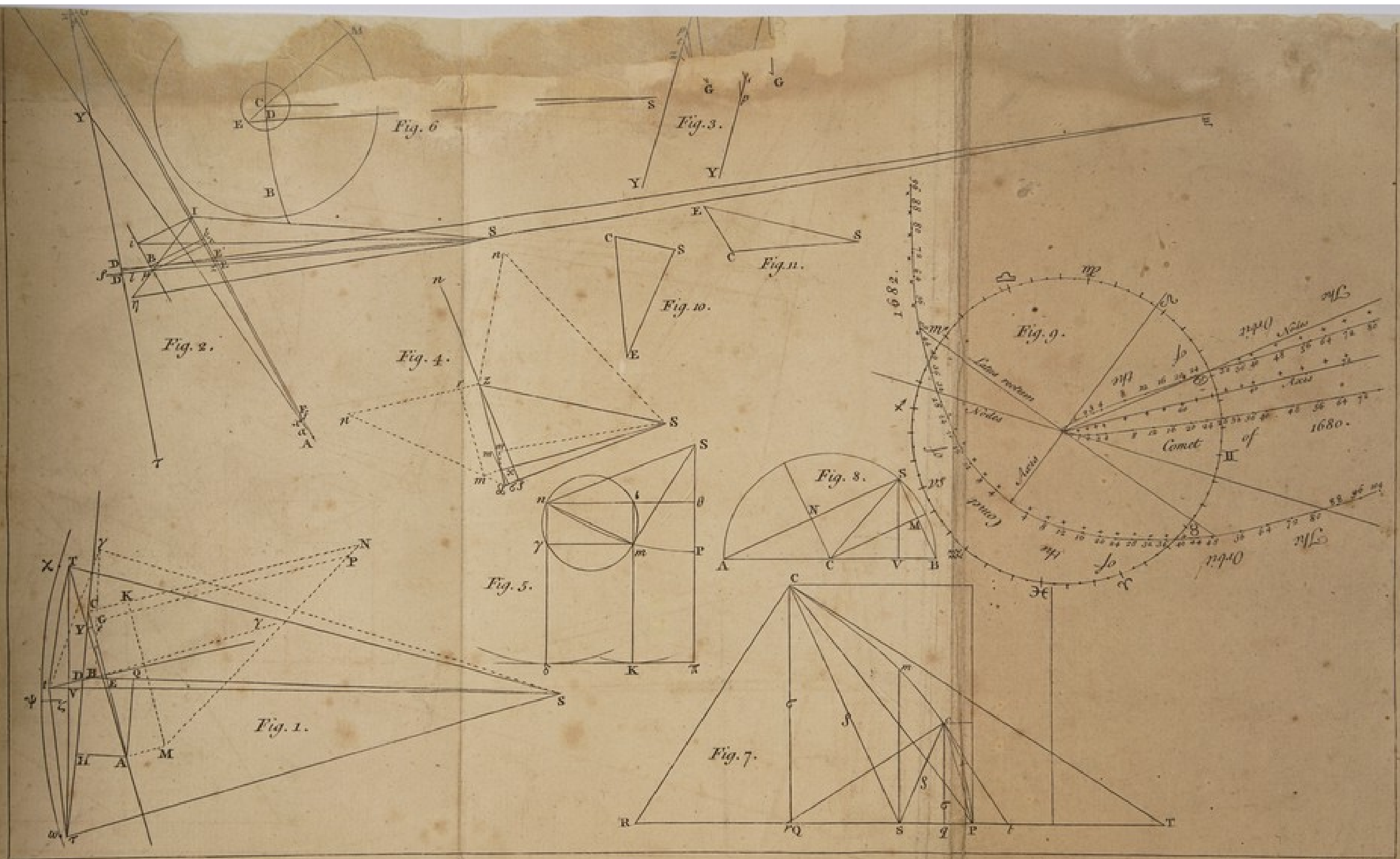
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
The Orbit of the Comet 1680.
The Orbit of the Comet
1682.
Nodes
Axis
Latus rectum

X. Mynde sc.

AN

ACCOUNT

OF THE

Difcoveries concerning Comets,

WITH

The Way to find their Orbits,

And fome Improvements

In conftructing and calculating their Places.

For which Reafon are here added

New TABLES, fitted to thofe Purpofes;

Particularly with regard to

That COMET *which is foon expected to return.*

By THOMAS BARKER, Gent.

JOB XXVI. 14. *Lo, thefe are a part of his ways: but how little a portion is heard of him!*

SEN. Quæft. Nat. Lib. VII. 31. *Multa feculis tunc futuris, cum memoria noftri exoleverit, refervantur. Pufilla res mundus eft, nifi in illo quod quærat omnis mundus habeat.*

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THE CONTENTS.

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THE

PREFACE.

THAT bright comet, which was ſeen in 1744, *having raiſed in me as well as others a greater curioſity about them; I had once thoughts of undertaking a kind of hiſtory of comets, which, beſide what is given here, ſhould contain an improvement of Hevelius's and Lubienietz's accounts of the ancient ones, and a continuation of them to the preſent time. The alterations I deſigned to make were theſe: Firſt, To leave out the aſtrological obſervations, which the old authors, looking on comets chiefly as prodigies, are full of, and Lubienietz's book is almoſt all ſo; to quote nothing but what relates to the comet itſelf; and in later times, when there are many accounts of the ſame comet, to inſert the principal, and perhaps paſs over ſome of them which contained nothing new. Secondly, Hevelius and Lubienietz take many comets only ſecond hand, from Rockenbach and other modern writers, but I would as much as poſſible have quoted the original authors. Thirdly, Different perſons not uſing the ſame chronology, have often made ſeveral comets of one. Thus the four Seneca reckons up* Nat. Quæſt. VII. 17. *after the death of Julius Cæſar, under Auguſtus, Claudius, and Nero, are in Hevelius increaſed to thirteen; and the two laſt of them, which he calls the two comets ſeen in our time* VII. 23. *Lubienietz has made eight of. Fourthly, Lubienietz ſwells his hiſtory with balls of fire, northern lights, and perhaps other meteors: all theſe, as alſo multiplying of real comets, I deſigned to have avoided where I could. In purſuit of this deſign, I made a liſt of the comets which had been ſeen, with references to the authors who mentioned them, ſo far as I had then found, leaving room to add more, as I met with them; and began to draw up the account of a few of the firſt with the authorities, but found ſo little ſatisfaction from the very imperfect accounts, that perceiving the benefit would not anſwer the trouble, I laid the deſign aſide. Yet having now had by me for ſeveral years a table of the parabola, which ſhews the ſpace, and diſtance from the focus at all angles, and will, I think, by it's length, better anſwer the end of calculating a comet's place, than Dr. Halley's table can, I choſe no longer to conceal it: but that it might not ſeem too imperfect, by being publiſhed alone, I have added a ſhort account of the diſcoveries about comets, a catalogue of their orbits, the way I calculated the parabolick* *table, and method of using it, also how to construct a comet's motion speedily. In particular I have given some account of the use of Sir Isaac Newton's famous problem for finding a comet's orbit from three observations, which till lately few persons have study'd; yet seems to me a much better method, than that Caille has given in art.* 518—560 *of his astronomy, which he shews in art.* 520, *does not answer in all cases, and requiring so much correction by guess, must I think be very troublesome. In studying this problem of Sir Isaac's I almost got beyond my depth; yet by comparing his explication with Dr. Gregory's, and the assistance at first of Mr. G. Whiston, with a repeated examination since, I hope I have gained a tolerable knowledge of it, and have endeavoured to render the process as exact, easy, and plain as I can. But though mathematicks is a science capable of absolute demonstration, yet in so complex a problem, especially where several parts are only approximations, the mind of man is frail, and may overlook some small circumstance, which may render his reasoning a little defective: such at least I own my understanding to be, and the more as living in a retired place, I am forced to trust to my own strength. If therefore on tryal I be caught tripping, far from taking any friendly admonition amiss, I shall think myself greatly obliged to any one more skilful than myself, who will by letter or otherwise inform me, either where I have mistaken, might have made the method shorter or easier, or have omitted any further use or improvement; I shall not fail on any proper occasion to acknowledge the favour, and, if opportunity offers, to make a due use of it, being desirous to compleat the affair as far as I can.*

Lyndon, Rutland.
Sept. 15, 1756.

P. S. *Mr. Facio, as Dr. Halley mentions, thought of a use which may now and then be made of comets; by observing the parallax of one when very near the earth, to find the sun's parallax, and consequently it's distance, now known only to a fourth part. The expected comet will not come much nearer the earth than Mars does, if it's perihelion should be in January or July; but would be within* 13 000 000 *of miles of the earth October* 19, *with a full minute's parallax, if it's perihelion is November* 27; *or have* $3'\frac{1}{2}$ *parallax May* 4, *at* 4 000 000 *of miles distance, if it's perihelion is March* 27.

OF

OF THE DISCOVERIES CONCERNING COMETS.

THOUGH the ancients knew little of the uſe of conick ſections, in compariſon of what has been diſcovered within theſe laſt hundred and fifty years, yet they applied them ſelves to the ſtudy of their properties, and thereby prepared the way for the readier applying them to the uſes lately found out. If thoſe who at that time employed themſelves in making aſtronomical obſervations, had been as careful in attending to the motion of comets, which do not require ſuch depth of thought as abſtruſe mathematical problems; though they knew too little then of the principles of motion to have found out their real path, yet probably we ſhould not have been ſo much at a loſs, as we ſtill are, as to their periods; but, by comparing their motions in different returns, even though the obſervations had been but groſs, might have arrived to a conſiderable perfection in the aſtronomy of comets. But as moſt of their periods ſeem to be very long, and it is but a little while that their motions have been carefully watched, it may be ſome ages yet, before we get any great knowledge about them. Moſt of the ancients, being of Ariſtotle's opinion, that comets were only inflamed vapours, raiſed, continuing, and diſperſed in our atmoſphere, took little further notice of them than as omens, often mentioning neither the time of year, or place they were ſeen in; and unleſs *both* are known, we can neither find their orbit, nor compare them with that of any known comet. Seneca indeed, and ſome others whom he mentions, believed comets to be *laſting heavenly bodies*, Nat. Quæſt. VII. 3 & 22. that *multitudes of them, which could not be ſeen on account of their poſition, kept on their ſtated courſe, and at certain times, when they got to the*

nearer

nearer end of their path, came within sight of men, Chap. 13, 17, 19. and he expected that *time and pains would discover what was then unknown, and posterity wonder that they did not know such plain things*, Chap. 25. In these several places there is a better guess about comets, than any made for above fifteen hundred years afterward: and further search has since confirmed what he thought, that it is the excentricity of their orbits which occasions their being only now and then seen. In all those dark ages, from the decline of the Roman empire to the Reformation, comets being only considered as ominous meteors, three only have been yet found described enough to determine their orbits, and those but in a gross manner: and I think Appian was the first, who, about 1530, began to observe their motion astronomically; and soon found that, so far from being within our air, they, having no sensible parallax, must needs be much further off than the moon: here then is the first step toward finding out the true nature of comets; and from that time all astronomers have allowed their place to be among the planetary orbits, and many observations were made of their motions by Tycho Brahe and others.

The two comets of 1664 and 65, coming within a few months of one another, made many persons very inquisitive about them; and in Birch's history of the Royal Society, Vol. II. there are two remarkable guesses, both read May 23, 1666. In page 93, are *Mr. Hooke's remarks on Mons. Petit's dissertation on the nature of comets, presented to the society some weeks before.* What that paper contained does not fully appear; but Mr. Hooke said, *the hypotheses were very ingenious, and some of them not improbable*, but whether the *comets were moved in equal spaces of a curve line in equal spaces of time, which Mons. Petit seemed inclined to believe, deserved to be further examined.* This last clause is remarkable, and that paper, if still preserved, is worth searching, to see how near Mons. Petit was to guessing the truth. The other paper, page 91, is Mr. Hooke's own, endeavouring to account for the planet's motions; where, having proposed the resistance of the æther, he says, *the second cause of inflecting a direct motion into a curve may be from an attractive property of the body placed in the center, whereby it continually endeavours to attract or draw it to itself: for if such a principle be supposed, all the phænomena of the planets seem possible to be explained, by the common principle of mechanick motions; and possibly the prosecuting this speculation may give us a true hypothesis of their motions.——By this hypothesis the phænomena of the comets as well as of the planets may be solved, and the motion of the secondary as well as of the primary planets: the motion also of the progression of the auges is very evident.* This I think was much about the time that Sir Isaac Newton discovered the property of gravity, and seems much like it; only Sir Isaac, being the deeper mathematician, prosecuted the matter further, and cleared it up more fully.

Hevelius was too good an astronomer, not to see that comets were far distant from the earth, and in his Cometographia, Book III. p. 149—164, largely

largely ſhews the abſurdity not only of ſuppoſing them in our air, but even below the moon, from the vaſt parallax they would have, and the various places they muſt needs be ſeen in at different times of day, as they riſe toward the zenith, or deſcend to the horizon: yet could he not ſhake off the eſtabliſhed opinion that they were meteors; but, to reconcile both, ſuppoſes comets to be vapours collected near any of the planets, whirling round about it till thrown out of the atmoſphere, and then moving in a ſtraight or curve line till diſperſed, Book VII. p. 384; that *comets are not ſpherical, but round and flat*, p. 338; and, from the time they leave the planet's atmoſphere, *always turn one flat ſide toward the Sun*, p. 666; and though, Book IX. p. 591—632, he calculates the places of ſeveral comets, as if moving in a ſtraight line, and generally comes nearer the obſerved place, than I ſhould expect ſuch an hypotheſis to do; yet he thinks that *their courſe is not really ſtraight*, p. 588; and in more largely treating on the ſubject, ſays, *it is a Parabola*, p. 659. It may ſurprize thoſe who have not read Hevelius, to hear that he firſt ſaid a comet's orbit is parabolical, a diſcovery generally attributed to Sir Iſaac Newton; and indeed not without reaſon, for Hevelius did but gueſs it, and knew not the principle on which its motion depended, but it was Sir Iſaac Newton who firſt proved it, and accounted for its motion in that curve, from that univerſal principle of Gravity, on which the motion of all the heavenly bodies depend. We may however give Hevelius his due praiſe as a good aſtronomer, and by a ſhort extract from his Cometographia, Book IX. ſhew how nearly he gueſſed at the true motion of comets, without knowing, or even ſuſpecting, the real cauſe which kept them in ſuch a trajectory. A comet then, he ſays, "by no means moves in a ſtraight line, but in a curve, always "concave toward the ſun," p. 658, that is, "*in a Parabola*," p. 659: this he illuſtrates by "the parabolick motion of projectiles," p. 660. He ſeems here to be got very near the point, yet ſhews afterward he did not think of gravity as the cauſe of a comet's parabola: for "as projectiles "move in a parabola, from a compound of their progreſſive motion and "gravity, ſo comets alſo have a double motion; one the force given them "at leaving the planet's atmoſphere, the other not gravity, yet ſomething "not unlike it, by which comets turn one of their flat ſides toward the "ſun, as the center of our ſyſtem, p. 666, as a magnetick needle points "toward the North, or toward a loadſtone. And as in projectiles gravity, "ſo in comets the inclination of their flat ſides, turns them out of their "ſtraight courſe," as a rudder turns about a ſhip, which he had before largely conſidered, p. 570—587. "And the farther a comet gets from "the ſun, the more will its flat ſide be oppoſed to its motion, which will "not only more and more retard its ſwiftneſs, but turn it out of its ſtraight "courſe, p. 667. But a comet differs from a projectile, in that a body "thrown up moves ſloweſt at the vertex of its parabola, and ſwifter both "in riſing and falling; while a comet moves ſwifteſt at the vertex, where "a line from the ſun is perpendicular to its path, and ſlower both in "approaching the ſun and retiring from it, p. 669. If you aſk whether "a comet's path is not an hyperbola," he "will not deny it: it is neither "circle nor ellipſis, but may be any other ſection of a cone, which is "moſt bent in the middle, and ſtraighter at each end: yet is ſatisfied it "is rather a parabola than an hyperbola," p. 683. Laſtly, "as the "planets regard the ſun as their center, ſo the comets alſo obey it in their "way," p. 701. We ſee here that Hevelius, whether by a mere gueſs at what he thought muſt needs follow from his notion of comets being flat bodies, generally ſtanding oblique to the path they move in, or finding ſuch a motion to agree beſt with his obſervations, came very near to what has ſince been found to be the truth: that comets move in a parabola, concave toward the ſun, ſwifteſt at the vertex, that is, when they are neareſt the ſun, and their motion perpendicular to a line from it, and that it is an action of the ſun on comets which makes them turn out of a ſtraight line into a curved trajectory. So far he is right, and ſeems got near the point, but is defective in not ſuſpecting the ſun to be the parabola's focus, expreſsly denying their moving in an ellipſis, and conſequently returning again; and the doctrine of gravity being a later diſcovery, he is forced to account for their curve another way. We may learn alſo from his book, that ſtudies, of which we do not at firſt ſee the benefit, are not therefore always uſeleſs. Hevelius made many obſervations and calculations of the motion of comets; on which if a perſon at that time had ſaid to him, *cui bono?* why ſo much time and pains ſpent on vapours, which were collected yeſterday, and will be diſperſed to-morrow? he, owning them to be nothing elſe, could not perhaps have given any ſufficient reaſon for it: yet if he and others had not taken that pains, Sir Iſaac Newton would hardly have found out their real motion; and there is a field yet open for further diſcoveries of future ages about them.

