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

PRESIDENT: P. Herget.
SECRETARY: G. A. Wilkins.
INTERPRETERS: J. Kovalevsky and E. Rabe.

First Meeting, 24 August 1967

The meeting was opened at $14^h\ 00^m$ by the President with a word of welcome, the introduction of the Secretary and Interpreters and a recognition of each of the 21 members present. The names of new members of the Commission were read: Debehogne, Galibrina, Marsden, Milet, Sekanina and Sitarski. The following members have retired: Jeffers, Kahrstedt, König and Reinmuth.

During a standing tribute to the memories of the members who had passed away during the last triennium the President read the following short obituaries:

Dirk Brouwer (1902–1966) was educated at Leiden and spent his entire astronomical career at Yale. He was an ardent worker, he published prolifically, and he became the dean of celestial mechanicians in America. He succeeded Schlesinger as director of the Yale Observatory in 1941, he carried out the completion of the Yale Zone Catalogues, and he has been a respected and admired leader in the current large astrometric programs. The advent of artificial satellites directed his attention to the peculiar problems of their general perturbations, and he set a high standard for all workers in this field. He also served as editor of the Astr. Journal since 1941. He was elected a member of the U.S. National Academy of Sciences in 1951, and he served as President of Commission 20 during the critical years from 1948 to 1955.

W. W. Heinrich (1884–1965) received his Doctors' degree from the Charles University in Prague in 1908, having published his first paper on the libration of Patroclus (the second known Trojan asteroid) in 1907. He spent short periods at Strasbourg, Göttingen and Königstuhl before returning in 1912 to Prague, where he became Professor in 1926 and remained until his retirement in 1957. He published about fifty papers on the three-body problem and was an active member of Commissions 7 and 20; at the age of eighty, he presented a paper at IAU Symposium No. 25 in Greece and afterwards attended the General Assembly at Hamburg.

F. Kepinski (1885–1966) studied at Warsaw and Göttingen. He was an assistant in Berlin-Babelsberg and then at Warsaw Observatory. In 1927 he became professor and head of the Observatory of the Warsaw College of Technology. In 1926 he started his investigations of the motion of the Comet Kopff. His research in this field was crowned by the rediscovery of that comet in 1958 after its close approach to Jupiter in 1954. He published two textbooks on spherical and practical astronomy and 88 scientific papers on problems of geodetic astronomy and on motion of comets and asteroids.

Gerrit Pels (1893–1966) from Woerden, The Netherlands, attended secondary school at Utrecht and in 1919 was appointed as a computer at Leiden. He continued his studies of mathematics, and he was a highly valued assistant to the senior staff. He worked with De Sitter on the satellites of Jupiter, with J. Woltjer on the satellites of Saturn, with Oort in stellar dynamics, and he became very skilled in computing the orbits of comets and minor planets, and in measuring and reducing the plates taken by Van Gent in South Africa. He used the photographic refractor to observe the selected minor planets of Brouwer's program, and selected proper motion stars from the lists of Platt and Blaauw. He searched two large regions of the sky for new members of the Hyades and Pleiades clusters. In 1954 he was appointed to the senior staff at Leiden in recognition of his outstanding contributions, and he continued work until his final illness.

M. F. Subbotin was born in Ostrolenka (Poland) in 1893. He studied in Warsaw University. In 1922 he was appointed Director of the Tashkent Observatory, from 1930–1960 he was professor of

Celestial Mechanics at the Leningrad University. In 1942–1964 he was Director of the Institute of Theoretical Astronomy. His contributions in Celestial Mechanics concerned the fundamental problem of improving the convergence of the expansions of the disturbing function and the determination of comet orbits. His well known three-volume manual of Celestial Mechanics and his activity in guiding astronomical institutions inspired many young people to work in this branch of astronomy. He worked also in pure mathematics. He was stricken with a heart attack on 26 December 1966 in Leningrad.

The appointment by the Executive Committee of the officers of the Commission for the coming triennium were announced: Professor G. A. Chebotarev, as President; and Professor F. K. Edmondson, as Vice-President. The President expressed his regrets that Dr S. G. Makover, the present Vice-President was not in good health and would not be able to serve as President.

The agenda for the sessions were announced. Z. Sekanina invited the members of the Commission to visit the Center for Numerical Mathematics in the University of Prague during the afternoon of 28 August.

The volume of Ephemerides of Minor Planets for 1968 had just been published by the Institute of Theoretical Astronomy, Leningrad, and copies were available for the members of the Commission.

DRAFT REPORT

The President expressed his thanks to those members who had contributed to the Draft Report, which he considered to be a very important activity of the Commission. The following contributions were, however, received too late for inclusion in the Report.

The Institute of Theoretical Astronomy, Leningrad, reports that the Crimean Astrophysical Observatory has obtained 908 positions of 135 minor planets in 1966 and 450 positions of 53 planets in the first half of 1967. The rate may be expected to remain at about 1000 positions per year.

Miss J. Gill (NASA) and Mrs B. Gault (Yale) have determined a new position of the pole of Neptune's equator using more than 3000 visual and photographic observations of Triton's position angle and separation. These observations encompassed 85 seasons from 1887 to 1958. The reciprocal mass of Neptune was found to be $1/19296 \pm 9$, which is 3 per cent smaller than the value 1/18730 published by Van Biesbroeck in 1957.

R. B. Hunter (*Mon. Not. R. astr. Soc.*, **136,** 245, 267, 1967), using hypothetical starting conditions, has investigated the evolution of the orbits of possible satellites of Jupiter and close minor planets, by means of numerical integration. His conclusions regarding stability are in agreement with the known satellites, and he is led to suspect the possibility of a ring of minor planets between Jupiter and Saturn.

PRESIDENTIAL ADDRESS

The President briefly reviewed the present status and problems of minor planet work. The Naval Ordnance Research Calculator (NORC) is being withdrawn from service, but it has completed the computation of some 33000 ephemerides at opposition for 450 numbered minor planets up to the year 2000 and for many unnumbered objects. The Minor Planet Center at Cincinnati has completed much of its set task of improving the orbits of numbered minor planets, and those based on recent identifications. The comparison with observations gives residuals that on average are less than $2''.5$; the orbits of some of these minor planets were previously not secure and one 'lost planet' was recovered. The Institute of Theoretical Astronomy at Leningrad continues to produce the annual volume of ephemerides and accepts responsibility for three-quarters of the numbered minor planets; about 300 orbits have been improved recently.

The completion of the Leiden survey of faint minor planets would raise the question as to whether it is worthwhile continuing to study minor planets individually once the properties of the minor planet population are known statistically. Certainly it is desirable to re-examine the aims and procedures of minor planet work. It is imperative to keep up the work on selected minor planets and it is desirable that observations down to the 17th magnitude should be made. On the other

hand the annual volume should mark those minor planets for which observations are no longer required. The Minor Planet Circulars give ephemerides for minor planets for which further observations are urgently needed; observations should be made over an extended arc to ensure correct identification. No progress had been made on the proposal (see *Trans. IAU*, **12B,** 236) to resurvey the sky since it has not been possible to find a suitable instrument or site.

GENERAL DISCUSSION AND REPORTS

The President suggested three topics for general discussion: (*a*) the accuracy with which positions should be given, (*b*) cooperation in reductions and (*c*) reference star catalogues.

(*a*) *Accuracy of Positions.* In the case of short-focus telescopes it seems desirable that the maximum precision should be obtained at the first attempt but otherwise it is sufficient to publish approximate positions and leave the accurate measurement and reduction until a request is made by a computer. *H. Hertz* asked whether it would be feasible for observers with much material to list the dates and centers of unmeasured plates. *Herget* commented that such a list is difficult to use, and that the limiting magnitude would also be significant. The situation should not exist, but perhaps the computer requiring the observations should circulate search ephemerides and let the observers look on any relevant plates.

(*b*) *Cooperative reductions.* The need for cooperative reductions is becoming less acute as electronic computers become more widespread. *E. Roemer* pointed out, however, that the problem will continue to exist for long-focus plates of faint minor planets and comets since ordinary reference stars cannot be used.

(*c*) *Reference star catalogues.* The situation would be considerably improved once the Bergedorf AGK2/3 program was completed. For the time being consideration might be given to the use of the Smithsonian Astrophysical Observatory catalogue which exists in printed form and on magnetic tape.

