris volume for 1952. This change from the use of Latin characters in previous volumes was a cause of trouble to many users of the ephemerides. He expressed to the U.S.S.R. delegates the wish that the use of Latin characters for the names be restored. The chairman supported this request.

Comets

The recommendation by J. H. Oort (see Draft Report) was adopted as follows:

The attention of computers of comet orbits is drawn to the interest of knowing, besides the oscillating elements, also the eccentricities of the original orbits of those comets for which the orbital major axis exceeds 500 astronomical units.

Recommendations 1 and 2 by A. D. Dubyago were discussed. G. Merton remarked that he could upon request furnish information contained in the I.A.U. *Circulars* and

also in *Harvard Announcement Cards* before the publication of the reference in the *Astronomisches Jahresbericht.*

The Commission agreed that re-publication of all data concerning comets published in I.A.U. *Circulars* would be an unwarranted duplication.

Concerning A. D. Dubyago's second recommendation, G. Merton explained that the publication of ephemerides of periodic comets two or three years in advance of their next apparition, however desirable, could not easily be accomplished in many cases. The work is done by many different computers who are amateurs, and who make the computations in their spare time. The schedule of such computations cannot be controlled to the same extent as would be possible with computations in a single central office. Moreover, the ephemeris computations cannot be started very early if good starting elements are not available. Computers who undertake the computation of elements must first complete their work and communicate their results. The Commission adopted the following motion by G. Merton:

The Commission urges computers of accurate elements of periodic comets to supply the results of their computations to the Computing Section of the British Astronomical Association several years before the comets are due to return or to supply the predicted elements and ephemerides in good time for printing in the Association's handbooks.

The third recommendation by A. D. Dubyago was made superfluous by the fact that copies of a *General Catalogue of Comet Orbits*, compiled by F. Baldet and G. de Obaldia were presented at the meeting. G. Merton, remarking that this publication made unnecessary a new compilation of comet orbits by the B.A.A., proposed a vote of thanks, seconded by F. L. Whipple. By unanimous vote the Commission adopted the resolution:

The Commission expresses its appreciation to F Baldet and G. de Obaldia for their compilation of the comprehensive *Catalogue général des orbites de comètes de l'an −466 à 1952.*

F L. Whipple spoke about work being done by S. Hamid on the construction of tables suitable for the evaluation of the secular perturbations of comets with orbits of high inclination and large eccentricity. He also reported on Mr Hamid's calculations, now in progress, of the values of the gravitational constant for sixty-five comets with definitive orbits of high quality. The method consists in solving the normal equations for seven unknowns, including Δk, instead of the customary six orbital elements. The purpose of this investigation is to determine the nature of possible physical forces affecting the motion of comets.

A second meeting of the Commission was held jointly with Commissions 7 and 17 on Monday, 8 September 1952.

A. Kopff informed the commissions on the work on minor planets at the Astronomisches Rechen-Institut in Heidelberg. Computations on orbit corrections and perturbations continue in co-operation with the Minor Planet Centre in Cincinnati. With regard to ephemeris calculations, duplication with activities elsewhere is avoided as much as possible.

Mrs Sophia Levy McDonald presented a brief account of the work by herself and A. O. Leuschner on the application of the group theory designed for the group one-half to thirty-four minor planets with a much wider range in mean daily motion than the range for which the group theory was originally developed. The results were recently published in *Lick Observatory Publ.* Vol. **20**, copies of which would be available during the meeting to interested members of Commissions 7 and 20. Further details on this work are found in the report of Commission 7.

The joint meeting of the three commissions then considered Recommendation 2 of Commission 4*a* (see Draft Report), dealing with the proposed amendment of the lunar ephemeris.

D. H. Sadler stated that the proposed changes in the lunar ephemeris (see *Monthly Notices R.A.S.* **111**, 624–9, 1951) are not inconsistent with a paper published in the *Astronomical Journal of the U.S.S.R.* After ample discussion, Commissions 7, 17 and 20 voted to support this recommendation made by Commissions 4 and 4*a*.