Sir Iſaac Newton having diſcovered that gravity is univerſal, and that a planet whoſe velocity was in a due proportion to its gravity toward the ſun, would revolve about it in a perfect circle; but in an ellipſis, of which the ſun is one focus, if its motion was either faſter or ſlower; on reconſidering the matter, on occaſion of that remarkable comet of 1680, he found, that, if a body is thrown with a velocity, which is to that neceſſary to keep it in a circle, *as the ſquare root of* 2 *to* 1; the ſame univerſal principle of gravity will make it move in a *parabola*, of which the ſun is the focus: and this being found agreeable to the obſerved motion of comets, has been ſince allowed by aſtronomers to be their real motion. It ſeems however not agreeable to the uniformity of the univerſe, that after a ſhort view of the ſun, they ſhould be continually flying farther off, in that wide void beyond the planetary bounds, to creep along that dark cold region for millions of years; (and in leſs time than that, they could not reach any other ſyſtem, if the parallax of the fixed ſtars be two ſeconds, which

Dr. Bradley

Dr. Bradley has found it cannot exceed;) but that they ſhould rather revolve round the ſun, in certain, though long periods: and the likeneſs of the elements of ſome of the comets ſeen in different ages, make it probable they were the ſame returning again; if ſo, their trajectories are not *really parabolas*; but they ſeem a kind of planets, revolving round the ſun in *ſo extreamly excentrick ellipſes*, that, ſo far as we can ſee them, they are not ſenſibly different from parabolas, which for eaſe of calculation we always ſuppoſe them to be: and that their motion is almoſt exactly a parabola, I intend to ſhew particularly as to the comet of 1744, ſee page 14. The true motion of comets being thus known, Sir Iſaac Newton applied himſelf to find a method, by which a comet's orbit might be determined from a courſe of obſervations; and, having attempted many ways in vain, hit at laſt on one, which he has explained, Boook III. Prop. 41, *&c.* of his *Principia*, taking for his example the comet of 1680. The ſame method Dr. Halley uſed for twenty-three more, ſome accurately, others groſsly, as the obſervations he met with were; and ſeveral more have been done ſince by others. From the likeneſs of the elements, ſome of theſe are ſuppoſed to be different returns of the ſame comet: firſt, thoſe of 1531, 1607, and 1682, with a period of 75 or 76 years, may be expected again about 1758: ſecondly, thoſe of 1532 and 1661, after a period of 128½ years, may probably return about 1789: thirdly, the obſervations of that in 1556 were very groſs, and thoſe in 1264 ſtill more defective, ſo that neither orbit can be ſuppoſed to be at all accurate; yet from their likeneſs, though not agreeing very well, may not unlikely be the ſame, and come again, after a period of 292 years, about 1848: laſtly, the comet of 1680 was a very remarkable one; and as at equal intervals, *A. C.* 44, *A. D.* 531, and 1106, others were ſeen in ſome reſpects like it, ſeveral perſons have ſuppoſed they might be the ſame, being 575 years going round the ſun; yet, no obſervations being made at any of the three former times, it was but a gueſs; and if the comet of 1106 was ſeen in March in Cancer, as the manuſcript Mr. Dunthorne mentions, Phil. Tranſ. XLVII. p. 287, ſeems to ſay, it could by no means be the ſame as that of 1680, which cannot get beyond Taurus in March, nor be ſeen in Cancer after December; the period therefore of that comet muſt remain doubtful, till further light appears.

It may be objected, that the two periods of the comet of 1682 being a whole year different one from the other, there is no knowing when to expect it again. The difference indeed is very great, conſidering how true the planet's motions are found to be; yet I fear we muſt not expect the ſame regularity in a comet's orbit as in a planet's, they being ſubject to many greater errors: firſt, croſſing all or moſt of the planet's paths, they may come nearer to one or other of them than any of the planets do to each other, and be more affected by their mutual attraction; eſpecially if near Jupiter or Saturn, the greatneſs of which bodies, weaker power of the ſun, ſlowneſs of their motion, and conſequent long continuance near one another, and direction of the comet's path nearly toward the ſun, all join to make the alteration of its orbit more ſenſible: 2dly, a ſmall change of angle will make little difference in a planet's orbit, which is always nearly perpendicular to the ſun; but when a comet's path makes only five or ten degrees angle with a line from the ſun, a little variation will bear a greater proportion to that ſmall angle, than to 90 degrees: 3dly, as a comet's greateſt diſtance is many times its leaſt, if by a planet's attraction the perihelion is altered but a few miles, that may be greatly multiplied in the aphelion; and if the angle at firſt is changed but one minute, it may make a great alteration of length, in running four times as far as Saturn, and back again: 4thly, there is but little difference in the velocity of a body, going round the ſun in one or two hundred years, and of one keeping a perfect parabola; ſmall therefore muſt be the difference of one revolving in 75 or 76 years, eſpecially if the ſame power, which increaſes its velocity, ſhould make its perihelion diſtance greater. Now the comet of 1682, in its deſcent toward the ſun, may be near Mars, but that being ſmall will hardly affect it much; again, in going from the ſun, it may paſs near Venus, a little before it gets to the deſcending node, and near the earth a little after it: if then one or more of theſe planets ſhould be in that part of their orbit when the comet paſſes by, they may make ſome change in its motion. The comet of 1680 is very liable to alteration, as in its deſcent it may paſs not remote from any of the planets, extremely near the earth, and but a little way from Venus; its motion alſo being all the time almoſt directly toward the ſun, and its perihelion diſtance ſo very ſmall, a little change in its motion might make a very great one in its orbit.

The method Sir Iſaac Newton gives, in his *Principia*, is from three obſervations of a comet, at proper intervals, to find its real trajectory; and Book III. Prop. 41, he has explained in order the ſeveral proceſſes, deſigned chiefly for conſtruction, which was the way he uſed in his example of the comet of 1680. This operoſe problem Dr. David Gregory has more fully explained and demonſtrated, in the fifth book of his aſtronomy: it may alſo be reduced to triangles, and calculated by numbers, which is much more accurate than conſtruction by lines; and though conſiſting of about an hundred triangles, Dr. Halley undertook it for 24 comets, as others have ſince for 20 more; and ſome of them, by greater care or nicer obſervations, to a very great degree of exactneſs. Yet as a compleat liſt of the triangles uſed, and ſeveral cautions neceſſary in practice, are not publiſhed, I have choſen to ſet them down here, not generally repeating the demonſtrations, which Sir Iſaac Newton and Dr. Gregory have already done, but ſuppoſing one of thoſe books at hand, to add ſome obſervations for preventing miſtakes, and ſhewing how it may be reduced to triangles: the letters here uſed are the ſame as in Sir Iſaac Newton,

except

except some few which he had not, and are generally those which Dr. Gregory uses.

He then who would calculate a comet's orbit by triangles, should first construct it as true as may be by lines; for as the method is approximation, it is to no purpose to calculate nicely, while the point tried is much wrong, as the first guess will most likely be; and as the accuracy depends on having, in fig. 2. B near μ, (see Greg. V. 18, 19.) he cannot at first chuse such observations as will make it so. First therefore, out of a set of observations on a comet, chuse three so that you guess that interval of time when the comet was nearest the sun is the shortest, but no great nicety is required this first time. On a large sheet of pasteboard, draw a circle ten inches radius for the *magnus orbis*; mark the points the earth was in at the three times of observation, and call them T, t, and τ, (see fig. 1); from these draw the three observed longitudes of the comet, T A, t B, and τ C: on t B take any point B, let V be the intersection of S t and T τ, and γ the place the comet was in perpendicularly over B; make $S\gamma^3 : SB \times R^2 :: tV : BE$, which set off on the line S B: through E (Newton's *Princip.* III. lemma 7.) draw A C cutting T A and τ C, so that $AE : EC$ as the time between the first and second observations, to the time between the second and third. A and C are near enough for the first trial, the curtate places of the comet in its orbit. To try how true they are, let T A be to the perpendicular A M, as radius to the tangent of the comet's apparent latitude the first time, and $\tau C : CN :: R :$ tang. of apparent latitude the last time, and draw MN the chord of the parabolick arc $M\gamma N$, along which the comet moved, while the projection of the points on the ecliptick are A, B, C: then say $SB : S\gamma :: SB + \frac{2}{3} BE$ to a fourth number, nearly equal to (SR, see Greg. V. 20.) the distance from the sun at which a comet would move the chord MN, in the same time as it really did go the arc $M\gamma N$: let X be the length run by a comet at the earth's mean distance from the sun, in the time between the first and third observations (Newt. *Prin.* III. 40.) then $\sqrt{SR} : \sqrt{\text{radius}} :: X : MP$, being the length a comet would go in the same time at the height SR. If MN be equal to MP, the point B was taken right; but if very different, as may easily be this first time, take a new point b, find $a\ c$, and try till MN is nearly equal to MP. Being now near the matter, we must be more exact: bisect the truest AC in I, (see fig. 2.) erect a perpendicular $Ii = Bb$, draw S i, and erect $\lambda\mu$: if μ falls on or near B, the observations are rightly chosen; if not, take one or more new observations, to make B as near as possible to μ, and rather between i and μ than otherwise, (Greg. V. 18, 19.)

The circle drawn for the *magnus orbis* will do again, as will T, t and τ, if carefully drawn as to angle and distance, and the same observations are still used; as also the three longitudes T A, t B, and τ C. Set off t B as near as now known, draw A C as before, bisect it in I, erect the perpendicular $Ii = Bb$, (see fig. 2.) compleat the rectangle $Ii\lambda\mu$, and μ is nearly the vertex of the parabolick arc A B C; (Greg. V. 19. coroll.) but may be

further

further corrected thus. Produce Iμ to n, so that $\mu n = \frac{1}{2} I \mu$; through S draw $n\xi = 3 Sn$, in the line Bξ take a new point E′, and if the former length BE is not true enough, which yet it will generally be for construction, a truer length for BE′ may be found, as directed presently for calculation, thus: a sidereal year is to the time between the first and third observations, as the circumference of a circle to the length of the mean arc the earth moves in that time; the square of half that arc divided by twice the radius, is the fall of the earth in half the time: this, if now done accurately, need not be repeated in N°. 7 of the calculation: then $SB : S\gamma :: SB + \frac{1}{3} I\mu : SL$ and $SL^3 : R^2 \times \overline{SB + \frac{1}{3} I\mu} ::$ the fall of the earth : BE′ the fall of the comet. Through E′ draw A′C′, and form the rectangle $I' i' \lambda' \mu'$, μ' is the vertex of the parabolick arc, (Greg. V. 19. coroll.) and Bξ divides the chord very nearly in proportion to the times (V. 18). It remains then to try whether the point B was guessed right: say then $SB : S\gamma :: S\mu' + \frac{2}{3} I'\mu' : SR$, and as above find MN and MP: if they are not equal, draw GP parallel to C′N, then is C′G the error; take a new length tb, and repeat the process to find a new mn and mp, and error $c'g$. The two figures 3, which are the small part YCG of fig. 1 and 2, shew the two cases of this correction, when C and c are on the same or opposite sides of z; where a line drawn through G and g the two points of error will cut YC, that is in the point the comet was really over, when, by a wrong guess at the length tB and tb, it came out C and c; and setting off A′F and $a'f$ equal to C′G and $c'g$, the true point x may be in like manner found. We may now either proceed to calculate the orbit arithmetically, from the length of tB now very nearly known, or find the elements of the orbit by construction thus; (see fig. 4.) two points of a parabola m and n, perpendicularly over the curtate places x and z, with the focus the sun, determine the whole curve: draw then xz, and erect two perpendiculars xm and zn, the tangents of the comet's latitude at the first and third observations, Tx and τz being the radii; S☊ drawn through the sun and the intersection of xz and mn, is the position of the comet's node. $z\varrho$ a perpendicular let fall from z on S☊, is to zn the tangent of its latitude, as radius, to tangent of the inclination of the orbit. Produce the perpendiculars $x\sigma$ and $z\varrho$ to m and n, as cosine of inclination to radius, which will be in that position to each other, the sun and line of nodes, as the comet was in its orbit at the first and third observations; on m and n (fig. 5.) with radius Sm and Sn draw two circles; a tangent to both circles may be drawn by the eye, or thus, bisect mn, draw a circle on that center passing through m and n, and set off $m\iota = n\gamma = Sn - Sm$, which produce to δ and $\varkappa$; $\pi\varkappa\delta$ being parallel to $m\gamma$, which is perpendicular to both radii $m\varkappa$ and $n\delta$, touches both circles, and Sπ a perpendicular on it from S, is double the perihelion distance: (De la Hire's plain conicks.) Wherefore P, the bisection of Sπ, is the vertex of the parabola or perihelion point, whose position is determined by the angle nSP or mSP; as is the time the comet was there, because the parabolick space nSm, is to the

the parabolick fpace mSP, as the time between the obfervations, to the time between the perihelion and firft obfervation.

Thus are the elements of a comet's orbit found by conftruction; but if exactnefs is required, lines will not do it, but the procefs muft be reduced to triangles, and calculated by numbers. And firft fee that the obfervations are good, or elfe be content with conftruction, for it is to little purpofe to calculate nicely by uncertain data. Next try whether the times are rightly chofen, by the directions already given, (fee page 7.) and, for further accuracy, be not content with the earth's places as found by the tables of the fun, but correct them by the menftrual parallax. The weight of the earth being to that of the moon as 39.788 to 1, the diftance of the moon, is to the diftance of the common center of gravity, as 40.788 to 1. (Newt. *Princ.* III. 37. cor. 4 and 6.) In fig. 6. E is the earth, and M the moon, revolving round C their common center of gravity which moves regularly along the *magnus orbis* ACB round the fun S; then at any time the fine of the moon's horizontal parallax, is to the fine of the fun's parallax divided by 40.788, as SC to CE. In the triangle SCE, given SC, CE and SCE, then CSE is the required correction of the fun's place, and SE the real diftance of the earth from the fun. This triangle however need not be folved, the tables IV. and V. giving the required correction in angle, and the length of the line ED, to be added to or fubftracted from SC, the diftance of the fun as found by the common tables. As the moon has fometimes above five degrees of latitude, and therefore the earth is not abfolutely in the plain of the ecliptick, for perfect exactnefs that fhould be allowed for; but as the whole menftrual parallax is very fmall, this, which is but a fmall part of it, may I fuppofe be fafely neglected. Laftly, before calculating, draw a fet of figures fuited to the particular cafe, for no general rule can be given where to add and where fubftract; the cafe I have drawn, and fuited the *plus* and *minus* to, is the comet of 1742; and another fet of figures will fhew, whether to add or fubftract in that cafe. Thus prepared, the following is a lift of the triangles required, what is given and what is fought, for fixing the due length of the lines, which determine the comet's trajectory.