Leiden Survey. C. J. van Houten gave a brief report on the Leiden Survey of faint minor planets. The survey is based on plates taken with the 48-inch Palomar-Schmidt telescope to a limiting magnitude of 20·5. Reliable orbits had been determined for 85 per cent of the 2100 objects for which at least 3 positions had been obtained. The material was being used to determine the number/-magnitude relationships in more detail, to look for fine structure in the number/mean-distance relationship near the Kirkwood gaps, and to find new families. In the ensuing discussion, he stated that 15 new Trojans had been found.

Absolute Magnitudes. T. Gehrels reported on his recent work on the photo-electric light curves of individual minor planets and on his new tabulation (see pp. 121–132) of the photographic magnitudes of the numbered minor planets. A full report of the work will appear in the *Astronomical Journal.*

First Session on Comets, 24 August 1967

CHAIRMAN: Dr E. Roemer.

Use of large telescopes. In the discussion of the draft of Resolution 4 (see below) *the Chairman* pointed out that faint comets are presently being observed only at Tucson and Tokyo, although she congratulated the observers at Skalnaté Pleso on the skilful work done with a smaller instrument. *Hirose* said that the 74-inch reflector could be used for observations of comets only 3 weeks a year but that the 36-inch Dodaira reflector is available for 2 weeks each month. Positions for faint reference stars pose a difficulty, for the Tokyo Observatory lacks, and has been unable to obtain, many volumes of the Astrographic Catalogue. *Dobrovol'skij* asked whether image converters would be useful, but it was pointed out that the small field of view and changing geometrical distortions render such devices presently suitable only for physical observations. *Roemer* drew attention to the need for accurate predictions (to 5′) for observations with large reflecting telescopes and stated that it was still useful to have two independent predictions. It was agreed that the resolution should be put forward.

Repository of positions. Herget stated that the Cincinnati Observatory can now offer more flexible facilities for the repository of positions. The data, to be supplied in a standard format specified by the Working Group, would be kept on a magnetic tape.

Current Comet Catalogue. The Chairman congratulated *Marsden* on the production of the Supplement to the BAA Catalogue of Orbits. After discussion it was agreed that bibliographic material should be published in the *Transactions IAU*, but that elements should continue to be given in the progress reports in *Quarterly Journal RAS*, preferably in the format of the Catalogue of Orbits.

Magnitude predictions. There was a lengthy discussion on the bases and forms of magnitude predictions, different systems being appropriate to different types of comet (according to the degree of central condensation) and to different instruments. There was also the further difficulty that the appearance of a comet, especially new comets, might change unpredictably. A review article giving practical guidance to observers and computers would be useful.

Cometography. Marsden suggested that consideration be given to the compilation of a new cometography. He pointed out that there is no recent cometography that has the completeness of Pingré's work, now almost two centuries old, even though the compendia by Holetschek, and more recently by Vsehsvjatskij, are very useful. An important feature of the new cometography would be an ephemeris for each comet giving both positions and geocentric and heliocentric distances. Such ephemerides would be helpful in studies of statistics of cometary discoveries and of nuclear sizes. The distances are often omitted from the first ephemerides of a new comet, or, if they are included, they may be substantially in error. Prediscovery ephemerides are obviously useful for identifying possible prediscovery observations. Information should also be included concerning comets for which orbits have *not* been calculated. At present, the most complete sources of data for such comets are the lists by Baldet in the *Annuaire* of the Bureau of Longitudes, but the data there are very brief and no references to the original literature are given. Since so many comets are involved (almost 900 for which orbits have been calculated and an equal number for which they have not), it would be desirable to incorporate only the more reliable observational reports in some form of code. It is also important to consider how the cometography might be kept up to date. *Roemer* noted that a very considerable effort would be involved and that costs of formal publication probably would be very high for a limited distribution. She suggested that it might be possible to issue information in loose-leaf form, starting currently and working backwards. *Candy* drew attention to the *Provisional List of Uncertain Comets* published by the Yamamoto Observatory, Kyoto, in 1956.

Catalogue of Original and Future Comet Orbits. Sekanina reported that he had completed, in 1966, a comprehensive catalogue of comets having nearly parabolic orbits, together with original and future orbits. He now has 15 additional orbits and requests that other computers send him their results, including sufficient detail for assessment of the accuracy, so that the catalogue may be kept current.

Evolution of orbits. Kazimirčak-Polonskaja described her recent numerical studies of the evolution during 400 years of the orbits of some 45 short-period comets under perturbations by the major planets. The work will be published in full elsewhere.

Second Session on Comets, 28 August 1967

CHAIRMAN: Dr E. Roemer.
ACTING SECRETARY: M.P. Candy.

Magnitude predictions. Since no concensus regarding procedure had been arrived at, the *Chairman* proposed that the Working Group study the problem further. Suggestions and comments, to be addressed to the chairman of the Working Group, were solicited.

Cometography. The feasibility of preparing a new cometography will be considered by a committee chosen from among the members of Commissions 15 and 20: Marsden (Chm.), Candy, Dossin, Kresák, Roemer, Sitarski, Vsehsvjatskij.

Non-gravitational forces. The motion of a number of periodic comets has now been studied with

sufficient care, so that non-gravitational effects can be recognized with some confidence. There is, however, a divergence of opinion as to whether the events that produce the anomalous accelerations are continuous or discontinuous and as to the extent to which the activity may be concentrated near perihelion. A number of short reports intended to be representative of recent work and current thinking were presented.

Marsden described a new study of the orbits of six comets at their recent returns. The excellent n-body integration program of Schubart and Stumpff was used, the attractions by all nine planets being considered. The coefficients for the differential corrections, which include the full effect of the planetary perturbations, were obtained by a completely numerical procedure.

Marsden then reported on behalf of *J. L. Brady* regarding P/Halley: In contrast to *Zadunaisky*, who found it necessary to utilize two orbits to represent the observations of P/Halley at the 1910 return, Brady finds that one orbit will suffice. The principal difference between the two investigations is that Zadunaisky made use of normal places while Brady used the individual observations. Brady remarks: 'One can force selected groups of residuals below a realistic threshold by using two orbits, but such a treatment is certainly not justified until an exhaustive search for a single gravitational model has failed.' He concludes that non-gravitational forces are not detectable in the observations of any one apparition, and possibly not in two apparitions. Evidence for significant non-gravitational effects arises, however, in trying to link three or more successive returns: On tracing back the orbit determined by linking the returns of 1910 and 1835, Brady has found that the calculated time of perihelion in 1759 was 4·2 days too early; in 1682 it was 8·2 days too early. A very similar result has been obtained by H. F. Michielsen, who, in tracing the orbit back to 1378, found it necessary to adjust the period by 4 days at each perihelion passage.

In discussion, *Marsden* commented regarding the hitherto normal supposition that a careful discussion of observations at two apparitions would lead to a reliable prediction at the third. His prediction at the third apparition of P/Honda-Mrkos-Pajdušáková had been almost 30′ in error, almost entirely due to non-gravitational effects. Taking note of Roemer's remark that recovery of comets with large reflectors is troublesome if the predicted positions are as much as 5′ in error, *Marsden* suggested that non-gravitational forces would have to be allowed for in some way if recoveries of affected comets at fourth and subsequent apparitions are to be made without undue waste of time. 'Perhaps one can take them into account by simply including a secular term in the mean motion, as has often been done in the past. My own preference is to include a velocity term in the original equations of motion. I am not convinced that a specific impulse has ever manifested itself in the positional observations of a comet. Even if impulses do occur, it seems to me that, from the point of view of representing the observations and of making satisfactory predictions for future returns, one might just as well assume that the non-gravitational forces act continuously.' *Roemer* pointed out that the largest non-gravitational effects seemed to occur in the comets of more diffuse appearance—the effects were less apparent in the well-condensed comets. *Candy* asked whether errors in the planetary masses could account for the discrepancies. *Marsden* said that this had been considered and was found not to be the case. *Hertz* asked whether there was any evidence of secular effects in the eccentricities. *Marsden* replied that the effects seemed to be mainly in the motion.