N°.	Triang.	Given.	Sought.	Remarks.
1	$ST\tau$	ST, $S\tau$, and $TS\tau$	$ST\tau$, $S\tau T$, [and $T\tau$]	$ST\tau - STY = \tau TY$. [$S\tau T - S\tau Y = T\tau Y$
2	$TY\tau$	$T\tau$ and τTY (N°. 1) and $TY\tau$	TY and τY	See fig. 1.
3	StB	tB (a guefs) St and StB	tSB and SB	$tS\tau + tSB = DS\tau$
4	$tB\gamma$	γ perpendicularly over B	R : tang. ap. [Lat.:: tB : $B\gamma$	
5	$SB\gamma$	SB (N°. 3) $B\gamma$ (N°. 4) $SB\gamma = (90°)$	$S\gamma$	[Conftruction
6		$SB : S\gamma :: SB + \frac{1}{4} I\mu$	$: SL$	$I\mu$ taken from the laft
7		$365.256 : U + W :: 2R \times 3.14159$	$: \chi \dotplus \omega$	$\frac{\frac{1}{2}\overline{\chi \dotplus \omega}^{2}}{2R} = {}^{r}_{2}\dotplus$. Greg. I. 25. [cor. 1.

N°.	Trian.	Given.	Sought.	Remarks.
8		$SL^3 : R^2 \times \overline{SB + \frac{1}{3} I\mu} :: \zeta \downarrow$	: B E	
9	$DS\tau$	$S\tau$, $S\tau D$ and $DS\tau$ (N°. 3)	SD and τD	$SD + BE - SB = DE$
10		$W : U + W :: DE$	: D Q	A H equal and parallel to [D Q
11	A H Y	A H (N°. 10) A Y H and A H Y (N°. 9)	AY and HY	$\tau D + HY - \tau Y = HD$
12		$U : U + W :: HD$	: H C	
13	A C H	A H, H C and A H C	ACH, CAH, [and AC	$AYC + ACH + YAC$ [$= 180°$
14		$U + W : U :: AC$	: A E	
15	B E b	BE(N°.8) BbE($=90°$) BEb($= SD\tau - ACH$)	$Bb = Ii$	See fig. 2.
16	S E I	SE($=SB-BE$) IE($=\frac{1}{2}AC - AE$) SEI(N°. 15)	S I E and S I	$SIE + 90° = SIi$
17	S I i	S I, I i (N°. 15) and S I i	S i I	
18	I $i\lambda$	Ii, I $i\lambda$ (N°. 17) i I λ ($= 90°$)	$i\lambda = I\mu$	$I\mu \times 1.5 = I\nu$
19	S I μ	SI (N°. 16) I μ and S I μ ($= SIE + I\lambda i$)	S μ	
20	S I ν	S I, I ν (N°. 18) and S I ν	ν S I and S ν	$2S\nu = S\xi . \nu SI - ISE = \nu SE$ [the Suppl. of B S ξ
21	S B ξ	S B, S ξ and B S ξ	S B ξ	Greg. V. 18.
22	B D D	BDD′(N°.9) DBD′($=SB\xi$) BD($=SD-SB$)	BD′ and DD′	
23		$SB : S\gamma :: S\mu + \frac{2}{3} I\mu$	: S L	Greg. V. 21.
24		$SL^3 : R^2 \times \overline{S\mu + \frac{1}{3} I\mu} :: \zeta \downarrow$	: B E′	$BD' + BE' = D'E'$
25	S E′ B	S B, B E′ and S B E′ (N°. 21)	SE′ and BSE′	
		Repeat 10—19 to find A′C′, S I′, I′μ' and S μ'		
(11) 27		A′ H′ Y $=$ B D′ D (N°. 22)		$\tau D + H'Y - \tau Y - DD'$ [$= H'D'$
(15) 31		B E′ b' (N°. 22 and 29)		
(16) 32		SE′ (N°. 25) S E′ I′ $=$ Suppl. B E′ b'	$+$ SBξ $+$ BSE′	
36		$S\mu' : S\mu' + \frac{1}{3} I'\mu'$	: S ρ ÷	
37		$SB : S\gamma :: S\rho$	: S R	
38	T A′ M	R : tang. Lat. : : T A′	: A′ M	
39	τ C′ N	R : tang. Lat. : : τ C′	: C′ N	
40	M K N	MK($=$A′C′) KN($=$C′N $-$ A′M) MKN($90°$)	M N	
41		$\sqrt{SR}$ (N°. 37) : $\sqrt{R} :: \chi \downarrow \omega$ (N°. 7)	: M P	Greg. I. 42. and V. 20.

If M N $=$ M P, M and N are two true Points in the comet's orbit, proceed therefore to N°. 89; and thence find the elements; but if not equal, take a new point b, so that $\left.\begin{array}{l} MN : MP \\ \sqrt{S\gamma'} : \sqrt{S\gamma} \end{array}\right\} :: Ye : Ye'$, and repeat the whole process, except N°. 1, 2, and 7.

N°.	Trian.	Given.	Sought.	Remarks.
80		$MN : NP :: A'C'$	: $C'G = A'F$	
81		$mn : np :: a'c'$	: $c'g = a'f$	See fig. 3.
82	$c'pg$	$c'g$, cpg ($=$ A′C′H′ N°. 29) $pc'g$ (N°. 67)	$c'p$ and pg	$YC' - Yc' \mp c'p = C'p$
83		$C'G \pm pg : C'p :: C'g$	: C′ z	$\tau C' - C'z = \tau z$
84 / 85	}	In like manner find A′ x		$TA' - A'x = Tx$
86	T $x m$	R : tang. Lat. : : T x	: $x m$	
87	$\tau z n$	R : tang. Lat. : : τz	: $z n$	
88	x Y z	Y x ($=$ T x $-$ T Y) Y z and x Y z	Y $z x$ and $x z$	
89	S T x	S T, T x and S T x	T S x and S x	
90	S τz	S τ, τz and S τz	τz S and S z	$\tau z S - Y z x = S z x$
91		($zn - xm =$) $rn : rm :: zn$	: z ☊	See fig. 4.
92	S z ☊	S z (N°. 90) z ☊ and S z ☊ (N°. 90)	zS☊ and S☊	$\tau Sz - zS$☊ $= \tau S$☊.
93	S $z\varrho$	S z, z S ϱ and S ϱz ($= 90°$)	$z \varrho$	[Place of the Node.
94	$n z \varrho$	$z\varrho$, zn and $nz\varrho$ ($= 90°$) $z\varrho : zn :: R$	: tang. $z \varrho n$	Inclination of the Orbit.
95	S $x m$	S x, $x m$ and S $x m$ ($= 90°$)	S m	
96	S $z n$	S z, $z n$ and S $z n$ ($= 90°$)	S n	
97	$r m n$	$r m$ (N°. 88) $r n$ (N°. 91) $m r n$ ($= 90°$)	$m n$	
98	S $m n$	S m, S n and $m n$	Snm and mSn	See fig. 5.
99	$m n \gamma$	mn, $n\gamma$ ($= Sn - Sm$) $m\gamma n$ ($= 90°$)	$m n \gamma$	$180° - Snm - mn\gamma = n$SP

N°.	Triang.	Given.	Sought.	Remarks.
100	S *n* ☋	S *n*, S ☋ (N°. 92) S *n* ☋	*n* S ☊	*n*SP − *n*S☊ = PS☋. Perihelion from [Node.
101	S *n* θ	S *n*, *n* S θ, and S θ *n* (= 90°)	S θ	$\frac{\theta\pi + S\theta}{2}$ = SP. Perihelion Diſtance.
102		Parabolick ſpace PS*n*—PS*m*, is to PS*m*, as time between the obſervations, to time between the Perihelion and firſt obſervation		Time of Perihelion.

N. B. The parabolick ſpace may be either taken out of the table of the parabola, or calculated in the ſame manner that was done.

N°. 7. I call the time between the firſt and ſecond obſervations U, and that between the ſecond and third W. Then a ſidereal year is to the whole time, as the circumference of the circle to the arc moved in that time: and the ſquare of half that arc, divided by twice the radius, is the earth's fall toward the ſun in half the time.

N°. 6, 7, 8. I find BE this way rather than Sir Iſaac Newton's, which is only an approximation, and irregularly too great or too ſmall, as the times are more or leſs unequally divided, and T $t\tau$ in the more or leſs curved parts of the earth's orbit. But this way, if found as in N°. 23, 24, would be true; and Sμ being not yet known, I uſe SB for it, which is very nearly the ſame: nor is Iμ yet found, but as the comet has been already conſtructed, it is there given near enough for this proceſs.

N°. 20. Since, by Greg. V. 18, the right line $nS\xi = 3Sn$ is the truth, full as eaſy, and, requiring no taking out natural numbers, is leſs liable to error, I wonder Sir Iſaac choſe to approximate it by the point σ, and $\sigma\xi = 3S\sigma + 3i\lambda$. (See his fig. Book III. Prop. 41.)

N°. 23, 24. In Greg. V. 21, the comet's fall at the height SL is MV = VZ, (ſee his fig.) Now B and μ nearly coinciding, by ſimilar triangles $SB : S\gamma$ (N°. 5) $:: Sl\ (= S\mu + \frac{1}{3}I\mu) : SL$. Again, $SL^2 : R^2 :: \zeta\psi$ (the earth's mean fall) : the fall at the point L. Greg. I. 42. And by ſimilar triangles $SL : S\mu + \frac{1}{3}I\mu ::$ the fall at L : BE; then $SL^3 : R^2 \times \overline{S\mu + \frac{1}{3}I\mu} :: \zeta\psi : BE$. This is the true length of μZ or BE, and ſeldom ſenſibly different from BE′, which yet being more perpendicular to AC, is a little ſhorter; and if BE is ſo long and ſo oblique to AC, that the very ſmall angle EBE′ will ſenſibly alter its length, then the ſine of BE′b : ſine of BEb :: BE : BE′ may be ſomething truer.

N°. 36. The third proportional to Sμ and $S\mu + \frac{1}{3}I\mu$, which is the truth, ſee Greg. V. 20, is eaſier found in Logarithms than $S\mu + \frac{2}{3}I\mu$.

N°. 37. It is here fit to ſhew cauſe for this conſiderable variation from Sir Iſaac Newton. Greg. V. 20, ſhews that a body at the height SR (ſee his fig.) would move the chord AB, while the comet really moved the arc AVB. Now μ, l and ϱ, in fig. 2, are the projection on the plain of the ecliptick of his V, L and R: then SR, the hypothenuſe of the right-angled triangle SϱR, is Gregory's line SR, and therefore the length ſought. Sir Iſaac's $ID = S\mu + \frac{2}{3}i\lambda$ is nearly the ſame as Sϱ; but his IO, being the comet's comet's mean height above the ecliptick, may if the time is unequally divided, and the inclination of the comet great, considerably differ from the height sought at $S\varrho$, which is in $S\mu$ produced: therefore, as in N°. 23, $SB:S\gamma::S\varrho:SR$, by similar triangles.

N°. 38, 39. M and N being the points the comet was really in, perpendicularly over A′ and C′, T A′, the curtate distance, is to A′ M the height, as radius to tang. of the apparent latitude at the first observation. The like of C′ N.

N°. 41. The reason of this double proportion is this: M N, and of course A′ C′ and the perpendicular $Y\varepsilon$, is too large in the proportion of M N to M P; but M P will increase or diminish, as $\sqrt{S\gamma'}$ is less or greater than $\sqrt{S\gamma}$. Greg. I. 27. This however is very hard to find, and only an approximation at last. An easier and as good a way is, to compare the error of the last construction with the error now found by calculation: thus $NP - NP$ the difference of the errors, is to $tB - tB$ the difference of the guesses, as N P the present error, to the required correction of tB.

N°. 80, 81. Sir Isaac Newton takes $CG = NP$; but as the correction is in the plain of A C, not of M N, I make G the projection of P, as C is of N. And if C G is not parallel to cg (fig. 3.) or Cc bears not the same proportion to τC, as Aa to T A, it may make some difference in the places of x and z, though seldom much.

N°. 80, 81, 82, 84, are not wanted if A C is parallel to ac; for then 83 and 85 will be, $NP \pm np : NP :: Aa : Ax :: Cc : Cz$.

Sir Isaac Newton in his next proposition, and Dr. Gregory V. 31, shew how, by the rule of false, to correct still further the comet's orbit as above found: but that I have here omitted, as hoping and expecting that the directions I have given, being contrived to avoid all error as much as possible, will give the orbit true enough without that laborious correction, which I can hardly think is much less trouble than the calculation of the orbit itself. The changing the comet's *parabolick orbit* into its real *elliptical one*, by this correction, thereby to discover its period, can I doubt be at best but imperfectly done, from the small part of the orbit we can see, especially if so true a parabola as the comet of 1744 had: and unless we see a comet for a very long time, we must be content to wait for that more certain, though tedious discovery, the returning after another period. If any one however, desirous of the utmost exactness, chuses to undertake this last correction, Sir Isaac Newton and Dr. Gregory have both explained and shewn the use of it.

As several persons, especially of late years, have apply'd themselves to finding by Sir Isaac Newton's method, the orbits of several comets, but the result of their labours is no-where that I know of, collected into one view, I have here made a general table of all that I have found. And as since 1700 many are calculated by two persons, I set down both orbits, not always knowing which is best, and thinking it useful to preserve all,

to

to be at leisure compared, either by observations already made, or by those who shall see their next returns. Some of these different orbits vary little, as that of 1744, others differ widely, as that of 1739; probably sometimes from defectiveness in the observations one or both of the calculators used. I found several difficulties in making this table, from false prints, and authors not being always careful to set down the *ascending node*, having more than once found two persons set down the same comet's node in the opposite signs. By comparing the orbits with the observations, I have aimed to avoid mistakes, but have not met with observations of all of them to compare with, and lesser errors may escape; if therefore the authors, or any one else, shall find any mistake inadvertently slipped in, I shall be obliged to them for an account of it, and not fail to correct it when opportunity offers. See the list in table I.

The first 7 of these comets, and those of 1593 and 1596, being but imperfectly observed, can be but grossly done; as also those of 1678 and 1702, unless the calculators used better observations than I have found: that of 1533 will by no means suit the observations in Hevelius, so that I suspect some mistake or false print: Struijck gives the comet of 1699 from Caille, but makes the perihelion Jan. 2, and the ascending node in ♒, which is right I do not know, any further than that I have found Caille carelessly setting down the wrong node in other instances: not having met with the observations, I can say nothing of the accuracy of those of 1699, 1706, 7, 29, 43, and 48: Downes's orbit of the comet of 1718 suits best, so far as I have tried it, and Caille's of 1739: none of the orbits of the comet of Jan. 1742 agree well with the set of observations in Phil. Trans. No. 481; mine, which was calculated from the observations there mentioned of Mar. 2 and 16, and Apr. 2, agrees I think as well as any of them, but generally gives the latitude too small, being done a good while ago, from a more imperfect list of triangles than that here given in pages 9, 10, 11: C and Struijck differ 10 degrees in the node of the comet of December 1742, which is probably a false print, but I cannot correct it: the comet of 1747 was seen in August 1746, half a year before its perihelion, being then between two and three times as far from the earth as the sun is, and between three and four times the earth's distance off the sun; and its perihelion being above twice the earth's distance, we must not expect exactness there: Dr. Bradley's two comets of 1723 and 1737 are very accurate; as is also Betts's of 1744, calculated from observations made between Dec. 23, 1743, and Feb. 18, 1743-4; but as it was seen for a little while about two months before, when far distant from the earth, and much more from the sun, I have compared three observations sent me from Mr. Morris with Betts's orbit, and found them to agree perfectly; which proves both the truth of the elements, and that the comet's ellipsis was so far at least insensibly different from a parabola; or else those observations, made four months before the perihelion, and two before the observations the orbit was found by, would not have agreed so well: the hour of observation not being given, I have in the following table calculated for $8^h\ 17'$ each evening.