Herget, on the other hand, considers the non-gravitational effects to be discontinuous. He reported that the experience with P/Pons-Brooks (1883–1884) showed a distinct deviation of the residuals after perihelion. Comet Schwassmann-Wachmann 1, which moves in a nearly circular orbit and therefore is observable for several months of each year, was studied initially at Cincinnati on the basis of observations 1934–1944 for the purpose of obtaining an accurate ephemeris for observers. No anomalies in the motion were found. A recent, more comprehensive study (*Astr. J.* **66**, 266, 1961), in which a sample of all observations since discovery were represented, revealed several rather sharp discontinuities in the run of residuals. The largest, which occurred in 1927, shortly after discovery, corresponds to a change of velocity of one meter per second if it is represented as a single impulse. P/Schwassmann-Wachmann 1 is an especially valuable example for investigation of the nature of non-gravitational effects because the time continuity of observations permits the recognition of discontinuous events that could be smoothed over in other comets. What is

needed to test the hypothesis of a discontinuous trajectory is to base a solution on all observations *after* perihelion at one apparition combined with those *before* perihelion at the next apparition. Then representation of the unused observations, those before the first perihelion passage and after the second, would show the importance of non-gravitational effects near perihelion. We need to find the magnitude of the "equivalent impulse" in as many cases as possible. In P/Reinmuth 2 *Rabe* found no evidence of non-gravitational forces.

Sekanina believes that the splitting of cometary nuclei is the strongest evidence supporting the existence of observable non-gravitational effects. He reported on his detailed study of three 'splits': Comet Ikeya-Seki in 1965, P/Biela, and Comet Wirtanen in 1957.

Sekanina suggested that (1) special attention be paid to astrometric observations of all the components of split comets, (2) independent orbits be calculated in such a way as to identify discontinuities for both short-periodic and near-parabolic comets, and (3) investigation be made of possible correlation of changes in physical characteristics with dynamical discontinuities.

In the general discussion that ensued, *Whipple* remarked that it was hard to see, from the physical point of view, how such large impulses could take place. The events in P/Schwassmann–Wachmann 1 must be mild ones. *Sitarski* commented that the form of the gravitational equation that Marsden suggested would preclude studies of evolutionary changes in orbital elements. *Sekanina* reported, in answer to a question, that he had tried to investigate correlations of impulse events with brightness changes, but specific associations could not be made because of insufficient observational data. He noted further that generally decreasing importance of non-gravitational effects in individual comets seemed reasonably associated with decreasing physical activity as an age effect. *Whipple* stated his view that splitting occurs most commonly as a result of increased rotation. It would appear, then, that the material of the comet nucleus must possess appreciable strength. A density of the order of 1·3 gm cm^{-3} would be associated with dirty-ice composition.

Second Meeting, 28 August 1967

The President opened the meeting at $10^h\ 30^m$ by outlining the substance of the letter that he was sending to the President of the Union in response to his request for suggestions for limiting the rapid growth in the attendance at General Assemblies.

PROPOSALS

The following resolutions were then passed without objection.

(1) 'Commission 20 recommends that the Minor Planet Center at Cincinnati continue to issue the *Minor Planet Circulars*, and that a sum of $ 500·00 per annum be made available to the Minor Planet Center for defraying the necessary expenditures.'

(2) 'Commission 20 recommends that the new improved list of values of g (magnitude at unit distances) prepared by Dr T. Gehrels be adopted for the magnitudes of these minor planets, and that the list be printed in the *Transactions IAU*.'

(3) 'Commission 20 recommends to all observers who have the appropriate facilities the urgent need for making early plans to observe (1566) Icarus by optical ($12 <$ magn. < 20) and electronic means during the coming apparition and the close approach (0·04 AU) of 1968 June 14–15, and notes that a reliable ephemeris based on the observations of 1966 is now available.'

(4) 'Commission 20 recognizes that the use of large telescopes for astrometric observations is essential to the study of the origin and physical evolution of comets and minor planets and therefore:

calls the attention of observers to the values of this area of work;

urges sympathetic consideration by the appropriate authorities of requests for observing time on suitable instruments;

solicits the cooperation of those observatories that have facilities for measurement and reduction of plates, including collections of star catalogues;

recommends the development of additional facilities, automatic insofar as practicable, for the measurement of plates up to 25 × 25 cm; and

commends the efforts of Commission 23 toward calculation of improved values of plate constants for the Astrographic Catalogue.'

The Commission then agreed to the recommendation of the President on the compositions of the Organizing Committee (namely: Arend, Herget, Hirose, Wood) and the Working Group on Comets (namely: Roemer (Chairman), Candy, Kresak, Makover, Marsden, Sitarski).

GENERAL DISCUSSION AND REPORTS

Misidentifications. Herget drew the attention of observers to the desirability of re-examining the plate when a *Minor Planet Circular* indicated a large residual after an orbit improvement had been made; this might be due to a misidentification and the correct object might be on the same plate at a position indicated by the residuals.

Icarus. Herrick drew attention to his new 4-day ephemeris of (1566) Icarus for 1968. The minor planet would not be visible until about 6 June, that is only a few days before the close approach on 15 June. The residuals should not exceed a few seconds of arc. He hoped that Icarus would be observed by radar and he would prepare special ephemerides if the requirement were made known to him. Observations should be reported as early as possible. *Herget* expressed his thanks to the observers at Pretoria who had made special efforts to obtain observations in 1966.

Eros. Herget stated that a new ephemeris of Eros by Dr Rabe was now available from the Minor Planet Center.

Observations. Hertz said that he had been encouraged by the response of observers to his appeal for more positions of the minor planet (197) Arete. There have been 69 oppositions since discovery in 1879 but only 71 accurate positions in 27 oppositions have been published in the open literature. He hoped that accurate positions for a further 13 oppositions would be made available, since he knew of at least 55 approximate positions. He suggested that one way in which additional observations might be found for a particular minor planet of interest was to look for occasions when it was close to other minor planets at times when they had been observed. Another approach calls for the preparation of lists of plates by observatories which have sizeable collections, giving date, plate center, field size, and magnitude limit. From such data, a computer could determine on which plates a particular asteroid could be found, and *Hertz* would like to find out whether any efforts in that direction could be undertaken.

Satellites. D. Pascu reported that he had taken a series of astrometric plates of the satellites of Mars with the 61-inch reflector of the U.S. Naval Observatory. A special filter was used to diminish the light from Mars in order to obtain an image of the planet to which the positions of the satellites could be referred. About 60 of the 88 exposures had measurable images for both satellites. At least five stellar images are present on each plate, and their positions will be determined from 25 astrographic plates taken with the Lowell and Naval Observatory astrographs. Photographs and further details are given in *Sky and Telescope*, **34**, 22, July 1967. *P. V. Sudbury* reported that he had obtained in 1967 a series of observations of Jupiter V at the Cassegrain focus of the 74-inch reflector of the Kottamia Observatory. A small neutral density filter was used to attenuate the light from the planet. Measures were made on a Ferranti-Zeiss digitized measuring engine, and computerized reduction procedures were developed. Although the coordinates of the satellites were well determined with respect to the background stars, the determination of the center of the planet has not so far been satisfactory. *Gehrels* said that a neutral density filter had been similarly used by Dollfus in his recent discovery of a new satellite of Saturn. He himself had used a small 'bucket' for such work.

Final Remarks. President *Čebotarev* then took the chair, and introduced Dr *Edmondson*, who gave a brief appreciation of the work of the retiring President and in particular of his responsibility for increasing the amount of cooperation in the reduction of observations and the calculation of orbits. In reply, *Herget* said that the cooperation in astronomy, in particular that between the Minor

Planet Center and the Institute of Theoretical Astronomy, was a fine example, and that he was proud to have served as President after such men as Brouwer and Leuschner.

Addendum

PHOTOGRAPHIC MAGNITUDES OF THE MINOR PLANETS

Prepared by *T. Gehrels*

The listing below replaces the one published in *Trans. IAU* **10**, 305, 1958, as about 1500 magnitude determinations were added from the Indiana Asteroid Program, 14 May 1958 – 31 December 1965. The results of the Indiana Asteroid Program are published regularly in the *Minor Planet Circulars*. A detailed description of this combination of asteroid magnitudes is in *Astronomical Journal* 72, (Dec. 1967;, in press).

The table contains the asteroid number and the absolute magnitude g, which is the magnitude at a distance of one astronomical unit from the Sun and from the Earth. The mean opposition magnitude, in the second column, is computed with $p_0 = g + 5 \log a(a-1)$, and a is the semimajor axis of the orbit. The last column contains the weight; unit weight corresponds to a probable error of ± 0.13 mag. Magnitudes that have relatively large weight and yet a colon (:) in the last column are uncertain, perhaps because of appreciable brightness variation due to large obliquity of the pole. The magnitudes are on the International Photographic System.

The cooperation of Dr F.K. Edmondson and his staff on the Indiana Asteroid Program, and the support by the National Aeronautics and Space Administration are gratefully acknowledged.

No.	p_0	g	wt.	No.	p_0	g	wt.	No.	p_0	g	wt.
1	7·45	4·00	4·0	51	11·11	8·56	5·6	101	12·30	9·24	1·8
2	8·52	5·06	6·0	52	11·58	7·52	6·0:	102	13·56	10·34	3·7:
3	9·57	6·33	6·0	53	12·84	9·71	3·9	103	11·76	8·45	2·3
4	6·74	4·20	8·0	54	12·05	8·72	2·2	104	13·56	9·42	8·0
5	10·95	7·90	2·9	55	12·38	8·95	3·3	105	12·23	9·66	1·4
6	9·30	6·60	3·5	56	12·57	9·48	5·2	106	12·84	8·66	7·0:
7	9·34	6·74	8·0	57	12·42	8·25	2·4	107	12·80	8·11	4·8
8	9·49	7·38	6·0	58	13·13	9·82	5·7:	108	13·47	9·21	2·2
9	9·77	7·17	5·5	59	11·97	8·63	2·6	109	13·33	10·03	2·0
10	10·62	6·46	4·5	60	12·57	9·95	2·1	110	11·83	8·45	2·7
11	10·44	7·68	8·3	61	12·54	8·67	5·0	111	12·05	8·97	4·9
12	11·17	8·71	2·2	62	13·85	9·72	5·3:	112	13·31	10·60	3·1
13	10·91	7·87	1·5	63	10·72	8·10	3·0:	113	12·15	9·58	2·6
14	10·38	7·31	2·0	64	12·02	8·75	1·8	114	12·62	9·36	4·3
15	9·38	6·19	6·0	65	12·34	7·77	4·5	115	11·60	9·02	1·5
16	10·53	6·78	6·1	66	13·65	10·45	6·9	116	12·12	8·68	3·1
17	11·39	8·59	4·0	67	12·47	9·79	2·5	117	12·95	9·07	2·4
18	10·06	7·69	6·1	68	11·67	8·19	2·2	118	12·59	9·87	3·9
19	10·98	8·25	3·3	69	12·03	8·18	1·8	119	12·38	9·33	4·8
20	10·03	7·38	2·0	70	12·18	9·05	1·8	120	12·92	8·82	5·0
21	11·30	8·58	2·3	71	11·79	8·37	4·0	121	12·87	8·23	2·7
22	11·09	7·37	4·1	72	12·52	10·23	2·5	122	13·23	8·97	7·7
23	11·39	8·24	3·9	73	13·43	10·19	3·5	123	13·34	10·04	3·2
24	12·21	8·08	2·8	74	13·49	10·02	3·6	124	12·15	8·99	5·1
25	11·61	8·98	4·0	75	13·14	9·89	2·7	125	12·91	9·51	2·1
26	11·76	8·54	4·4	76	13·39	8·88	1·9	126	13·04	10·31	4·6
27	10·96	8·46	2·2	77	12·79	9·55	5·2	127	12·86	9·44	5·8
28	11·52	8·05	3·5	78	12·17	9·03	5·7	128	12·10	8·68	7·8
29	10·15	7·16	4·4:	79	11·92	9·18	2·1	129	11·36	7·70	2·2
30	11·22	8·68	4·8	80	11·56	9·19	2·6	130	11·96	7·85	1·8
31	11·92	7·73	1·8	81	13·26	9·64	2·7	131	13·65	10·94	2·6
32	11·71	8·64	2·9	82	12·76	9·32	4·5	132	13·33	10·21	1·8
33	13·38	9·75	3·8	83	12·37	9·66	2·6:	133	12·92	8·92	3·9
34	12·76	9·48	4·4:	84	12·71	10·17	4·1	134	12·67	9·65	4·7
35	13·58	9·68	5·5	85	12·02	8·81	4·1	135	11·81	9·11	6·3
36	13·33	9·92	1·0	86	13·72	9·65	7·4	136	13·12	10·78	3·9
37	11·58	8·39	6·6	87	12·84	8·16	6·0	137	12·99	8·89	1·1
38	12·97	9·58	4·4	88	11·57	8·12	2·6	138	13·35	10·60	2·0
39	10·76	7·31	12·6	89	11·08	8·09	2·3	139	12·55	9·07	2·0
40	10·64	8·35	2·4	90	13·37	9·24	4·4	140	12·75	9·37	5·3:
41	11·65	8·21	4·3:	91	12·71	9·64	2·1	141	12·79	9·55	2·0
42	11·47	8·74	2·7	92	12·18	7·94	2·7	142	14·02	11·34	2·2
43	11·20	9·08	2·1	93	12·07	8·65	4·8	143	13·88	10·45	2·4
44	10·60	7·91	3·9	94	12·88	8·72	1·8	144	12·07	8·86	5·4
45	11·77	8·42	3·5	95	12·80	8·79	1·8	145	12·08	8·83	4·4
46	12·13	9·20	3·7	96	12·97	8·98	2·2	146	12·49	9·14	3·2
47	12·74	9·08	2·4	97	11·81	8·57	2·1	147	13·85	9·72	7·8
48	12·07	7·98	4·4	98	13·53	10·25	2·1	148	12·11	8·66	2·2:
49	12·63	8·56	5·6:	99	14·64	11·41	1·5	149	14·09	12·05	3·5
50	13·50	10·30	3·0	100	13·07	9·02	4·8	150	13·01	9·15	2·0

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No.	p_0	g	wt.	No.	p_0	g	wt.	No.	p_0	g	wt.
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152	13·71	9·58	2·0	202	12·84	8·82	4·7	252	14·70	10·54	2·0
153	14·11	8·75	4·6	203	13·49	10·10	4·6	253	14·60	11·40	3·3
154	12·58	8·37	2·3	204	13·48	10·23	2·3	254	15·24	13·15	1·8
155	15·18	11·45	0·6	205	13·83	10·36	2·1	255	14·76	11·36	3·4
156	12·87	9·50	3·4	206	13·39	9·90	4·2	256	14·85	10·96	2·6
157	15·39	12·34	1·2	207	13·27	10·93	5·5	257	14·24	10·13	2·1
158	14·21	10·57	3·8:	208	14·05	10·36	5·1	258	12·58	9·45	3·4
159	13·37	9·29	2·3	209	13·16	8·99	5·7	259	13·20	9·07	5·7
160	13·39	10·02	6·4	210	13·82	10·46	2·2	260	14·97	10·33	4·5
161	12·74	10·16	2·1	211	12·90	8·94	3·4:	261	12·98	10·52	7·5
162	13·92	9·98	4·5	212	13·47	9·37	3·5	262	15·73	12·73	1·0
163	12·92	10·37	4·1	213	13·33	9·91	4·0	263	15·28	11·60	5·9:
164	12·82	9·65	1·0	214	13·46	10·34	2·5	264	13·43	9·92	2·2:
165	12·80	8·68	5·1	215	14·26	10·81	4·9	265	15·37	12·69	1·3
166	13·94	10·66	1·8	216	11·52	8·02	3·4	266	12·99	9·47	2·6
167	14·18	10·57	6·2	217	14·62	10·97	2·6	267	15·47	12·01	2·0
168	13·59	9·07	3·1	218	13·04	9·80	2·6	268	13·50	9·44	6·1
169	13·08	10·55	4·1	219	12·87	10·35	3·6	269	14·35	11·22	2·1
170	13·61	10·62	1·2:	220	14·83	12·32	3·1	270	12·14	10·04	5·0
171	13·79	9·66	1·7	221	12·84	8·92	3·1	271	14·77	10·86	3·1
172	12·12	9·54	3·9	222	14·42	10·27	4·4	272	15·15	11·68	1·7
173	12·30	8·89	1·9	223	15·10	11·04	2·6	273	14·09	11·47	3·2:
174	13·09	9·47	4·9	224	12·99	9·80	5·4	274	15·12	11·16	3·9
175	14·18	9·90	7·2	225	14·02	9·54	2·7	275	13·38	9·92	6·5
176	13·60	9·42	1·3	226	14·31	10·97	2·8	276	13·41	9·31	2·1
177	13·96	10·50	2·2	227	14·18	10·05	3·4	277	14·83	11·15	3·1
178	13·34	10·56	7·4:	228	15·99	13·88	2·6	278	14·02	10·60	6·7
179	13·42	9·58	4·4:	229	15·02	10·44	6·0	279	15·42	9·68	4·6
180	14·77	11·41	4·0	230	11·10	8·51	1·9:	280	15·64	11·86	2·9
181	13·05	8·95	2·0	231	14·24	10·49	5·1	281	14·88	12·81	1·8
182	12·62	9·95	5·0	232	14·52	11·53	3·9	282	14·34	11·86	2·5
183	14·37	10·87	2·5	233	12·75	9·52	3·9	283	13·40	9·43	2·4
184	13·63	9·43	6·2	234	12·87	10·27	4·1	284	13·98	11·45	3·8
185	11·82	8·43	3·1	235	13·51	9·84	2·0	285	15·92	11·78	2·0
186	12·82	10·28	2·4	236	12·99	9·48	3·1	286	14·49	10·26	3·3
187	12·83	9·45	2·3	237	14·17	10·73	2·8	287	11·90	9·38	1·8
188	13·79	10·35	3·0:	238	12·96	9·24	2·6	288	14·36	10·93	3·7
189	13·10	10·35	3·3	239	15·52	11·69	1·9	289	14·37	10·72	2·0
190	13·82	8·48	3·1	240	12·92	9·68	3·9	290	15·63	13·15	1·2
191	13·59	9·90	3·2	241	12·66	8·68	2·5	291	14·87	12·70	2·0
192	10·94	8·30	1·9	242	14·10	10·46	4·1	292	13·88	10·94	1·6
193	14·00	10·91	3·9:	243	14·72	11·09	2·2	293	14·53	10·90	3·3
194	11·96	8·83	5·8	244	15·39	13·35	4·0	294	15·16	10·99	1·8
195	13·83	10·16	2·3	245	13·67	9·60	3·4	295	14·96	11·45	1·6
196	11·67	7·58	2·1	246	13·14	9·84	2·1	296	15·65	13·46	2·8
197	14·17	10·78	3·5	247	12·52	9·13	2·5	297	14·54	10·35	5·7
198	12·34	9·56	1·8	248	14·22	11·42	3·2	298	14·65	12·37	3·5
199	14·05	9·86	2·6	249	15·02	12·44	2·2	299	15·68	12·97	6·4
200	12·73	9·34	2·1	250	12·80	8·66	2·0	300	14·79	10·54	8·2