Comet of 1744, *seen in* 1743.				
	Observation.		Calculation.	
	Long.	Lat.	Long.	Lat.
	° ′	° ′	° ′	° ′
Oct. 22	♉ 26 . 46	N. 7 . 35	♉ 26 . 41	N. 7 . 35
27	24 . 14	8 . 28	24 . 15	8 . 31
Nov. 1	21 . 25	9 . 26	21 . 25	9 . 28

I collected these orbits from first, Dr. Halley's 24 comets, now printed in his astronomical tables; secondly, Caille's list in his astronomy, art. 560, Robertson's translation, page 236; thirdly, a collection by N. Struijck, Phil. Transf. N°. 492; fourthly, several single ones, 1723, 37, 39, 44, and 1264, from Phil. Transf. N°. 382, 446, 461, 474, and Vol. 47, page 283, and Mr. G. Whiston's of 1718, from himself. The reason of my adding and altering some particulars in this table are these: the articles used in calculating a comet's place are, the time of the perihelion, log. of diurnal motion, distance of perihelion from node, cosine and sine of the comet's inclination, place of the node, whether direct or retrograde, and log. of the perihelion distance; these therefore are all inserted: and since, notwithstanding care, false prints will sometimes creep in, and I have met with difficulties from them, I aim to frame this table so as to find them out. The observations will soon shew whether the year of the comet is right; but on the second column I neither have, nor know how to find any check: the log. of the diurnal motion is found from the log. of the perihelion distance, if therefore these articles agree together, both are probably right, if they do not, the natural perihelion distance will shew which is true: the perihelion place is a fictitious thing, for its distance from the node is measured in the plain of the comet's orbit; but that, especially in a very oblique comet, is by no means the same number of degrees on the ecliptick, except at the nodes and their perpendiculars; the only use therefore of inserting it is, by comparing that, the node, and perih. post nod. together, to find out any false print: as to the seventh column, Dr. Halley gave the distance of the perihelion from the node, whether before or after; but I count the number of degrees a comet moves, from passing its ascending node to its perihelion, whether more or less than 180 degrees; this saves a little trouble in computing a comet's place, as I shall shew when I come to explain that, (see page 18). The node, being the connexion of the plain of the ecliptick with the comet's orbit, is the key of the whole work; and whoever calculates or collects orbits, should remember, that it is the *ascend-*

ing

ing node must be inserted, and the article perih. post nod. reckoned from that, or else confusion is caused, and the comet found in false latitude: giving the inclination of the orbit is not strictly necessary, if its sine and cosine are but given, which prove one another: the twelfth column needs no explaining: and in the last I give the calculator's name, where I know it; but as Caille names no author, those taken only from him are marked C, as I can trace them no further.

Dr. Halley made a table of the parabola, for finding a comet's place at any time, printed with his list of orbits, and shewed the way of using it: he goes the direct way, for, dividing the first quadrant of the parabola into 100 equal parts, he gives the angle each is in from the vertex, and its increase of distance from the focus: but the calculation being tedious, and one such part altering the angle but little, at a distance from the vertex, he computed every part only to 100, that is, to the *latus rectum*, and to every second, fourth part, or greater interval afterwards. This table is 240 lines in all, but though very useful has some defects; for, being too short, the differences are often too large, and too unequal, for finding proportional parts truly, especially in the log. of the distance; again, proportional parts can hardly be found at the breaks, where the interval alters from 1 to 2, 4, 10, 20, 500, 40000, and 50000; lastly, it may however serve as far as 1000, that is, 144°$\frac{1}{2}$ from the perihelion, which is far enough for many comets, but those whose perihelion distance is small, are seen much further; that of 1680 goes near 162°$\frac{3}{4}$ within four days after its perihelion, and may be seen to about 174°, this table therefore will by no means do for that. Finding these inconveniences, and not caring for so difficult a calculation as Dr. Halley's, I thought of interlining his table by the differences, but found it very troublesome; and being advised to make a new table, on an easier plan, to find the distance and space from the angle, I considered it, and found the demonstration plain, the calculation very easy, the method such as might be carried on regularly, from beginning to end of the table, and having finished it, the differences were more regular than I expected; for proportional parts will determine to about half a second, the angle the comet of 1680 is in from the sun, at the greatest distance we can see it, and the log. of distance almost to perfect exactness, in any part of the table. The principles of this method may be seen in fig. 7. and let R stand for radius, *s* for sine, and *v* for versine.

(1) $\begin{cases} SC = ST = SR \\ Sc = St = Sr \end{cases}$ De la Hire's plain conicks. Parabola, Prop. 4, cor.

(2) $\begin{cases} PQ = PT = SC - SP = \varrho - 1 \\ Pq = Pt = Sc - SP = \varrho - 1 \end{cases}$ Prop. 7.

(3) $RQ = rq = 2SP$ Prop. 9.

(4) $SmnP = \frac{2}{3}\overline{Sm \times SP} = 1.3 \quad \because 1 = \frac{3}{4} SmnP$

(5) $\begin{cases} RQ : SC :: v.\text{ of } RSC : R \\ rq : Sc :: v.\text{ of } rSc : R \end{cases} :: 2 : \varrho = \frac{2}{v}$ (See 1. and 3.)

(6) $R : s :: \rho : \sigma = \rho s$

(7) $\begin{cases} SCmP = \frac{1}{2}\overline{SP + \frac{1}{6}PQ} \times \sigma \\ ScnP = \frac{1}{2}\overline{SP + \frac{1}{6}Pq} \times \sigma \end{cases}$ Quadrature of parabola.

(8) $\begin{cases} \frac{3}{4} SCmP = \frac{3SP + PQ}{8} \times \sigma = \frac{3 + \rho - 1}{8} \times \sigma = \frac{2 + \rho}{8} \times \sigma \\ \frac{3}{4} ScnP = \frac{3SP + Pq}{8} \times \sigma = \frac{3 + \rho - 1}{8} \times \sigma = \frac{2 + \rho}{8} \times \sigma \end{cases}$

ρ may be found a little easier thus, by fig. 8.

(9) $SB^2 = AB \times VB = 2Rv$ by similar triangles.

(10) $SM^2 = \frac{Rv}{2} = s^2$ of $\frac{1}{2}$ SCB

(11) $\frac{R}{SM^2} = \frac{2R}{Rv} = \frac{2}{v} = \rho$ as before found.

Examples of the first method.

Angle from aphelion	112°. 55′		65°. 50′	
2	0.3010300		0.3010300	
v	0.1428248		9.7712991	
$\sigma \begin{cases} \rho \\ s \end{cases}$	0.1582052 =	1.4394	0.5297309 =	3.3863
	9.9642937	2.	9.9601655	2.
$2 + \rho$	0.5364926	237	0.7312940	55
Ar. Comp. 8.	9.0969100	126	9.0969100	81
ScnP	9.7559015	302	0.3181004	129
		99		34

Examples of the latter method.

Angle rSc	122°. 45′		Angle RSC 61°. 10′	
	1.2978		3.8629	
$\frac{R}{SM^2}$	0.1132346		0.5869212	
s.	9.9248161	268	9.9425171	77
$2 + \rho$	0.5182349	132	0.7681176	74
Ar. Comp. 8.	9.0969100		9.0969100	
		334		112
ScnP	9.6531956	106	0.3944659	51

This method of calculation, by which the parabolick table, N°. II. is made to every fifth minute of angle, supposes, as is the natural and regular way, that the parabolick space at 90 degrees from the vertex is 1, and so I should have entered it in the table, had I been to choose; but Dr. Halley having divided that space into 100 parts, and fitted the log. of diurnal motion and method of reckoning to that, I have, to avoid confusion, suited

(C) my

my table to his, by adding two to the index of the ſpace as above found. The log. of diſtance proceeds regularly all the way, with increaſing differences; but one break was neceſſary in the mean motion, for the log. of ſpace is extreamly unequal near the perihelion, as is the natural ſpace at a great diſtance from it; the firſt 45 degrees therefore is the natural ſpace, and the reſt of the table its logarithm: yet no difficulty can hence ariſe, ſince both are very regular where the table alters. As the differences increaſe very faſt toward the end of the table, No. III. ſhews how near proportional parts will give a comet's real angle and diſtance: 45 degrees from the perihelion is tried, becauſe there the differences of the log. of mean motion decreaſe, while thoſe of the log. of diſtance increaſe, yet no ſenſible error does thence ariſe: few comets are ſeen above 155 degrees, nor that of 1680 more than about 174 degrees from the perihelion. The two firſt columns are the angle, and true log. of mean motion; the third is the angle which proportional parts would give as anſwering to that logarithm: for inſtance, 7.522283 is the true log. of mean motion for $178^\circ . 57' . 30''$, but proportional parts would give $178^\circ . 57' . 27''$ for it, that is $3''$ wrong; and 7.523327, the arithmetical mean between the mean motion at $178^\circ . 55'$ and 179°, would be called the log. of mean motion for $178^\circ . 57' . 30''$. The fourth column is the true logarithm of diſtance; and the fifth what logarithm of diſtance proportional parts would give, as anſwering to the true log. of mean motion: and though the differences increaſe ſo greatly toward the end of the table, yet as both log. of mean motion and log. of diſtance increaſe proportionally, no error is thereby cauſed; and this is the caſe uſed in calculating a comet's place: but if on any other occaſion, the log. of diſtance at any certain angle is required, the ſixth column gives the log. of diſtance found by equal diviſions, the ſeventh its error, and the eighth how much that point of the parabola is by this error carried too far from the focus: for inſtance, 2.115806 is the true log. of diſtance at $169^\circ . 57' \frac{1}{2}$, by equal diviſions 2.115813 will be found for it, which is 7 too much, and that point is by this means made $\frac{1}{60000}$th part too far diſtant from the focus; this is the greateſt error between $169^\circ . 55'$ and 170°, for if tried at $169^\circ . 56'$, $57'$, $58'$, or $59'$, the error is leſs. We ſee then that in the caſe of computing a comet's place, this table will never err more than half a ſecond in angle, (much nicer than any orbit is known,) and in all places gives the log. of diſtance true.

Since the velocity of a body moving in a parabola, is to that of one moving in a circle, as $\sqrt{2}$ to 1, (Newton's *Princ.* I. 16, cor. 7.) the periodical time of a planet, is to the time a comet of equal perihelion diſtance takes to go its firſt quadrant, as the area of the circle $= 1 \times 3.14159$, to the area of that quadrant divided by the $\sqrt{2}$, that is, $\frac{1 \times \frac{4}{3}}{\sqrt{2}} = 1 \times \frac{2}{3} \times \sqrt{2}$; and is therefore thus found, in a comet whoſe perihelion diſtance is the radius of the *magnus orbis*:

$3.14159 : \frac{2}{3}\sqrt{2} :: 365^{d}.6^{h}.9'.12''\ (365.25639) : (109.61543)\ 109^{d}.14^{h}.46'.13''.$

365.25639 =	2.5625978
√2	0.1505150
2	0.3010300
3	0.4771212
3.14159	0.4971499
109.61543 =	2.0398717
100.	2.

0.9122802 = 9.9601283 Diurnal motion.

	Diurnal motion of comet 1682.	Comet 1664.
Log. perih.	9.765877	0.011044
$\frac{1}{2}$	9.882939	5522
Perih. ſeſq.	9.648816	0.016566
	9.960128	9.960128
Log. d. mot.	0.311312	9.943562

Its diurnal motion therefore is 100, the number of parts that quadrant is divided into, divided by $109^{h}.14^{d}.46'.13''$, the time it is going it; that is, 0.912280, whoſe log. is 9.960128. Hence any other comet's diurnal motion is found; for velocity is reciprocally as the ſquare root of the diſtance from the ſun, and the ſine of the angle (and therefore in ſmall angles the angle itſelf) is reciprocally as the diſtance; the apparent motion therefore of a comet as ſeen from the ſun, is reciprocally as the cube of the ſquare root of its diſtance: the velocity being the root, the diſtance is the ſquare, and the apparent motion the cube. The diurnal motion therefore, of which I have juſt given two examples, is perih. ſeſq. : 1 :: 0.912280 : diurnal motion.

The log. of diurnal motion thus found, ſaves the four lines uſed in finding it every time the comet's place is computed: the log. of the time between the comet's perihelion and time ſought (reduced to decimals of a day, by table VII.) added to the log. of diurnal motion, gives the log. of mean motion, and if that is above 1.517428, its natural number is not wanted: find then in the parabolick table, N°. II. the article next below the mean motion ſought, and ſay, difference : remainder :: 300″ : proportional parts :: difference of log. of diſtance : its proportional parts. Required the angle and log. of diſtance, anſwering to 1.519782; this is above 45°. 15′; then 986:378 :: 300 : 115 :: 263 : 101; the angle therefore is 45°. 16′. 55″, and the log. of diſtance 0.069658. The next thing wanted is the comet's

378	2.577		2.577
300	2.477	263	2.420
986	2.994		2.994
115 =	2.060	101 =	2.003

angle from the node: here, that we may always find it by addition, and ſave two lines in doing it by a ſingle proceſs, and not take it firſt from the perihelion, and thence from the node, I vary from Dr. Halley's method; for the article perih. poſt nodum is always the angle the comet moves, after paſſing its aſcending node till it comes to the perihelion, be it more or leſs than 180 degrees; and uſing always the angle the comet has moved ſince

its

its laſt perihelion, (by taking the ſupplement to 360°, of the angle found by the parabolick table, if the place computed is before the comet's perihelion,) theſe two angles muſt always be added together, whether the comet is direct or retrograde, before or after its perihelion, and in whatever part of the orbit its node is; and rejecting 360° if neceſſary, if the angle is leſs than 180° the comet is in *north latitude*, if more, in *ſouth*. The tangent and ſine of this angle being uſed in the two next proportions, we muſt obſerve, that an angle, its ſupplement, and 180° more or leſs, have the ſame ſine and tangent, and that the angle reduced to the ecliptick, is always nearer 0, 180, or 360 degrees, than the angle from the node. So then R : coſ. of Incl. of the orbit : : tang. of angle from node : tang. of the angle on the ecliptick, which added to the place of the comet's node if direct, or ſubſtracted if retrograde, gives the *heliocentrick longitude*; as R : *s*. Incl. : : *s*. of angle from node : *s*. of *heliocentrick latitude*.

Again, the log. of the comet's perihelion diſtance, + log. of its increaſed diſtance as above found, + coſ. of heliocentrick latitude, gives the projection of the comet's place on the plain of the ecliptick, and the ſun's place and diſtance from the earth being found, in the triangle SCE, fig. 10, are given SC, SE, and CSE, therefore the leſſer ſide is to the greater, as R : tang. of an angle, and R : tang. of that angle — 45° : : tangent of half the ſum : tang. of half the difference of the two other angles; then ½ the ſum + ½ the difference being the greater, and ½ ſum — ½ difference the leſſer angle, the comet's *geocentrick longitude* is thence known. Laſtly, EC : SC, that is, ſine of angle at the ſun : ſine of angle at the earth : : tang. of heliocentrick latitude : tang. of *geocentrick*. Taking out natural numbers being troubleſome and liable to error, I avoid it as much as may be; for inſtance, when the ſine of the heliocentrick latitude is 9.852389, which is above 45°. 23′, its coſine and tangent are wanted, but not the angle itſelf; then difference of ſine is to difference of tangent, as remainder of ſine to remainder of tangent; 21 : 42 : : 18 : 36 for the tangent, which is therefore 10.005847, as the coſine is 9.846542. In like manner let 10.261606 be the tangent of an angle above 61°. 17′. 50″; then the tangent of 45° leſs, or above 16°. 17′. 50″ is thus found, 50 : 78 : : 27 : 42, the tangent then is 9.465972.