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No.	p_0	g	wt.	No.	p_0	g	wt.	No.	p_0	g	wt.
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303	14·01	9·90	3·9	353	15·58	12·20	4·8	403	13·72	10·19	2·5
304	13·58	10·94	4·8	354	10·97	7·47	3·8	404	12·89	9·81	1·1
305	14·26	10·20	5·7	355	14·60	11·64	2·0	405	12·68	9·62	3·7
306	12·59	10·06	2·9:	356	12·44	9·01	3·2	406	15·05	11·31	3·6
307	14·61	10·88	2·3	357	13·56	9·42	2·7	407	13·35	10·20	2·6
308	12·40	8·99	5·8:	358	13·90	10·23	8·5	408	14·88	10·72	7·4
309	14·63	11·39	2·6	359	13·78	10·41	3·6	409	11·57	8·53	4·8
310	15·04	11·60	3·8	360	13·38	9·49	2·3	410	12·98	9·62	1·8
311	14·83	11·13	2·5	361	14·86	9·55	3·3	411	13·91	10·14	2·5
312	13·68	10·21	3·2	362	12·86	9·81	2·3	412	13·63	10·19	4·6
313	12·16	9·59	4·3	363	13·38	9·97	3·1	413	14·05	10·99	0·9
314	15·25	11·10	2·0	364	13·16	10·99	3·9	414	15·31	10·59	3·1
315	15·99	13·77	3·6	365	13·84	10·32	2·2	415	13·77	10·28	3·6
316	15·05	10·87	6·2	366	13·87	9·73	5·8	416	12·75	9·26	2·5
317	13·48	11·14	3·9	367	14·13	11·97	3·3	417	14·09	10·58	5·3
318	14·53	10·28	2·5	368	15·06	11·03	3·4	418	13·78	10·70	2·6
319	15·79	11·25	1·2	369	12·72	9·52	1·8	419	12·53	9·45	4·3
320	15·55	11·63	2·4	370	14·07	11·63	3·6	420	13·91	9·32	3·8
321	14·96	11·28	6·4	371	13·23	9·86	3·1	421	15·89	12·93	1·0
322	13·80	10·33	2·3	372	12·60	8·43	3·0	422	14·19	12·00	2·6
323	13·89	11·30	1·3	373	14·33	10·22	3·6	423	12·43	8·42	2·6
324	11·31	8·04	4·5	374	13·40	9·93	8·8:	424	14·15	10·69	3·3
325	14·22	10·00	2·0	375	12·41	8·28	3·6	425	14·40	10·72	4·9
326	12·45	10·03	1·2	376	12·80	10·45	2·8	426	13·18	9·49	1·8
327	14·75	11·29	5·7	377	13·06	9·77	6·7	427	14·41	10·56	3·3
328	14·00	9·91	1·7	378	14·44	10·98	4·8	428	15·22	12·82	1·9
329	13·45	10·64	1·5	379	14·12	9·97	4·3	429	13·93	10·82	2·2
330	15·19	13·40	0·6	380	13·76	10·50	5·9	430	15·26	11·66	2·4
331	14·25	10·31	2·0	381	13·72	9·48	2·3	431	14·10	9·98	5·8
332	14·18	10·72	4·1:	382	13·79	9·67	3·5	432	12·44	9·88	3·7
333	14·48	10·36	5·2	383	14·86	10·75	1·3	433	11·43	12·31	2·1
334	13·73	8·48	3·4	384	13·82	10·61	2·5	434	13·34	12·02	1·2
335	12·71	9·90	3·7	385	12·40	8·80	3·9	435	13·99	11·24	3·5
336	13·13	10·88	3·6:	386	12·00	8·30	0·8	436	15·26	11·03	3·9
337	12·54	9·95	2·8	387	12·29	8·90	1·9	437	14·13	11·53	5·4
338	13·43	9·70	3·3	388	13·15	9·25	3·1	438	13·49	10·50	2·1
339	14·28	10·37	3·6	389	12·29	9·18	1·3	439	14·72	10·60	1·5
340	14·45	11·04	1·7	390	14·59	11·38	2·0	440	14·93	12·79	2·9
341	14·66	12·55	4·8	391	14·67	12·24	1·7	441	13·20	9·67	4·7:
342	14·16	11·14	2·6	392	14·20	10·52	1·6	442	13·56	11·06	2·1
343	15·23	12·57	2·5	393	12·58	9·11	3·5	443	13·65	11·50	6·8
344	12·30	9·21	3·3	394	14·24	10·80	7·0	444	12·79	9·34	4·2
345	12·47	10·03	5·1	395	14·86	11·37	4·4	445	14·28	10·08	2·4
346	12·52	9·02	2·5	396	14·55	11·15	5·5	446	13·39	9·90	2·4
347	13·25	10·13	2·1	397	13·38	10·21	2·7	447	14·15	10·29	3·1
348	14·50	10·67	2·7	398	15·24	11·86	0·8	448	15·08	10·95	3·1
349	10·95	7·20	4·7	399	14·47	10·47	2·0	449	13·63	10·64	3·0:
350	14·00	9·92	2·2	400	15·43	11·31	3·7	450	15·16	11·24	1·6

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452	16·99	13·35	0·6	502	14·81	12·22	2·3:	552	14·49	10·33	4·2:
453	13·94	11·88	5·7	503	13·57	10·21	4·4	553	15·56	13·37	2·0
454	13·14	9·99	1·9	504	14·39	11·04	3·4	554	11·96	9·39	4·3
455	13·13	9·91	3·1	505	13·32	10·04	2·8	555	15·80	11·63	2·0
456	14·35	10·87	3·5	506	13·67	9·70	3·3	556	13·26	10·47	3·1
457	16·99	12·94	0·6	507	14·45	10·30	4·8	557	15·70	12·97	4·2
458	14·36	10·49	2·6	508	13·59	9·42	2·4	558	13·70	9·98	4·0
459	14·95	11·81	2·5	509	13·68	9·67	2·0	559	13·87	10·53	1·8
460	15·26	11·91	4·6	510	14·04	10·93	6·9	560	15·11	11·70	1·8
461	15·62	11·52	2·0	511	11·24	7·02	6·5:	561	16·04	11·87	0·8
462	14·39	10·74	6·3	512	14·13	12·05	2·5	562	14·72	10·80	3·1
463	15·43	12·80	1·9	513	14·38	10·47	4·9	563	12·80	9·47	3·5
464	13·80	10·28	2·6	514	14·16	10·18	2·2	564	15·10	11·70	1·5
465	15·01	10·95	2·3	515	15·91	11·80	5·9	565	14·74	12·01	1·4
466	13·62	9·11	3·5	516	12·68	9·42	1·6	566	13·59	9·05	3·0
467	15·79	12·01	6·2	517	14·51	10·37	5·3	567	14·53	10·37	6·0
468	14·70	10·54	4·9	518	15·16	12·20	5·6	568	14·01	10·33	2·1
469	14·05	9·89	2·6	519	13·68	10·18	2·1	569	14·04	10·82	3·8
470	14·00	11·36	4·0	520	15·74	11·83	3·1:	570	14·62	10·02	4·9
471	11·44	7·76	2·2	521	13·25	9·86	2·1	571	15·47	12·81	3·1
472	13·46	10·49	2·6	522	14·83	9·93	8·2	572	14·41	11·78	5·8
473	14·95	11·10	0·6	523	14·45	10·63	3·4	573	14·57	10·66	4·2
474	14·58	11·82	2·5	524	13·95	10·78	3·4	574	15·99	13·74	3·2
475	15·41	12·32	1·2					575	15·25	12·26	2·6
476	12·86	9·66	2·4	526	14·95	10·83	3·3	576	14·48	10·61	3·6
477	14·06	11·39	6·2	527	14·64	11·28	4·4	577	14·78	10·69	5·4
478	12·71	8·79	2·7:	528	14·40	9·85	3·5	578	13·84	10·43	1·7
479	14·29	10·94	2·6	529	14·97	11·04	4·9	579	13·18	9·26	4·4
480	13·05	9·86	2·1	530	14·21	9·95	3·7	580	15·15	10·87	3·6
481	13·14	9·74	3·6	531	15·74	12·22	0·6	581	15·12	10·85	3·8
482	13·87	9·99	2·8	532	11·34	7·88	3·4:	582	13·50	10·38	3·6:
483	14·17	9·57	1·7	533	14·92	11·06	1·1	583	14·47	10·25	2·6
484	14·62	11·37	2·3	534	14·53	10·85	3·1	584	12·52	9·95	3·1
485	12·97	9·56	2·9	535	13·46	10·43	2·3	585	14·11	11·40	5·4
486	14·69	12·18	3·6	536	13·97	9·25	3·3	586	14·26	10·30	5·8
487	12·77	9·52	3·4	537	14·01	10·00	3·4	587	15·95	13·48	0·8
488	13·09	8·94	2·6	538	14·67	10·49	4·1	588	16·05	9·34	9·1
489	13·78	9·63	2·5	539	14·41	11·02	2·6	589	14·10	9·97	2·7
490	13·63	9·44	4·4	540	14·29	12·13	7·3	590	14·96	11·07	2·0
491	14·14	9·91	2·5	541	14·78	11·24	5·4	591	15·09	11·83	2·2
492	14·96	10·88	8·2:	542	13·92	10·20	2·6	592	14·45	10·52	2·3
493	15·84	11·75	2·8	543	14·52	10·52	5·3	593	13·71	10·40	3·2
494	13·85	9·98	7·6	544	14·27	11·19	4·6	594	16·87	13·71	2·4
495	14·29	11·45	1·8	545	13·61	9·42	7·4	595	13·41	9·16	2·0
496	15·03	12·92	3·8	546	13·78	10·69	3·3	596	13·51	9·75	2·5
497	14·22	10·61	2·5	547	14·31	10·84	3·6	597	13·94	10·69	1·6
498	13·09	9·88	4·6	548	14·80	12·47	2·3	598	13·28	9·84	3·1
499	15·47	10·12	2·6	549	15·00	11·73	1·9	599	13·42	9·96	3·3
500	13·57	10·45	6·1	550	13·37	10·30	3·4	600	14·57	11·35	3·6

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602	13·64	9·59	1·8	652	15·29	12·29	2·0	702	12·85	8·62	2·2:
603	16·44	13·46	1·3	653	14·45	10·53	3·3	703	15·63	13·59	1·9
604	14·40	10·22	2·4	654	12·15	9·78	2·0	704	11·50	7·50	1·1
605	14·40	10·52	2·3	655	14·40	10·53	3·6	705	13·47	9·72	2·0
606	14·56	11·50	3·8	656	15·29	11·11	5·6	706	15·37	12·00	1·3
607	14·37	10·76	5·4	657	15·04	11·92	4·3	707	15·41	13·36	1·7
608	15·72	11·78	2·6	658	15·24	11·62	5·1	708	14·99	11·74	2·0
609	15·21	11·17	6·0	659	16·31	9·59	6·6	709	13·50	9·77	2·0
610	17·23	13·20	1·3	660	12·89	9·94	4·2:	710	16·29	12·15	3·2
611	14·35	10·50	2·1	661	14·52	10·61	2·9	711	14·75	12·54	1·7
612	16·43	12·29	0·6	662	14·76	11·77	7·9	712	12·51	9·47	2·3
613	14·66	10·92	4·1	663	14·45	10·45	1·5	713	14·43	9·86	3·5
614	15·29	11·99	2·6	664	15·46	11·28	3·3	714	13·14	10·19	3·6
615	14·38	11·22	7·1	665	13·85	9·69	3·3	715	14·44	10·99	6·5
616	14·60	11·61	3·5	666	14·99	11·91	6·5	716	15·32	11·79	4·1
617	15·76	9·06	10·7:	667	14·73	10·50	3·5	717	16·01	11·88	4·1
618	13·71	9·50	3·3	668	16·76	13·30	2·1	718	14·71	10·73	2·6
619	14·04	11·12	2·6	669	15·24	11·33	3·6	719	19·83	16·77	0·6
620	15·12	12·40	1·8	670	14·60	11·08	3·8	720	14·58	10·90	2·6
621	15·79	11·68	3·9	671	15·10	11·04	2·0	721	15·19	10·40	4·0
622	14·33	11·67	2·3	672	15·28	12·28	1·9	722	15·08	13·05	2·0
623	14·21	11·44	1·5	673	14·65	11·11	3·9:	723	15·19	11·31	1·8
624	15·18	8·56	10·8	674	12·13	8·39	1·3	724	17·45	14·74	0·6
625	14·17	10·98	2·3	675	12·61	9·16	4·1:	725	15·30	12·27	1·5
626	13·02	9·99	1·2	676	14·47	10·47	3·9	726	15·06	12·04	2·6
627	14·73	11·02	3·3	677	14·68	10·87	6·1	727	14·20	11·18	3·0
628	13·41	10·36	2·1	678	13·59	10·56	2·7:	728	16·08	13·78	0·6
629	14·90	10·80	2·6	679	12·20	9·13	1·0	729	14·38	10·95	0·8
630	15·53	12·38	2·0	680	14·90	10·80	3·1	730	16·89	14·66	1·4
631	13·55	10·06	2·1	681	15·97	11·89	2·1	731	14·38	10·52	3·1
632	16·41	13·18	1·8	682	16·66	13·47	0·6	732	14·65	11·88	1·1
633	14·93	11·01	2·6	683	13·58	9·48	1·8	733	14·63	10·09	0·8
634	14·98	11·01	1·8	684	14·76	12·05	3·3	734	15·07	10·91	5·1
635	14·10	9·97	3·0	685	15·07	12·86	2·2	735	14·23	10·86	2·0
636	14·33	10·61	2·6	686	14·50	11·43	2·1:	736	14·24	12·13	3·3
637	16·02	11·86	2·5	687	16·30	12·95	1·6	737	12·74	9·67	2·3
638	14·35	10·97	7·0:	688	14·95	11·64	4·4	738	14·96	11·01	5·8
639	13·21	9·30	3·1	689	15·68	13·26	3·1	739	13·39	10·00	1·9
640	14·48	10·30	1·7	690	12·96	8·79	1·6	740	14·28	10·30	2·2
641	15·90	13·74	1·3:	691	14·34	10·43	2·6	741	14·61	11·25	2·0
642	14·91	10·72	2·5	692	14·60	10·10	1·0	742	14·29	10·38	5·0
643	14·93	10·47	3·1:	693	14·16	10·37	3·2	743	14·70	11·20	7·2
644	14·80	11·71	3·1	694	13·34	10·09	5·4	744	15·34	11·15	3·7
645	15·22	11·01	2·0	695	12·68	9·72	2·3	745	15·30	10·99	2·1
646	16·64	14·20	1·0	696	14·47	10·24	5·4	746	14·60	10·51	2·6
647	15·32	12·58	1·8	697	13·96	10·29	1·0	747	12·61	8·73	3·1
648	14·89	10·71	2·6	698	15·45	11·80	1·5	748	15·06	9·75	4·7
649	17·08	14·10	1·0	699	16·23	13·10	2·1	749	15·08	12·85	1·0
650	16·24	13·47	3·7	700	14·55	12·36	2·2	750	15·67	12·94	2·5

https://doi.org/10.1017/S0251107X0001573X Published online by Cambridge University Press