78	1.892
27	1.431
50	1.699
42	1.624

Caille's

Caille's Comet of 1739.			*Barker's Comet of Jan. 1742.*		
Log. diurn. mot.	0.217546	May 17d.8h.39'	0.130344	Feb. 18d. 8h.32'	
Time 20.0556	1.302236	Perih. June 6.9.59	20.7368 1.316742	Jan. 28.14.51	
		20.1.20		20.17.41	
Log. mean mot.	1.519782	1.12	1.447086	16.48	
Natural number		7.12	27.9954	43.12	
Angle	45°.16'.55"	378.577 | 577 | 52	39°.23'.34"	495.695 | 695 | 8 38	
Supplement	314.43.5	300.477 | 263.420		300.477 | 226.354 | 1 09	
Perih. post node	104.46.34	986.994 | 994	328.30.10	694.841 | 841	
		115.060 | 101.003		214.331 | 161.208	
Ang. from node	59.29.39		7.53.44		
Cos. Inclination	9.750778	3s.8°.17'.35" 23 0.006154 37 3 ⊖'s dist. a ⊙ 6194	9.582340	3s.8°.20'.37" 8 9.996519 11 ⊖'s dist. a ⊙ 530	
T. ang. from node	10.229750		9.142021		
Tangent of angle	9.980528		8.724361		
on ecliptick	43°.42'.58"		3°.2'.4"		
Sine of Inclinat.	9.917095		9.965701		
S. ang. from node	9.935294		9.137884		
S. helioc. lat.	9.852389	1739, 6s.12°.13'.42" May 17. 4.15.1.38 8h 19.43 39' 1.36 10.27.36.39 3.8.17.58 + 1.1.13 Sun's place 2.6.55.50	9.103585	1742, 6s.12°.26'.49" Feb. 18. 1.18.17.40 8h 19.43 32' 1.19 8.1.5.31 3.8.20.45 + 1.42.52 Sun's place 11.11.9.8	
Helioc. lat.					
Long.	♍ 13°.42'.16"		♎ 2°.7'.26"		
Log. of perih.	9.828388		9.886522		
Log. of distance	0.069658		0.052367		
Cos. helioc. lat.	9.846542		9.996473		
Curtate distance	9.744588		9.935362		
Earth from sun	0.006194		9.996530		
Tangent	10.261606	78 8s. 6°.55'.50"	10.061168	33½	6s. 2°. 7'.26"
Angle	61°.17'.50"	27 5.13.42.16	49°.1'.10"	301	5.11.9.8
		50 2.23.13.34			20.58.18
T. of ang. — 45°	9.465972	42 3.6.46.26	8.846994	42½	159.1.42
Tang. of ½ sum	10.051465	½ sum 48.23.13	10.732633	238	79.30.51
		½ diff. 18.13.14			20.48.0
Tang. of ½ diff.	9.517437	66.36.27	9.579627	54	100.18.51
S. ang. at earth	9.701147	30.9.59	9.931756	167	58.42.51
Tang. helioc. lat.	10.005847		9.107112		
		See fig. 10.		165	See fig. 11.
S. ang. at sun	9.996958		9.553769	55	
Tang. geoc. lat.	9.710036		9.485099		
		Place observed.			Place observed.
Geocent. lat.	N. 27°.9'.10"	N. 27°.9'	N. 16°.59'.30"		N. 16°.58'
Long.	♋ 7.5.50	♋ 7.6	♑ 12.26.20		♑ 12.24

Besides calculating a comet's place, the parabolick table may be used in drawing any *parabola*. For, first, the natural number of the log. of distance at any angle, is the distance of that point of the parabola from the focus, in parts of the focal length; thus any number of points may be set off, by the angle from the vertex, and distance from the focus. Thus the log.

log. of distance at 42 degrees from the vertex is 0.059697; its natural number 1.14735, that point of the parabola therefore is distant from the focus about 1 $\frac{1}{7}$ of the focal length.

Secondly, One process reduces this distance from the focus, to any other known measure: as let the focal length of a parabola be 3.6 inches; then a point 42 degrees of angle from the vertex is 4.1305 inches from the focus

Log. dist.	0.059697
3.6	0.556302
	0.615999
Dist. in inches	4.1305

Thirdly, The angle in a parabola, at a great distance from the vertex, alters very little; in that case therefore, the points may perhaps be better set off, by the distances from the focus and from the axis, that is, the ordinate; which is thus found, R : s. ang. from vertex : : dist. from focus : ordinate. And if it be thought better, it may be done by the ordinate and abscissa, which is always one focal length less than the distance from the focus. Take for instance the ordinate, distance from focus, and abscissa at 170 degrees from the vertex, both in parts of the focal length and inches.

S. 170° —	9.239670		9.239670
Dist. a foc.	2.119408	In.	2.119408
Focal length			3.6 = 0.556302
Ordinate	1.359078		1.915380
	22.8601	Inches	82.2962
Dist. a foc.	131.6461		473.9254
Abscissa	130.6461		470.3254

Fourthly, But the best way to draw a comet's orbit round the sun is, marking the points at some certain interval from each other, as suppose 4, 8, 12, &c. days motion from the perihelion; hereby the point the comet is in at any time may quickly be known. To find these points, multiply the comet's diurnal motion by the number of days; the angle in the table corresponding to that, is the angle it is from the perihelion; as the corresponding log. of distance + log. of perihelion distance, gives the distance from the sun, in parts of the *magnus orbis*. Try the comet of 1682, 40 days from its perihelion.

Fifthly, When a comet whose perihelion distance is very small, is a great way from the sun, its angle from the perihelion alters very slowly; the points therefore, if thought better, may be laid out by the distances from the sun and from the axis, as just now proposed in the third use. Find then the angle distance and ordinate of the comet of 1680, at 120 days from its perihelion. Yet if when a comet is much further from the sun than the earth is, its

Log. diur. mot.	0.311312
40 days	1.602060
	1.913372
Ang. from per.	82°. 9′
Log. dist.	0.245413
Log. perih.	9.765877
	0.011290
Comet from sun	1.0263
Log. diur. mot.	3.279469
120 days	2.079181
	5.358650
Angle	174°. 30′. 35″
Log. dist.	2.639480
Log. perih.	7.787106
2.6705 =	0.426586
S. of angle	8.980807
	9.407393
Ordinate	0.2555

angle be not set off in the *magnus orbis*, but on a larger concentrick circle, it will I believe be as well done, by the angle from the perihelion and distance from the sun.

In this manner the angle, distance and ordinate of the comet of 1680, and the angle and distance of that of 1682, are given for every fourth day from the perihelion, as far as they can be seen, in table VIII. Table IX. gives the length of the abscissa and ordinate of a parabola, in parts of the focal length, for every tenth degree, and oftener at last. And table X. gives the hourly motion of a comet, at different distances from the sun, (which is as the square root of its distance,) both in parts of the earth's mean distance, and in miles, supposing the earth 77,000,000 of miles from the sun, that is the sun's parallax 10 $\frac{1}{2}$ seconds; and the times which comets of different perihelion distances take to go from their perihelion to their *latus rectum*; which are to one another as the square root of the cube of their perihelion distance, as I mentioned above in page 18.

Sixthly, As to the use of the table in the parabolick motion of projectiles, see fig. 7. The abscissa PQ, which is the height they rise, is always equal to SC—SP, that is one less than the distance from the focus, which is given by the table: the horizontal distance they fly, is twice the ordinate CQ: and QT (=2PQ, that is twice the abscissa) is to CQ (the ordinate) as radius to cot. of QCT, the angle of elevation.

Calculating a comet's place by a parabola, which is a very regular figure, has no proper difficulty in it; yet, being full 30 lines besides the sun's place, &c. is tedious; therefore an easy way to construct a comet's place may be very useful, where only a general account of a comet's motion is wanted, though by no means sufficient where nicety is required. See then fig. 9. On a sheet of pasteboard draw a circle five or ten inches radius for the *magnus orbis*, the center of which is the sun; and the real distance of the earth may be marked about the eighth degree of each sine, a little without the circle from ♎ to ♈, and a little within it from ♈ to ♎; and divide the circle into signs and degrees. From the table of elements, N°. I. mark true, both as to angle and distance, the perihelion of the comet required: through the sun draw the axis of the parabola, and by article 4. of the uses of the parabolick table, (page 21) set off the several points of the orbit, where the comet is at every fourth day's interval, on on each side of its perihelion. But as comets do not move in the plain of the ecliptick, on the proper angle, draw through the sun its line of nodes, and from the several points of the orbit, let fall perpendiculars upon it; on them mark a fresh row of points, whose distance from the line of nodes shall each be to their respective perpendiculars, as the cosine of the inclination of the comet's orbit is to radius. These points, which for distinction I make little crosses, form the curve of the projection of the comet's orbit on the plain of the ecliptick, which is always used in constructing a comet's place, and is, as Caille shews, art. 519 of his astronomy, itself also a parabola,

rabola, yet has by no means the ſame focus or poſition of axis, as the orbit itſelf; as would more plainly appear, by drawing the comet of 1577. For better diſtinction, the parabola itſelf is a fine ſtroke; the figures are written on that ſide of the orbit which is fartheſt from the line of nodes, and conſequently from the projection of the orbit on the ecliptick; and the titles of the comets, are written the ſame way as the comet moves. Thus is the orbit of a comet made ready for uſe at any time, and its apparent place may be thus found:

Count the days from the comet's perihelion to the time required, and mark the point in the projection of the orbit, over which the comet then is; lay one edge of a parallel rule, from that point to the place of the earth at the ſame time, and the other edge paſſing through the ſun, will cut the *magnus orbis* in the apparent longitude of the comet. Again, draw two right lines, cutting each other in the angle of the comet's inclination; from their interſection ſet off in one of them the length of the perpendicular from the comet's curtate place to the line of nodes, and a perpendicular erected to the other is the tangent of the comet's apparent latitude, making the curtate diſtance of the comet from the earth the radius. Thus may firſt, the courſe of a known comet quickly be traced, and in what part of the heavens to expect firſt to ſee it, when it returns again, be found; for ſince the period of no comet is yet known exactly, and for the reaſons mentioned in page 5, they will not perhaps be always equal, we cannot fix the very month a comet will return in; and ſhould therefore know where to look, if it comes a little ſooner or later than is expected. Secondly, when a known comet returns, one obſervation will, with this ſcheme, ſhew its whole future courſe; for from the earth's place, at the time of obſervation, draw a line in the obſerved longitude of the comet, this cuts the projection of the comet's orbit in the place where it then was, whether the latitude agrees may be tried as above directed; and the day's motion marked on that curve, will ſhew where it will be at any other time. Thirdly, the periods of comets may perhaps be ſometimes found by this ſcheme, when the obſervations are too defective to calculate the orbit by. For inſtance, no comet ſeen in Auguſt in ♒ can be that of 1682, nor can one ſeen in June eaſily be that of 1680, which muſt be then cloſe to or beyond the ſun, but one ſeen in January between ♒ and ♊ may; it remains then to try, whether the latitude, motion, and other circumſtances agree with what might be expected of that comet, and as they agree or not, there is a probability of its being the ſame, or a proof that it is not.

I have choſen as an example of this method of conſtructing, the comet of 1682, which is ſhortly expected to return; and in twelve ſhort tables, N°. XI. ſuppoſing its perihelion any month in the year, ſhew what the apparent courſe of the comet would be, which are very different one from another; for as appears on view, from April to November it would move direct, be in ſome of the ſigns from ♈ counting forward to ♐, and chiefly in in north latitude: between November and April it would be retrograde, between ♊ and ♍ counting backward, and be ſeen, diſappear, and be ſeen again: that if ſeen about the beginning of ſummer, being at or a little after its perihelion, it would make the beſt ſhew, and be ſeen the ſhorteſt time; but will make very little figure in winter. The two firſt articles in each table, are the place about which the comet might be firſt ſeen, if its perihelion ſhould prove that day which is ſet at the head of the table; for inſtance, if its next perihelion ſhould be Sept. 23, whether 1757 or 1758, then about Auguſt 14 it may begin to be ſeen, being in 24 degrees of ♊, with 7 or 8 degrees north latitude. Theſe tables ſhew in general how the comet would move, but in the middle of its courſe cannot be depended upon for a nicety; as a ſmall inaccuracy may occaſion great error, if the comet ſhould croſs the *magnus orbis* in its deſcent toward the ſun about the middle of October, or in its aſcent about the beginning of May, when it may move 40° in a day: ſo alſo if its perihelion ſhould be a week or fortnight different from what I have ſuppoſed, it may make a conſiderable variation in its track. The two known periods of this comet are indeed more different than one could ſuſpect; for the laſt was not 75 years, and an equal interval would make its next perihelion July 25, 1757; but if this revolution ſhould be as long as the former was, that is above 76 years, it cannot be till Oct. 25, 1758. Yet as the reſt of the elements agree ſo well all the three times, we cannot but ſuppoſe them to be the ſame; and as I can ſee no principle in nature to make its period alternately longer and ſhorter, I can refer the different intervals to nothing but thoſe irregularities to which comet's orbits are liable. Yet on this account I have in another table, N°. XII. ſhewn in what part of the heavens the comet may be expected to begin to be ſeen, in any month of the year; as ſuppoſe it firſt gets near enough to be ſeen the beginning of July, we find that its apparent motion will be then direct, its place the beginning of ♊, the latitude north and increaſing, and that it will come to its perihelion about a month afterwards.

Thus I have treated of the motion of comets, the gradual diſcovery of it, the way to find their real path, and to trace it either with reſpect to the ſun or the earth; by which means we may hope to know the times of their revolutions better hereafter. But of their nature and uſes I have not ventured to ſpeak, chuſing rather to leave ſuch points as are at preſent ſo little, I may almoſt ſay not at all known, to thoſe, if any ſuch ſhall hereafter be, who by greater light afforded them ſhall be enabled to ſearch deeper into thoſe hidden works of God. The works of an infinite Creator are without number; knowledge, though ſo greatly increaſed of late, has by no means compleated the ſearch into the works of nature; freſh ſubjects of admiration and praiſe will ſtill appear, as long as God ſees fit to continue men upon earth, I nor can ſuppoſe that increaſe of knowledge will then ceaſe. The farther we ſearch into the works of God, the more inſtances of power,

wiſdom,

wiſdom, and goodneſs we continually meet with. *There are yet hid greater things than theſe be, for we have ſeen but a few of his works*, was a wiſe remark of the ſon of Syrach, when contemplating and praiſing God for his many and wonderful works; and the ſame acknowledgment we may ſtill make. For to begin near home, multitudes of things, both inanimate, plants, and animals familiar to us, were unknown in former times; and great proofs of wiſdom and goodneſs appear in their ſeveral properties, the plentiful proviſion made for the well-being and ſupport of all, and the fitneſs of every thing to its proper end, yet new diſcoveries are continually made. But how greatly does our proſpect enlarge, when we look on this world only as one ſmall part of the works of our Creator, and on every other planet and comet as a ſcene of as many and ſtill various wonders! nor can we regard the moſt diſtant bodies otherwiſe than as multiplied inſtances of the ſame power and wiſdom: how greatly then, conſidered in this light, do *the heavens declare the glory of God!*

> Theſe are thy glorious works, Parent of good
> Almighty; thine this univerſal frame
> Thus wondrous fair, thyſelf how wondrous then!
>
> MILTON.