No.	p_0	g	wt.	No.	p_0	g	wt.	No.	p_0	g	wt.
751	12·95	9·96	1·6	801	15·51	12·40	2·0	851	15·05	12·86	2·6
752	14·19	11·41	2·0	802	15·61	13·51	2·0	852	13·85	11·31	1·8
753	14·26	11·81	2·6	803	14·82	10·57	3·1	853	14·94	12·53	7·7
754	14·24	10·38	1·9	804	12·74	9·15	2·7	854	15·90	13·35	4·3
755	14·78	10·60	4·5	805	14·77	10·50	2·4	855	15·35	12·81	4·2
756	15·45	11·16	0·8	806	15·33	11·09	1·0	856	14·63	11·91	6·6
757	14·00	11·43	3·1	807	15·73	11·81	4·4:	857	14·75	12·67	2·5
758	13·48	9·23	2·4	808	14·30	10·90	2·3	858	14·92	11·39	3·5
759	15·09	11·96	2·0	809	15·41	13·08	2·6	859	15·11	10·86	3·6:
760	13·61	9·46	4·2	810	16·18	14·13	2·4	860	14·25	10·75	2·3
761	15·39	11·76	3·8	811	15·45	11·75	5·7	861	14·91	10·76	4·9
762	13·33	9·18	2·0	812	15·63	12·41	0·6	862	14·75	11·23	1·4
763	16·03	13·81	3·9	813	15·24	13·07	2·5	863	14·45	10·22	2·3
764	14·83	10·62	4·6	814	14·05	9·85	2·4				
765	16·99	14·01	0·6	815	15·15	11·93	3·0	865	15·81	13·14	3·6
766	14·78	10·84	3·9	816	15·21	11·32	3·6	866	14·46	10·35	3·2
767	15·18	11·09	6·8	817	14·95	11·88	4·3	867	16·10	12·09	2·1
768	15·38	11·26	1·0	818	14·52	10·32	2·3	868	14·45	11·13	4·6
769	14·36	10·14	3·8	819	15·25	13·15	5·7	869	16·51	13·22	2·8
770	14·26	12·09	2·0	820	15·26	11·14	1·8	870	15·34	12·91	1·1
771	14·77	11·56	2·0	821	15·84	12·38	2·8	871	15·86	13·69	2·6
772	13·54	9·65	1·0	822	14·81	12·55	5·2:	872	14·51	11·14	4·7
773	14·15	10·53	2·3	823	14·85	12·68	2·6	873	15·46	12·31	3·6
774	13·86	9·90	3·4	824	14·87	11·37	3·1	874	15·05	10·88	2·9
775	15·20	11·29	3·1	825	15·21	13·03	4·6	875	15·72	12·73	1·6
776	12·57	8·80	3·0	826	15·72	12·38	1·8:	876	15·78	11·86	2·0
777	15·49	11·22	2·7	827	16·15	13·84	2·6	877	14·58	11·74	10·1
778	15·69	11·50	1·8	828	15·27	11·06	5·7	878	19·04	16·50	0·6
779	12·89	9·65	0·8	829	14·97	11·92	4·0	879	15·63	12·67	0·6
780	14·23	10·14	2·6	830	14·74	10·50	2·0	880	16·87	12·96	0·8
781	14·75	10·45	2·0	831	15·63	13·48	0·6	881	16·62	13·50	1·1
782	14·59	12·54	2·3	832	15·67	12·03	3·9	882	15·66	11·55	2·6
783	14·57	12·08	3·3	833	16·14	12·23	1·2	883	15·78	13·57	1·5
784	14·34	10·27	4·7	834	15·53	10·37	4·1	884	16·48	9·77	4·3:
785	13·41	10·37	2·7	835	16·16	11·93	2·8	885	15·73	11·67	4·0
786	14·21	10·02	3·1	836	16·35	14·27	0·8	886	14·32	10·17	1·8:
787	14·28	11·32	1·3	837	15·32	12·95	1·9	887	19·15	16·23	0·9
788	13·57	9·46	2·1:	838	14·88	11·18	3·5	888	14·18	10·85	2·2
789	15·54	12·27	2·4	839	14·79	11·66	2·0	889	14·93	12·19	2·2
790	13·56	9·02	3·1	840	14·61	10·50	0·6	890	15·21	11·27	1·5
791	14·75	10·62	2·1	841	15·60	13·34	1·6:	891	14·83	11·20	4·6
792	14·21	11·07	1·3	842	15·97	11·71	1·0	892	14·92	10·62	3·1
793	14·36	10·86	2·2	843	16·54	14·22	0·6	893	14·72	10·74	3·4
794	16·45	12·29	2·4	844	14·83	10·61	5·7	894	14·99	10·89	2·5
795	14·12	10·71	3·2	845	14·89	11·11	1·8	895	13·99	9·74	2·5
796	13·42	10·25	3·5	846	15·51	11·37	4·4	896	15·29	12·95	3·3
797	14·56	11·61	5·1	847	14·81	11·33	2·2	897	15·11	12·14	1·5
798	14·49	10·58	2·6	848	15·93	11·84	2·0	898	16·74	13·37	1·3
799	14·37	11·41	6·2	849	13·06	8·90	1·5	899	15·10	11·38	1·7
800	14·65	12·56	3·1	850	14·51	10·62	2·6	900	15·68	12·87	3·0

https://doi.org/10.1017/S0251107X0001573X Published online by Cambridge University Press

No.	p_0	g	wt.	No.	p_0	g	wt.	No.	p_0	g	wt.
901	14·93	12·75	3·5:	951	15·14	13·01	2·3	1001	14·72	10·50	3·1
902	16·28	13·54	1·1	952	14·15	10·29	4·9	1002	15·53	12·04	1·2
903	15·06	10·75	0·6	953	14·98	11·49	2·6	1003	15·39	11·23	2·9
904	15·22	11·34	1·3	954	15·82	11·70	1·0	1004	15·24	10·70	2·6
905	14·39	12·24	1·8	955	15·71	12·63	1·0	1005	15·08	10·91	5·3
906	14·33	10·63	3·2	956	15·87	13·50	3·3	1006	16·92	12·79	2·6
907	14·15	10·64	2·9	957	14·70	10·96	3·5	1007	15·87	12·54	2·9
908	14·83	12·02	3·0	958	16·35	11·03	1·6	1008	15·91	11·86	1·6
909	14·31	9·54	2·0	959	16·02	11·80	0·8	1009	19·95	16·82	0·6
910	14·94	11·17	6·6	960	16·33	14·09	3·5	1010	15·42	11·66	1·8
911	15·45	8·82	3·2	961	15·68	12·38	2·6	1011	16·25	13·63	2·0
912	13·38	9·27	2·4	962	16·31	12·60	4·5	1012	15·96	13·13	2·0
913	15·79	13·69	1·0	963	15·75	13·51	2·2	1013	13·85	10·58	1·9
914	13·15	10·39	1·6	964	15·92	11·94	1·4	1014	16·48	12·95	2·3
915	15·22	13·04	3·6	965	15·88	11·70	2·7:	1015	14·47	10·23	2·6
916	15·14	12·60	2·6	966	14·43	11·08	1·4	1016	15·35	13·19	3·8
917	15·08	12·49	4·3	967	15·42	13·24	2·0	1017	15·28	12·17	1·1
918	15·60	11·96	6·0	968	14·93	11·29	4·6	1018	14·59	11·63	3·5
919	15·76	12·30	2·4	969	16·11	13·33	1·3	1019	15·06	13·85	0·6
920	15·07	11·93	1·7	970	16·45	13·43	1·6	1020	15·59	12·11	1·1
921	15·36	11·15	2·3	971	14·36	11·18	3·4:	1021	13·27	9·89	3·1
922	16·29	13·01	2·6	972	14·68	10·68	2·5	1022	14·76	11·24	0·8
923	15·78	12·65	1·0	973	15·20	10·91	4·9	1023	15·15	10·97	4·1
924	14·14	10·37	4·1	974	14·61	11·66	2·2	1024	15·53	11·88	3·2
925	11·95	8·64	2·4	975	14·89	11·31	1·8	1025	15·48	14·04	0·8
926	15·46	11·61	1·5	976	14·65	10·44	6·9	1026	16·76	14·52	0·8
927	14·30	10·05	2·3	977	14·81	10·71	2·5	1027	16·10	11·92	4·2
928	14·87	10·72	3·1	978	14·97	10·74	2·7	1028	14·90	10·33	2·6
929	15·82	13·61	2·1	979	15·07	10·92	3·9	1029	15·59	11·90	5·7
930	15·20	12·49	1·1	980	12·58	9·19	1·6	1030	15·64	11·54	1·8
931	14·61	10·44	2·9	981	16·13	12·06	3·8	1031	14·67	10·69	1·2
932	13·35	10·68	2·3	982	15·28	11·27	2·6	1032	15·06	10·94	2·7
933	15·97	13·41	2·7	983	14·85	10·66	2·1	1033	16·02	12·13	3·6
934	14·84	11·43	1·5:	984	14·18	10·66	5·4	1034	16·02	13·66	2·3
935	16·35	14·19	3·0	985	16·53	14·15	1·9	1035	15·83	11·69	2·0
936	15·22	11·08	4·6	986	14·83	10·70	3·4	1036	13·98	10·76	1·8
937	15·29	13·10	3·1	987	14·77	10·64	6·5	1037	17·12	15·05	0·8
938	16·52	12·33	3·1	988	16·55	12·39	0·8	1038	16·88	11·59	0·6
939	15·53	13·29	2·0	989	16·54	13·32	0·6	1039	15·44	12·17	3·8
940	14·96	10·40	2·0	990	16·15	12·91	3·4	1040	15·64	11·53	1·5
941	15·47	12·00	3·2:	991	15·96	11·83	1·0	1041	14·96	10·93	1·8
942	15·66	11·48	2·4	992	16·08	12·15	1·6	1042	15·20	10·95	2·3
943	14·97	10·88	2·5	993	16·95	13·31	1·1	1043	14·98	10·92	5·8
944	19·18	11·95	0·9	994	14·35	11·41	2·7	1044	15·19	12·15	6·4
945	14·49	11·32	2·5	995	14·58	14·45	3·6:	1045	17·13	14·60	1·3
946	15·41	11·29	2·5	996	15·68	11·63	1·8	1046	15·34	11·47	3·9
947	14·26	10·85	1·8	997	16·23	12·99	2·1	1047	15·62	13·40	2·8
948	16·22	12·27	2·6	998	16·20	12·11	0·6	1048	13·98	10·60	2·6
949	14·78	10·90	6·7	999	15·46	12·34	2·5	1049	15·81	11·75	0·8
950	14·97	12·41	1·0	1000	15·54	11·29	0·6	1050	16·98	13·83	0·9

No.	p_0	g	wt.	No.	p_0	g	wt.	No.	p_0	g	wt.
1051	15·46	11·19	2·2	1101	16·32	11·98	1·3	1151	17·45	14·81	0·6
1052	15·25	13·04	2·9:	1102	14·86	10·85	3·2	1152	14·93	12·23	3·6
1053	16·49	13·36	3·1	1103	14·79	13·51	1·2	1153	15·42	13·32	2·6
1054	15·32	11·57	4·9	1104	16·66	13·50	1·5	1154	15·92	11·35	2·4
1055	14·73	12·63	2·4	1105	15·07	11·16	3·8	1155	15·78	13·00	2·5
1056	15·00	12·81	2·3	1106	15·96	12·87	1·0	1156	16·16	13·89	1·1
1057	15·57	11·88	2·6	1107	14·41	10·18	5·7:	1157	15·42	11·17	3·3
1058	15·23	13·13	4·1	1108	15·04	12·34	1·6:	1158	15·19	12·17	5·1
1059	15·46	12·27	2·4:	1109	15·18	10·94	3·6	1159	15·50	12·92	2·9
1060	16·48	14·27	2·1	1110	15·41	13·25	3·3	1160	15·78	12·77	1·5
1061	16·09	11·98	2·9	1111	15·31	11·43	5·2	1161	16·88	12·70	0·6
1062	15·07	11·17	6·5	1112	14·80	10·88	2·6	1162	15·58	10·24	2·8
1063	14·83	12·41	2·9	1113	14·70	10·60	6·2	1163	15·83	11·58	3·1
1064	15·23	12·25	2·0	1114	14·73	10·67	2·6	1164	16·42	14·03	1·3
1065	16·31	13·78	2·1:	1115	14·62	10·54	2·6	1165	15·63	11·49	1·8
1066	16·74	14·10	1·2	1116	14·56	10·81	2·0	1166	15·54	12·58	1·5
1067	15·72	12·06	2·9	1117	15·35	13·11	2·5	1167	15·52	10·93	2·6
1068	15·76	12·03	4·1:	1118	15·22	10·98	2·0	1168	16·00	13·01	1·9
1069	14·84	10·72	2·6	1119	15·46	12·32	5·0	1169	16·72	14·29	1·9
1070	16·34	12·08	1·6	1120	15·48	13·33	1·2	1170	15·55	13·11	2·0
1071	14·83	11·32	4·4	1121	15·50	12·52	0·8	1171	14·91	10·75	2·2
1072	15·90	11·68	1·3	1122	15·85	12·74	1·5	1172	16·01	9·32	2·7
1073	16·66	12·47	2·0	1123	15·06	12·88	5·9	1173	16·63	10·03	4·6
1074	15·41	11·25	3·6	1124	15·81	12·05	1·6	1174	16·77	12·84	0·6
1075	15·40	11·48	1·8	1125	18·36	14·20	0·8	1175	15·86	11·59	1·6
1076	15·80	12·98	7·1	1126	16·01	13·70	1·5	1176	15·48	12·18	1·5
1077	16·53	13·92	1·6	1127	14·72	11·64	1·1	1177	14·93	10·44	2·4
1078	15·06	12·76	4·6	1128	15·23	11·74	3·1	1178	16·16	12·89	0·7
1079	15·69	12·03	3·0	1129	14·96	11·03	2·6	1179	18·13	15·00	0·6
1080	16·23	13·55	1·6	1130	15·61	13·42	2·5	1180	15·51	10·13	4·7
1081	16·23	12·16	4·4	1131	17·51	15·32	1·0	1181	15·86	12·63	0·6
1082	15·69	11·57	4·2	1132	15·10	11·82	1·7	1182	14·85	12·58	2·3
1083	16·36	13·91	1·0	1133	15·17	13·10	2·5	1183	15·58	12·99	3·9
1084	15·00	11·72	2·6	1134	18·56	15·29	1·6:	1184	15·38	12·14	4·1:
1085	14·91	10·71	4·4	1135	14·91	11·67	2·5	1185	15·47	13·26	3·7
1086	14·80	10·62	2·6	1136	15·24	12·22	3·6	1186	14·65	10·73	1·7
1087	14·81	10·89	2·3	1137	14·67	11·98	2·6	1187	16·00	12·82	2·6
1088	14·79	12·68	2·6	1138	16·35	12·20	1·7	1188	15·11	13·03	4·2
1089	14·97	12·82	4·4	1139	15·58	14·25	1·1	1189	14·87	11·11	3·1
1090	16·50	13·97	1·4	1140	14·65	11·19	2·0	1190	15·88	13·17	1·1
1091	16·45	11·85	0·9	1141	16·81	14·51	0·8	1191	15·33	11·64	1·9
1092	15·45	11·74	3·5	1142	15·72	11·53	3·0	1192	16·12	13·58	1·0
1093	14·06	9·91	2·1	1143	16·04	9·34	5·5	1193	16·42	13·22	1·9
1094	15·91	12·93	1·8	1144	15·97	10·90	2·1	1194	15·25	11·52	2·3
1095	14·54	12·56	1·1	1145	14·91	12·22	2·6	1195	16·78	14·51	0·6
1096	14·40	11·30	2·1	1146	14·87	10·89	1·1	1196	14·68	11·47	4·0
1097	16·26	13·08	1·8	1147	15·75	13·45	2·0	1197	14·80	11·12	1·8
1098	15·16	11·88	1·6	1148	15·15	11·23	1·7	1198	18·93	16·69	0·6
1099	15·83	11·67	1·3	1149	15·13	11·42	3·6	1199	15·23	11·31	3·8
1100	15·95	12·25	6·9	1150	16·66	14·58	2·6	1200	15·72	11·72	3·9

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1214	15·37	12·04	2·8:	1264	14·48	10·84	1·3	1314	16·42	14·05	0·9
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