To come then to the preſent point, *he hath made all things for their uſes:* comets, which are much more numerous than the planets, are doubtleſs deſigned for as wiſe ends, yet being ſo very different from them, both in appearance and motion, ſerve probably to quite different purpoſes; and poſſibly we who inhabit a planet, can have no more idea of the deſign of a comet, than one who never knew any thing of hearing could have of the uſe of an ear; he might juſtly conclude, that ſo artful a machine was not placed in the head for nothing, and ſo may we of comets, but the real intention we could in neither caſe find out. The appearance of a comet's tail is very ſurprizing, and various have been the gueſſes at the cauſe of it; Sir Iſaac Newton's I think as plauſible as any; yet it is much eaſier to make objections againſt any of the opinions, than to give a better.

I mean not hereby to diſcourage inquiry into the nature and uſes of comets; no, there is ſcarce any employment better becomes a creature, than ſearching into any of the works of the great Creator. Yet let us not ſtop at the diſcovery of the works, but be thereby led to acknowledge the workmaſter. *If we are aſtoniſhed at their power and virtue, let us underſtand how much mightier he is that made them.* If we obſerve the uniformity of that univerſal principle of gravity, let us conſider the infiniteneſs of that one God, who in ſo wonderful yet hidden a manner, reſtrains the amazing ſwiftneſs of ſuch vaſt bodies, by a power which yet does not hinder the leaſt creature of its proper motion. When we ſee that the ſame power which guides thoſe numberleſs, vaſt, and immenſely diſtant bodies, is yet

 not

not unmindful of the most minute, we must remember, that he who regards the good of the merely sensitive beings, will much more observe in every action, how we employ that reason he has entrusted us with: that nothing can be concealed from him who made all things; that one constantly employed in doing good cannot be pleased with trifling, nor the wise with folly; that the holy cannot but hate wickedness, the just abhor injustice, and the merciful detest cruelty; and that the all-powerful maker and ruler of the world, must needs in due time distinguish between *him that serveth God, and him that serveth him not:* and above all, that no swiftness can escape him, who threw the astonishingly swift planets and comets, and guides the still much more impetuous light; no distance avoid him, who is not confined to the entire solar system, nor to those multitudes of others, of which we can but just discover the central bright point; that no craft can deceive him from whom all the wisdom in the world is derived; and no power resist him, at whose rebuke the earth trembles, and the very foundations of the hills shake; nor can any greatness protect from him, who *made the small as well as the great, and careth for all alike*, and by whose stroke the greatest monarch is reduced to the same mouldering dust as the lowest of his subjects.

Again, if we admire the wisdom of God as shewn forth in his works, wonder at those inconceivably vast regions of light, the nebulous stars; the surprizing singularity of saturn's ring; and the entire diversity of the comets from the planets; whose uses are all too far beyond our ken to discover: and to come more within our own view, if we remark that wonderful instinct, by which *the swallow knoweth his appointed time*; the careful sorting of proper fruits and creatures, to all the so various climates on our own earth; and the no less surprizing diversity of inhabitants, allotted to such different mediums as air, water, earth, and still harder substances; and the connecting links as it were in the chain of beings, which are between plants and animals, air and water creatures, beasts and birds, *&c.* let none then pretend to be wiser than God, or above being taught by him; for as we cannot but know it is our interest to please him in whose power we entirely are, so it is as certain, that none knows his will so well as he does himself: nor can there well be a greater folly, than to prefer the uncertain deductions of frail, created reason, (which 4 or 5000 years experience shewed can never form a uniform system of morality; though it could not refuse its assent, when christianity had explained it;) to the clear discoveries, I do not say of unauthorized human glosses, but of the genuine revelations from perfect, self-existent wisdom. Two extreams are here to be avoided; either despising that noble faculty, and glory of man, *reason*, and refusing to see any thing, because we cannot see every thing; this is slighting the gift of God, hiding our talent in the earth, and tends to *enthusiasm:* or on the other hand so glorying in it, as to forget it is the gift of God, and preferring a candle to the light of the sun when

offered;

offered; this is despising God himself, refusing to submit to his governance, and tends to *atheism*. Lastly, if on a review of the whole we may justly say, *the works of the Lord are great, sought out of all them that have pleasure therein*; it will appear from contemplating them, that *there is one wise and greatly to be feared, the Lord sitting on his throne:* and as it is plain, that *the Lord is king, be the people never so impatient*, so it is as true, when we consider his extensive wisdom and goodness, that *the earth may be glad thereof.* When therefore, reflecting on the power, wisdom, and goodness of God, as shining forth in his mighty works, *you glorify the Lord, exalt him as much as you can, for even yet he will far exceed; and when you exalt him put forth all your strength, and be not weary, for you can never go far enough.*

TABLE

Time of Perihelion.		Perih. Dist.	Log. of it.	L.D.Mo.	Place of Perih.	Per.p.Nod.
1264	July 6d 8h ′ ″	44500	9.648360	0.487588	♑s 21° ′ ″	122° ′ ″
1337	June 2 6 25	40666	9.609236	0 546274	♊ 7 59 0	46 22 0
1472	Feb. 28 22 23	54273	9.734584	0.358252	♉ 15 33 30	236 12 50
1531	Aug. 24 21 18 30	56700	9.753583	0.329754	♒ 1 39 0	107 46 0
1532	Oct. 19 22 12	50910	9.706803	0.399924	♋ 21 7 0	30 40 0
1533	June 16 19 30 0	20280	9.307068	0.999526	♌ 27 16 0	338 28 0
1556	April 21 20 3	46390	9.666424	0.460492	♑ 8 50 0	103 8 0
1577	Oct. 26 18 45	18342	9.263447	1.064958	♌ 9 22 0	256 30 0
1580	Nov. 28 15 0	59628	9.775450	0.296953	♋ 19 5 50	90 8 30
1585	Sept. 27 19 20	1.09358	0.038850	9.901853	♈ 8 51 0	331 8 30
1590	Jan. 29 3 45	57661	9.760882	0.318805	♏ 6 54 30	308 36 10
1593	July 8 13 38	08911	8.949940	1.535218	♍ 26 19 0	12 4 45
1596	July 31 19 55	51293	9.710058	0.395041	♏ 18 16 0	83 56 30
1607	Oct. 16 3 50	58680	9.768490	0.307393	♒ 2 16 0	108 5 0
1618	Oct. 29 12 23	37975	9.579498	0.590881	♈ 2 14 0	286 13 0
1652	Nov. 2 15 40	84750	9.928140	0.067918	♈ 28 18 40	300 8 40
1661	Jan. 16 23 41	44851	9.651772	0.482470	♋ 25 58 40	33 28 10
1664	Nov 24 11 52	1.02575 ½	0.011044	9.943562	♌ 10 41 25	310 32 35
1665	April 14 5 15 30	10649	9.027309	1.419164	♊ 11 54 30	156 7 30
1672	Feb. 20 8 37	69739	9.843476	0 194914	♉ 16 59 30	109 29 0
1677	April 26 0 37 30	28059	9.448072	0.788020	♌ 17 37 5	99 12 5
1678	Aug. 16 14 3 0	1.23802	0.092727	9.821037	♒ 27 46 0	166 6 0
1680	Dec. 8 0 6	00612 ½	7.787106	3 279469	♐ 22 39 30	350 37 30
1682	Sept. 4 7 39	58328	9.765877	0.311312	♒ 2 52 45	108 23 45
1683	July 3 2 50	56020	9.748343	0.337614	♊ 25 29 30	87 53 30
1684	May 29 10 16	96015	9.982339	9.986620	♏ 28 52 0	330 37 0
1686	Sept. 6 14 33	32500	9.511883	0.692304	♊ 17 0 30	86 25 50
1698	Oct. 8 16 57	69129	9.839660	0.200638	♑ 0 51 15	356 53 0
1699	Jan. 3 8 22	74400	9.871570	0.152773	♏ 2 31 6	289 14 29
1702	Mar. 2 14 12	64590	9.810165	0.244881	♌ 18 41 3	309 15 48
1706	{ Jan. 19 4 22	42581	9.629218	0.516301	♊ 12 29 10	59 17 30
	19 4 56 0	42686 ½	9.630291	0.514692	12 36 25	59 25 2
1707	{ Nov. 30 23 29	85974	9.934368	0.058576	♊ 19 54 56	27 8 21
	30 23 43 6	85904	9.934013	0.059109	19 58 9	27 7 40
1718	{ Jan. 4 1 14 55	1.02565	0.010999	9.943629	♌ 1 26 36	6 28 50
	3 23 38	1.02655	0 011380	9.943058	1 30 0	7 13 0
	4 7 48	1.02743	0.011753	9.942499	1 3 40	7 17 20
1723	Sept. 16 16 10	99865	9.999414	9.961007	♉ 12 52 20	331 23 40
1729	{ June 14 10 56	4.26140	0.629552	9.015800	♒ 22 40 0	12 7 23
	12 6 35 41	4.06980	0.609573	9.045769	16 53	11 41 38
1737	Jan. 19 8 20	22282	9.347960	0.938188	♒ 25 55 0	99 33 0
1739	{ June 6 9 59	67358	9.828388	0.217546	♋ 12 38 40	104 46 34
	9 9 14	69614	9.842697	0.196083	5 11	110 7
1742	{ Jan. 28 4 38	76568	9.884049	0.134055	♏ 7 35 13	328 3 16
	28 4 20 50	76555 ½	9.883693	0.134589	7 33 44	328 1 1
	28 14 51	77005 ½	9.886523	0.130344	6 39 20	328 30 10
1742	{ Dec. 30 20 25	83501	9.921690	0.077593	♋ 2 41 45	14 20 30
	30 21 15 16	83811 ½	9.923304	0.075172	2 58 4	24 47 16
1743	Sept. 9 21 16 18	52157	9.717313	0.384159	♐ 6 33 52	118 42 33
1744	{ Feb. 19 8 12	22206	9.346472	0.940420	♎ 17 12 55	151 27 55
	19 8 3	22250	9.347325	0.939141	17 10 0	151 23 49
1747	{ Feb. 20 7 10	2.19851	0.342128	9.446936	♑ 7 2 0	230 16 50
	17 11 44 38	2.29388	0.360571	9.419272	10 5 41	226 52 46
1748	April 17 19 25	84066 ½	9.924624	0.073192	♏ 5 0 50	17 51 25
1748	June 7 1 24 15	65525 ½	9.816410	0.235513	♑ 6 9 24	241 29 41

Aſcending Node.				Inclination			Coſ. of it.	Sine of it.		Calculator.
♍s	19°	′	″	36°	30′	″	9.905179	9.774388	Direct	Dunthorne.
♊	24	21	0	32	11	0	9.927549	9.726426	Retrog.	Halley.
♑	11	46	20	5	20	0	9.998116	8.968249	Retrog.	Halley.
♉	19	25	0	17	56	0	9.978370	9.488424	Retrog.	Halley.
♊	20	27	0	32	36	0	9.925545	9.731404	Direct	Halley.
♌	5	44	0	35	49	0	9.908964	9.767300	Retrog.	Downes. (See p. 13.)
♍	25	42	0	32	6	30	9.927906	9.725521	Direct	Halley.
♈	25	52	0	74	32	45	9.425644	9.984007	Retrog.	Halley.
♈	18	57	20	64	40	0	9.631326	9.956089	Direct	Halley.
♉	7	42	30	6	4	0	9.997561	9.024016	Direct	Halley.
♍	15	30	40	29	40	40	9.938932	9.694712	Retrog.	Halley.
♍	14	14	15	87	58	0	8.549995	9.999726	Direct	C.
♒	12	12	30	55	12	0	9.756418	9.914422	Retrog.	Halley.
♉	20	21	0	17	2	0	9.980519	9.466761	Retrog.	Halley.
♊	16	1	0	37	34	0	9.899078	9.785105	Direct	Halley.
♊	28	10	0	79	28	0	9.261994	9.992619	Direct	Halley.
♊	22	30	30	32	35	50	9.925559	9.731371	Direct	Halley.
♊	21	14	0	21	18	30	9.969247	9.560369	Retrog.	Halley.
♏	18	2	0	76	5	0	9.381134	9.987061	Retrog.	Halley.
♑	27	30	30	83	22	10	9.062457	9.997085	Direct	Halley.
♏	26	49	10	79	3	15	9.278481	9.992026	Retrog.	Halley.
♍	11	40	0	3	4	20	9.999375	8.729122	Direct	Downes.
♑	2	2	0	60	56	0	9.686482	9.941539	Direct	Halley.
♉	21	16	30	17	56	0	9.978370	9.488424	Retrog.	Halley.
♍	23	23	0	83	11	0	9.074424	9.996919	Retrog.	Halley.
♐	28	15	0	65	48	40	9.612515	9.960090	Direct	Halley.
♓	20	34	40	31	21	40	9.931409	9.716363	Direct	Halley.
♐	27	44	15	11	46	0	9.990777	9.309474	Retrog.	Halley.
♌	21	45	35	69	20	0	9.547689	9.971113	Retrog.	Caille. (See p. 13.)
♎	9	25	15	4	30	0	9.998659	8.894643	Direct	Caille.
♈	13	11	40	55	14	10	9.756024	9.914612	Direct	C.
	13	11	23	55	14	5	9.756039	9.914605		Struijck.
♉	22	46	35	88	36	0	8.387962	9.999870	Direct	C.
	22	50	29	88	37	40	8.379260	9.999875		Struijck.
♌	7	55	20	31	12	53	9.932083	9.714536		Downes.
	8	43	0	30	20	0	9.936062	9.703317	Retrog.	C. (See p 13.)
	8	21	0	30	48	30	9.933940	9.709398		Whiſton.
♈	14	16	0	49	59	0	9.808218	9.884148	Retrog.	Bradley.
♒	10	32	37	76	58	4	9.353126	9.988667	Direct	C.
	10	35	15	77	1	58	9.351010	9.988781		Downes.
♏	16	22	0	18	20	45	9.977346	9.497968	Direct	Bradley.
♎	27	25	14	55	42	44	9.750778	9.917095	Retrog.	Caille.
	25	18		53	25		9.775240	9.904711		Zanotti. (See p. 13.)
♎	5	38	29	66	59	14	9.592106	9.963985		C.
	5	34	45	67	4	11	9.590631	9.964250	Retrog.	Struijck.
	5	9	30	67	31	40	9.582340	9.965701		Barker. (See p. 13.)
♊	18	21	15	2	19	33	9.999642	8.608337	Direct	C.
	8	10	48	2	15	50	9.999661	8.596619		Struijck.
♈	5	16	25	45	48	21	9.843290	9.855508	Retrog.	Klinkenberg.
♉	15	45	20	47	8	36	9.832616	9.865138	Direct	Betts.
	15	46	11	47	5	18	9.833064	9.864751		C.
♌	27	18	50	79	6	20	9.276462	9.992101	Retrog.	C.
	26	58	27	77	56	55	9.319707	9.990321		Chezeaux.
♏	22	52	15	85	27	0	8.899432	9.998629	Retrog.	Maraldi.
♉	4	39	43	56	59	3	9.736293	9.923513	Direct	Struijck.

TABLE II. *A general Table of the Parabola.*

Angle from Perihelion.	Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.	Mean Mot.	Diff.	Log. Dist.	Diff.
° ′					° ′				
0 5	0.0545	—545	0.000000	— 0	4 35	3.0030	—547	0.000695	—25
10	0.1091	546	0.000001	1	40	3.0577	547	0.000720	25
15	0.1636	545	0.000002	1	45	3.1124	547	0.000746	26
20	0.2182	546	0.000004	2	50	3.1672	548	0.000773	27
25	0.2727	545	0.000006	2	55	3.2219	547	0.000800	27
30	0.3272	545	0.000008	2	5 0	3.2766	547	0.000827	27
35	0.3818	—546	0.000011	— 3	5	3.3314	—548	0.000855	—28
40	0.4363	545	0.000015	4	10	3.3862	548	0.000883	28
45	0.4909	546	0.000019	4	15	3.4409	547	0.000912	29
50	0.5454	545	0.000023	4	20	3.4957	548	0.000941	29
55	0.6000	546	0.000028	5	25	3.5505	548	0.000971	30
1 0	0.6545	545	0.000033	5	30	3.6053	548	0.001001	30
5	0.7091	—546	0.000039	— 6	35	3.6601	—548	0.001031	—30
10	0.7636	545	0.000045	6	40	3.7149	548	0.001062	31
15	0.8182	546	0.000052	7	45	3.7697	548	0.001094	32
20	0.8727	545	0.000059	7	50	3.8245	548	0.001126	32
25	0.9273	546	0.000066	7	55	3.8793	548	0.001158	32
30	0.9819	546	0.000074	8	6 0	3.9342	549	0.001191	33
35	1.0364	—545	0.000083	— 9	5	3.9890	—548	0.001224	—33
40	1.0910	546	0.000092	9	10	4.0439	549	0.001258	34
45	1.1456	546	0.000101	9	15	4.0988	549	0.001293	35
50	1.2001	545	0.000111	10	20	4.1536	548	0.001327	34
55	1.2547	546	0.000121	10	25	4.2085	549	0.001362	35
2 0	1.3093	546	0.000132	11	30	4.2634	549	0.001398	36
5	1.3638	—545	0.000144	—12	35	4.3183	—549	0.001434	—36
10	1.4184	546	0.000155	11	40	4.3732	549	0.001471	37
15	1.4730	546	0.000167	12	45	4.4281	549	0.001508	37
20	1.5276	546	0.000180	13	50	4.4830	549	0.001545	37
25	1.5822	546	0.000193	13	55	4.5380	550	0.001583	38
30	1.6368	546	0.000207	14	7 0	4.5929	549	0.001622	39
35	1.6914	—546	0.000221	—14	5	4.6479	—550	0.001661	—39
40	1.7460	546	0.000235	14	10	4.7028	549	0.001700	39
45	1.8006	546	0.000250	15	15	4.7578	550	0.001740	40
50	1.8552	546	0.000266	16	20	4.8128	550	0.001780	40
55	1.9098	546	0.000281	15	25	4.8678	550	0.001821	41
3 0	1.9644	546	0.000298	17	30	4.9228	550	0.001862	41
5	2.0190	—546	0.000314	—16	35	4.9778	—550	0.001903	—41
10	2.0736	546	0.000332	18	40	5.0328	550	0.001945	42
15	2.1283	547	0.000349	17	45	5.0879	551	0.001988	43
20	2.1829	546	0.000368	19	50	5.1429	550	0.002031	43
25	2.2375	546	0.000386	18	55	5.1980	551	0.002074	43
30	2.2922	547	0.000405	19	8 0	5.2531	551	0.002118	44
35	2.3468	—546	0.000425	—20	5	5.3081	—550	0.002163	—45
40	2.4015	547	0.000445	20	10	5.3632	551	0.002208	45
45	2.4561	546	0.000465	20	15	5.4183	551	0.002253	45
50	2.5108	547	0.000486	21	20	5.4734	551	0.002299	46
55	2.5654	546	0.000507	21	25	5.5286	552	0.002345	46
4 0	2.6201	547	0.000529	22	30	5.5837	551	0.002392	47
5	2.6748	—547	0.000552	—23	35	5.6389	—552	0.002439	—47
10	2.7295	547	0.000574	22	40	5.6940	551	0.002487	48
15	2.7842	547	0.000597	23	45	5.7492	552	0.002535	48
20	2.8389	547	0.000621	24	50	5.8044	552	0.002583	48
25	2.8936	547	0.000645	24	55	5.8596	552	0.002632	49
30	2.9483	547	0.000670	25	9 0	5.9148	552	0.002682	50
		—547		—25			—552		—50

Angle.	Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.	Mean Mot.	Diff.	Log. Dist.	Diff.
° ′					° ′				
9 5	5.9700	—552	0.002732	—50	13 35	8.9744	—561	0.006117	—75
10	6.0253	553	0.002782	50	40	9.0305	561	0.006192	75
15	6.0805	552	0.002833	51	45	9.0866	561	0.006268	76
20	6.1358	553	0.002884	51	50	9.1428	562	0.006344	76
25	6.1911	553	0.002936	52	55	9.1989	561	0.006421	77
30	6.2464	553	0.002988	52	14 0	9.2551	562	0.006498	77
35	6.3017	—553	0.003041	—53	5	9.3113	—562	0.006576	—78
40	6.3570	553	0.003094	53	10	9.3676	563	0.006655	79
45	6.4123	553	0.003148	54	15	9.4238	562	0.006733	78
50	6.4677	554	0.003202	54	20	9.4801	563	0.006813	80
55	6.5230	553	0.003257	55	25	9.5364	563	0.006892	79
10 0	6.5784	554	0.003312	55	30	9.5927	563	0.006972	80
5	6.6338	—554	0.003367	—55	35	9.6490	—563	0.007053	—81
10	6.6892	554	0.003423	56	40	9.7054	564	0.007134	81
15	6.7446	554	0.003479	56	45	9.7617	563	0.007216	82
20	6.8000	554	0.003536	57	50	9.8181	564	0.007298	82
25	6.8555	555	0.003594	58	55	9.8745	564	0.007380	82
30	6.9109	554	0.003652	58	15 0	9.9310	565	0.007463	83
35	6.9664	—555	0.003710	—58	5	9.9874	—564	0.007546	—83
40	7.0219	555	0.003769	59	10	10.0439	565	0.007630	84
45	7.0774	555	0.003828	59	15	10.1004	565	0.007714	84
50	7.1329	555	0.003887	59	20	10.1569	565	0.007799	85
55	7.1885	556	0.003947	60	25	10.2135	566	0.007884	85
11 0	7.2440	555	0.004008	61	30	10.2701	566	0.007970	86
5	7.2996	—556	0.004069	—61	35	10.3267	—566	0.008056	—86
10	7.3551	555	0.004131	62	40	10.3833	566	0.008143	87
15	7.4107	556	0.004193	62	45	10.4399	566	0.008230	87
20	7.4663	556	0.004255	62	50	10.4966	567	0.008318	88
25	7.5220	557	0.004318	63	55	10.5533	567	0.008406	88
30	7.5776	556	0.004381	63	16 0	10.6100	567	0.008494	88
35	7.6333	—557	0.004445	—64	5	10.6667	—567	0.008583	—89
40	7.6890	557	0.004509	64	10	10.7234	567	0.008673	90
45	7.7447	557	0.004574	65	15	10.7802	568	0.008763	90
50	7.8004	557	0.004639	65	20	10.8370	568	0.008853	90
55	7.8561	557	0.004705	66	25	10.8938	568	0.008944	91
12 0	7.9118	557	0.004771	66	30	10.9507	569	0.009036	92
5	7.9676	—558	0.004838	—67	35	11.0076	—569	0.009127	—91
10	8.0234	558	0.004905	67	40	11.0645	569	0.009220	93
15	8.0792	558	0.004973	68	45	11.1214	569	0.009312	92
20	8.1350	558	0.005041	68	50	11.1783	569	0.009406	94
25	8.1908	558	0.005109	68	55	11.2353	570	0.009499	93
30	8.2467	559	0.005178	69	17 0	11.2923	570	0.009593	94
35	8.3025	—558	0.005247	—69	5	11.3493	—570	0.009688	—95
40	8.3584	559	0.005317	70	10	11.4063	570	0.009783	95
45	8.4143	559	0.005388	71	15	11.4634	571	0.009879	96
50	8.4702	559	0.005458	70	20	11.5205	571	0.009975	96
55	8.5262	560	0.005530	72	25	11.5776	571	0.010071	96
13 0	8.5822	560	0.005602	72	30	11.6348	572	0.010168	97
5	8.6381	—559	0.005674	—72	35	11.6919	—571	0.010266	—98
10	8.6941	560	0.005746	72	40	11.7491	572	0.010364	98
15	8.7501	560	0.005819	73	45	11.8063	572	0.010462	98
20	8.8062	561	0.005893	74	50	11.8636	573	0.010561	99
25	8.8622	560	0.005967	74	55	11.9209	573	0.010660	99
30	8.9183	561	0.006042	75	18 0	11.9782	573	0.010760	100
		—561		—75			—573		—100

Angle	Mean Mot.	Diff.	Log. Dift.	Diff.
° ′				
18 5	12.0355	—573	0.010860	—100
10	12.0928	573	0.010961	101
15	12.1502	574	0.011062	101
20	12.2076	574	0.011164	102
25	12.2650	574	0.011266	102
30	12.3225	575	0.011369	103
35	12.3800	—575	0.011472	—103
40	12.4375	575	0.011576	104
45	12.4951	576	0.011680	104
50	12.5526	575	0.011784	104
55	12.6102	576	0.011889	105
19 0	12.6679	577	0.011995	106
5	12.7255	—576	0.012101	—106
10	12.7832	577	0.012207	106
15	12.8409	577	0.012314	107
20	12.8986	577	0.012421	107
25	12.9564	578	0.012529	108
30	13.0142	578	0.012637	108
35	13.0720	—578	0.012746	—109
40	13.1299	579	0.012855	109
45	13.1878	579	0.012965	110
50	13.2457	579	0.013075	110
55	13.3036	579	0.013186	111
20 0	13.3616	580	0.013297	111
5	13.4196	—580	0.013409	—112
10	13.4776	580	0.013521	112
15	13.5357	581	0.013633	112
20	13.5938	581	0.013746	113
25	13.6519	581	0.013860	114
30	13.7100	581	0.013974	114
35	13.7682	—582	0.014088	—114
40	13.8264	582	0.014203	115
45	13.8847	583	0.014319	116
50	13.9430	583	0.014435	116
55	14.0013	583	0.014551	116
21 0	14.0596	583	0.014668	117
5	14.1180	—584	0.014785	—117
10	14.1764	584	0.014903	118
15	14.2348	584	0.015021	118
20	14.2933	585	0.015140	119
25	14.3518	585	0.015259	119
30	14.4103	585	0.015379	120
35	14.4688	—585	0.015499	—120
40	14.5274	586	0.015620	121
45	14.5861	587	0.015741	121
50	14.6447	586	0.015862	121
55	14.7034	587	0.015984	122
22 0	14.7621	587	0.016107	123
5	14.8209	—588	0.016230	—123
10	14.8797	588	0.016353	123
15	14.9385	588	0.016477	124
20	14.9974	589	0,016602	125
25	15.0563	589	0.016727	125
30	15.1152	589	0.016852	125
		—589		—126

Angle.	Mean Mot.	Diff.	Log. Dift.	Diff.
° ′				
22 35	15.1741	—589	0.016978	—126
40	15.2331	590	0.017104	126
45	15.2922	591	0.017231	127
50	15.3512	590	0.017359	128
55	15.4103	591	0.017486	127
23 0	15.4695	592	0.017615	129
5	15.5286	—591	0.017743	—128
10	15.5878	592	0.017873	130
15	15.6471	593	0.018002	129
20	15.7063	592	0.018132	130
25	15.7657	594	0.018263	131
30	15.8250	593	0.018394	131
35	15.8844	—594	0.018526	—132
40	15.9438	594	0.018658	132
45	16.0032	594	0.018791	133
50	16.0627	595	0.018924	133
55	16.1223	596	0.019057	133
24 0	16.1818	595	0.019191	134
5	16.2414	—596	0.019326	—135
10	16.3011	597	0.019461	135
15	16.3607	596	0.019596	135
20	16.4204	597	0.019732	136
25	16.4802	598	0.019869	137
30	16.5400	598	0.020005	136
35	16.5998	—598	0.020143	—138
40	16.6597	599	0.020281	138
45	16.7196	599	0.020419	138
50	16.7795	599	0.020558	139
55	16.8395	600	0.020697	139
25 0	16.8995	600	0.020837	140
5	16.9596	—601	0.020977	—140
10	17.0196	600	0.021118	141
15	17.0798	602	0.021259	141
20	17.1400	602	0.021401	142
25	17.2002	602	0.021543	142
30	17.2604	602	0.021686	143
35	17.3207	—603	0.021829	—143
40	17.3810	603	0.021973	144
45	17.4414	604	0.022117	144
50	17.5018	604	0.022261	144
55	17.5623	605	0.022407	146
26 0	17.6228	605	0.022552	145
5	17.6833	—605	0.022698	—146
10	17.7439	606	0.022845	147
15	17.8045	606	0.022992	147
20	17.8651	606	0.023139	147
25	17.9258	607	0.023287	148
30	17.9865	607	0.023436	149
35	18.0473	—608	0.023585	—149
40	18.1081	608	0.023734	149
45	18.1690	609	0.023884	150
50	18.2299	609	0.024035	151
55	18.2909	610	0.024186	151
27 0	18.3519	610	0.024337	151
		—610		—152

Angle.		Mean Mot.	Diff.	Log. Dist.	Diff.
°	′				
27	5	18.4129	—610	0.024489	—152
	10	18.4740	611	0.024641	152
	15	18.5351	611	0.024794	153
	20	18.5962	611	0.024947	153
	25	18.6574	612	0.025101	154
	30	18.7187	613	0.025256	155
	35	18.7800	—613	0.025410	—154
	40	18.8413	613	0.025566	156
	45	18.9027	614	0.025722	156
	50	18.9641	614	0.025878	156
	55	19.0256	615	0.026035	157
28	0	19.0871	615	0.026192	157
	5	19.1486	—615	0.026350	—158
	10	19.2102	616	0.026508	158
	15	19.2719	617	0.026666	158
	20	19.3336	617	0.026826	160
	25	19.3953	617	0.026985	159
	30	19.4571	618	0.027145	160
	35	19.5189	—618	0.027306	—161
	40	19.5808	619	0.027467	161
	45	19.6427	619	0.027629	162
	50	19.7047	620	0.027791	162
	55	19.7667	620	0.027954	163
29	0	19.8288	621	0.028117	163
	5	19.8909	—621	0.028280	—163
	10	19.9530	621	0.028444	164
	15	20.0152	622	0.028609	165
	20	20.0774	622	0.028774	165
	25	20.1397	623	0.028940	166
	30	20.2021	624	0.029106	166
	35	20.2645	—624	0.029272	—166
	40	20.3269	624	0.029439	167
	45	20.3894	625	0.029607	168
	50	20.4519	625	0.029775	168
	55	20.5145	626	0.029943	168
30	0	20.5771	626	0.030112	169
	5	20.6398	—627	0.030282	—170
	10	20.7025	627	0.030452	170
	15	20.7653	628	0.030622	170
	20	20.8281	628	0.030793	171
	25	20.8910	629	0.030965	172
	30	20.9539	629	0.031137	172
	35	21.0169	—630	0.031309	—172
	40	21.0799	630	0.031482	173
	45	21.1430	631	0.031656	174
	50	21.2061	631	0.031830	174
	55	21.2693	632	0.032004	174
31	0	21.3326	633	0.032179	175
	5	21.3958	—632	0.032354	—175
	10	21.4592	634	0.032530	176
	15	21.5226	634	0.032707	177
	20	21.5860	634	0.032884	177
	25	21.6495	635	0.033061	177
	30	21.7130	635	0.033239	178
			—636		—178

Angle.		Mean Mot.	Diff.	Log. Dist.	Diff.
°	′				
31	35	21.7766	—636	0.033417	—178
	40	21.8402	636	0.033596	179
	45	21.9039	637	0.033776	180
	50	21.9677	638	0.033955	179
	55	22.0315	638	0.034136	181
32	0	22.0953	638	0.034317	181
	5	22.1592	—639	0.034498	—181
	10	22.2232	640	0.034680	182
	15	22.2872	640	0.034862	182
	20	22.3513	641	0.035045	183
	25	22.4154	641	0.035229	184
	30	22.4796	642	0.035412	183
	35	22.5438	—642	0.035597	—185
	40	22.6081	643	0.035782	185
	45	22.6724	643	0.035967	185
	50	22.7368	644	0.036153	186
	55	22.8013	645	0.036339	186
33	0	22.8658	645	0.036526	187
	5	22.9303	—645	0.036713	—187
	10	22.9949	646	0.036901	188
	15	23.0596	647	0.037090	189
	20	23.1243	647	0.037278	188
	25	23.1891	648	0.037468	190
	30	23.2540	649	0.037658	190
	35	23.3189	—649	0.037848	—190
	40	23.3838	649	0.038039	191
	45	23.4488	650	0.038230	191
	50	23.5139	651	0.038422	192
	55	23.5790	651	0.038615	193
34	0	23.6442	652	0.038807	192
	5	23.7095	—653	0.039001	—194
	10	23.7748	653	0.039195	194
	15	23.8401	653	0.039389	194
	20	23.9055	654	0.039584	195
	25	23.9710	655	0.039779	195
	30	24.0366	656	0.039975	196
	35	24.1022	—656	0.040172	—197
	40	24.1678	656	0.040368	196
	45	24.2335	657	0.040566	198
	50	24.2993	658	0.040764	198
	55	24.3651	658	0.040962	198
35	0	24.4310	659	0.041161	199
	5	24.4970	—660	0.041360	—199
	10	24.5630	660	0.041560	200
	15	24.6291	661	0.041761	201
	20	24.6952	661	0.041962	201
	25	24.7614	662	0.042163	201
	30	24.8277	663	0.042365	202
	35	24.8940	—663	0.042567	—202
	40	24.9604	664	0.042770	203
	45	25.0268	664	0.042974	204
	50	25.0933	665	0.043178	204
	55	25.1599	666	0.043382	204
36	0	25.2265	666	0.043587	205
			—667		—206

Angle.	Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.	Mean Mot.	Diff.	Log. Dist.	Diff.
° ′					° ′				
36 5	25.2932	—667	0.043793	—206	40 35	28.9946	—704	0.055650	—233
10	25.3600	668	0.043999	206	40	29.0652	706	0.055884	234
15	25.4268	668	0.044205	206	45	29.1358	706	0.056119	235
20	25.4937	669	0.044412	207	50	29.2064	706	0.056353	234
25	25.5607	670	0.044620	208	55	29.2772	708	0.056589	236
30	25.6277	670	0.044828	208	41 0	29.3480	708	0.056825	236
35	25.6948	—671	0.045037	—209	5	29.4189	—709	0.057061	—236
40	25.7619	671	0.045246	209	10	29.4899	710	0.057298	237
45	25.8291	672	0.045455	209	15	29.5609	710	0.057536	238
50	25.8964	673	0.045665	210	20	29.6320	711	0.057774	238
55	25.9637	673	0.045876	211	25	29.7032	712	0.058012	238
37 0	26.0311	674	0.046087	211	30	29.7745	713	0.058251	239
5	26.0986	—675	0.046298	—211	35	29.8459	—714	0.058491	—240
10	26.1661	675	0.046511	213	40	29.9173	714	0.058731	240
15	26.2337	676	0.046723	212	45	29.9888	715	0.058971	240
20	26.3014	677	0.046936	213	50	30.0604	716	0.059213	242
25	26.3691	677	0.047150	214	55	30.1321	717	0.059454	241
30	26.4369	678	0.047364	214	42 0	30.2039	718	0.059697	243
35	26.5048	—679	0.047579	—215	5	30.2757	—718	0.059939	—242
40	26.5727	679	0.047794	215	10	30.3476	719	0.060183	244
45	26.6407	680	0.048010	216	15	30.4196	720	0.060426	243
50	26.7088	681	0.048226	216	20	30.4917	721	0.060671	245
55	26.7770	682	0.048443	217	25	30.5639	722	0.060915	244
38 0	26.8452	682	0.048660	217	30	30.6361	722	0.061161	246
5	26.9134	—682	0.048878	—218	35	30.7085	—724	0.061407	—246
10	26.9818	684	0.049096	218	40	30.7809	724	0.061653	246
15	27.0502	684	0.049315	219	45	30.8534	725	0.061900	247
20	27.1187	685	0.049534	219	50	30.9259	725	0.062148	248
25	27.1872	685	0.049754	220	55	30.9986	727	0.062396	248
30	27.2559	687	0.049974	220	43 0	31.0713	727	0.062644	248
35	27.3246	—687	0.050195	—221	5	31.1441	—728	0.062893	—249
40	27.3933	687	0.050416	221	10	31.2170	729	0.063143	250
45	27.4621	688	0.050638	222	15	31.2900	730	0.063393	250
50	27.5310	689	0.050861	223	20	31.3631	731	0.063644	251
55	27.6000	690	0.051083	222	25	31.4363	732	0.063895	251
39 0	27.6691	691	0.051307	224	30	31.5095	732	0.064147	252
5	27.7382	—691	0.051531	—224	35	31.5829	—734	0.064399	—252
10	27.8074	692	0.051755	224	40	31.6563	734	0.064652	253
15	27.8766	692	0.051980	225	45	31.7298	735	0.064905	253
20	27.9459	693	0.052206	226	50	31.8033	735	0.065159	254
25	28.0153	694	0.052432	226	55	31.8770	737	0.065413	254
30	28.0848	695	0.052658	226	44 0	31.9508	738	0.065668	255
35	28.1544	—696	0.052885	—227	5	32.0246	—738	0.065924	—256
40	28.2240	696	0.053113	228	10	32.0986	740	0.066180	256
45	28.2937	697	0.053341	228	15	32.1726	740	0.066436	256
50	28.3634	697	0.053570	229	20	32.2467	741	0.066693	257
55	28.4333	699	0.053799	229	25	32.3209	742	0.066951	258
40 0	28.5032	699	0.054028	229	30	32.3952	743	0.067209	258
5	28.5732	—700	0.054259	—231	35	32.4695	—743	0.067468	—259
10	28.6432	700	0.054489	230	40	32.5440	745	0.067727	259
15	28.7134	702	0.054720	231	45	32.6185	745	0.067987	260
20	28.7836	702	0.054952	232	50	32.6932	747	0.068247	260
25	28.8539	703	0.055184	232	55	32.7679	747	0.068508	261
30	28.9242	703	0.055417	233	45 0	32.8427	748	0.068769	261
		—704		—233			—749		—262

N. B. Here the second column begins to be the Logarithm of the Mean Motion.

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
45	5	1.517428	—989	0.069031	—262	49	35	1.569434	—940	0.083983	—292
	10	1.518417	989	0.069294	263		40	1.570373	939	0.084275	292
	15	1.519404	987	0.069557	263		45	1.571312	939	0.084567	292
	20	1.520390	986	0.069820	263		50	1.572250	938	0.084861	294
	25	1.521376	986	0.070084	264		55	1.573187	937	0.085154	293
	30	1.522360	984	0.070349	265	50	0	1.574123	936	0.085449	295
	35	1.523343	—983	0.070614	—265		5	1.575059	—936	0.085743	—294
	40	1.524325	982	0.070880	266		10	1.575994	935	0.086039	296
	45	1.525306	981	0.071146	266		15	1.576928	934	0.086335	296
	50	1.526286	980	0.071413	267		20	1.577862	934	0.086631	296
	55	1.527265	979	0.071680	267		25	1.578794	932	0.086928	297
46	0	1.528243	978	0.071948	268		30	1.579726	932	0.087226	298
	5	1.529221	—978	0.072216	—268		35	1.580658	—932	0.087524	—298
	10	1.530197	976	0.072485	269		40	1.581588	930	0.087823	299
	15	1.531172	975	0.072755	270		45	1.582518	930	0.088122	299
	20	1.532146	974	0.073025	270		50	1.583447	929	0.088422	300
	25	1.533119	973	0.073295	270		55	1.584375	928	0.088723	301
	30	1.534091	972	0.073566	271	51	0	1.585303	928	0.089024	301
	35	1.535063	—972	0.073838	—272		5	1.586230	—927	0.089325	—301
	40	1.536033	970	0.074110	272		10	1.587156	926	0.089627	302
	45	1.537002	969	0.074383	273		15	1.588082	926	0.089930	303
	50	1.537971	969	0.074656	273		20	1.589007	925	0.090233	303
	55	1.538938	967	0.074930	274		25	1.589931	924	0.090537	304
47	0	1.539905	967	0.075204	274		30	1.590855	924	0.090841	304
	5	1.540870	—965	0.075479	—275		35	1.591778	—923	0.091146	—305
	10	1.541835	965	0.075755	276		40	1.592700	922	0.091452	306
	15	1.542799	964	0.076031	276		45	1.593622	922	0.091758	306
	20	1.543762	963	0.076307	276		50	1.594543	921	0.092065	307
	25	1.544724	962	0.076585	278		55	1.595463	920	0.092372	307
	30	1.545685	961	0.076862	277	52	0	1.596383	920	0.092680	308
	35	1.546645	—960	0.077140	—278		5	1.597302	—919	0.092988	—308
	40	1.547604	959	0.077419	279		10	1.598220	918	0.093297	309
	45	1.548563	959	0.077698	279		15	1.599138	918	0.093606	309
	50	1.549520	957	0.077978	280		20	1.600055	917	0.093916	310
	55	1.550477	957	0.078259	281		25	1.600972	917	0.094227	311
48	0	1.551433	956	0.078540	281		30	1.601888	916	0.094538	311
	5	1.552388	—955	0.078821	—281		35	1.602803	—915	0.094850	—312
	10	1.553342	954	0.079103	282		40	1.603718	915	0.095162	312
	15	1.554295	953	0.079386	283		45	1.604632	914	0.095475	313
	20	1.555247	952	0.079669	283		50	1.605545	913	0.095789	314
	25	1.556199	952	0.079953	284		55	1.606458	913	0.096103	314
	30	1.557149	950	0.080237	284	53	0	1.607370	912	0.096418	315
	35	1.558099	—950	0.080522	—285		5	1.608282	—912	0.096733	—315
	40	1.559048	949	0.080807	285		10	1.609193	911	0.097049	316
	45	1.559996	948	0.081093	286		15	1.610104	911	0.097365	316
	50	1.560944	948	0.081380	287		20	1.611014	910	0.097682	317
	55	1.561890	946	0.081667	287		25	1.611923	909	0.098000	318
49	0	1.562836	946	0.081954	287		30	1.612832	909	0.098318	318
	5	1.563781	—945	0.082242	—288		35	1.613740	—908	0.098636	—318
	10	1.564725	944	0.082531	289		40	1.614647	907	0.098955	319
	15	1.565668	943	0.082820	289		45	1.615554	907	0.099275	320
	20	1.566611	943	0.083110	290		50	1.616461	907	0.099596	321
	25	1.567553	942	0.083400	290		55	1.617367	906	0.099917	321
	30	1.568494	941	0.083691	291	54	0	1.618272	905	0.100238	321
			—940		—292				—905		—322

Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dift.	Diff.	Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dift.	Diff.
54 5	1.619177	—905	0.100560	—322	58 35	1.667334	—881	0.118827	—354
10	1.620081	904	0.100883	323	40	1.668214	880	0.119182	355
15	1.620985	904	0.101206	323	45	1.669095	881	0.119537	355
20	1.621888	903	0.101530	324	50	1.669975	880	0.119893	356
25	1.622791	903	0.101855	325	55	1.670854	879	0.120249	356
30	1.623694	903	0.102180	325	59 0	1.671733	879	0.120606	357
35	1.624595	—901	0.102505	—325	5	1.672612	—879	0.120964	—358
40	1.625496	901	0.102832	327	10	1.673490	878	0.121322	358
45	1.626397	901	0.103158	326	15	1.674369	879	0.121681	359
50	1.627297	900	0.103486	328	20	1.675247	878	0.122041	360
55	1.628197	900	0.103814	328	25	1.676124	877	0.122401	360
55 0	1.629096	899	0.104142	328	30	1.677001	877	0.122762	361
5	1.629995	—899	0.104471	—329	35	1.677878	—877	0.123123	—361
10	1.630893	898	0.104801	330	40	1.678755	877	0.123485	362
15	1.631790	897	0.105131	330	45	1.679631	876	0.123847	362
20	1.632688	898	0.105462	331	50	1.680507	876	0.124211	364
25	1.633584	896	0.105794	332	55	1.681383	876	0.124574	363
30	1.63448	896	0.106126	332	60 0	1.682258	875	0.124939	365
35	1.635376	—896	0.106458	—332	5	1.683133	—875	0.125304	—365
40	1.636271	895	0.106791	333	10	1.684008	875	0.125669	365
45	1.637166	895	0.107125	334	15	1.684883	875	0.126036	367
50	1.638060	894	0.107460	335	20	1.685757	874	0.126402	366
55	1.638954	894	0.107795	335	25	1.686631	874	0.126770	368
56 0	1.639848	894	0.108130	335	30	1.687504	873	0.127138	368
5	1.640740	—892	0.108466	—336	35	1.688378	—874	0.127507	—369
10	1.641633	893	0.108803	337	40	1.689251	873	0.127876	369
15	1.642525	892	0.109140	337	45	1.690124	873	0.128246	370
20	1.643417	892	0.109478	338	50	1.690997	873	0.128616	370
25	1.644308	891	0.109817	339	55	1.691869	872	0.128987	371
30	1.645199	891	0.110156	339	61 0	1.692741	872	0.129359	372
35	1.646089	—890	0.110496	—340	5	1.693613	—872	0.129732	—373
40	1.646978	889	0.110836	340	10	1.694484	871	0.130105	373
45	1.647868	890	0.111177	341	15	1.695355	871	0.130478	373
50	1.648757	889	0.111518	341	20	1.696226	871	0.130852	374
55	1.649645	888	0.111860	342	25	1.697097	871	0.131227	375
57 0	1.650534	889	0.112203	343	30	1.697968	871	0.131603	376
5	1.651421	—887	0.112546	—343	35	1.698838	—870	0.131979	—376
10	1.652309	888	0.112890	344	40	1.699708	870	0.132356	377
15	1.653196	887	0.113235	345	45	1.700578	870	0.132733	377
20	1.654082	886	0.113580	345	50	1.701448	870	0.133111	378
25	1.654968	886	0.113925	345	55	1.702317	869	0.133490	379
30	1.655854	886	0.114271	346	62 0	1.703186	869	0.133869	379
35	1.656739	—885	0.114618	—347	5	1.704055	—869	0.134249	—380
40	1.657624	885	0.114966	348	10	1.704924	869	0.134629	380
45	1.658509	885	0.115314	348	15	1.705793	869	0.135010	381
50	1.659393	884	0.115662	348	20	1.706661	868	0.135392	382
55	1.660277	884	0.116012	350	25	1.707529	868	0.135774	382
58 0	1.661160	883	0.116362	350	30	1.708397	868	0.136157	383
5	1.662043	—883	0.116712	—350	35	1.709265	—868	0.136541	—384
10	1.662926	883	0.117063	351	40	1.710133	868	0.136925	384
15	1.663808	882	0.117415	352	45	1.711000	867	0.137310	385
20	1.664690	882	0.117767	352	50	1.711867	867	0.137696	386
25	1.665572	882	0.118120	353	55	1.712734	867	0.138082	386
30	1.666453	881	0.118473	353	63 0	1.713601	867	0.138468	386
		—881		—354			—866		—388

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
63	5	1.714467	—866	0.138856	—388
	10	1.715334	867	0.139244	388
	15	1.716200	866	0.139633	389
	20	1.717066	866	0.140022	389
	25	1.717932	866	0.140412	390
	30	1.718797	865	0.140802	390
	35	1.719663	—866	0.141193	—391
	40	1.720528	865	0.141585	392
	45	1.721393	865	0.141978	393
	50	1.722258	865	0.142371	393
	55	1.723123	865	0.142765	394
64	0	1.723988	865	0.143159	394
	5	1.724853	—865	0.143554	—395
	10	1.725717	864	0.143950	396
	15	1.726681	864	0.144346	396
	20	1.727446	865	0.144743	397
	25	1.728310	864	0.145141	398
	30	1.729173	863	0.145539	398
	35	1.730037	—864	0.145938	—399
	40	1.730901	864	0.146337	399
	45	1.731764	863	0.146737	400
	50	1.732628	864	0.147138	401
	55	1.733491	863	0.147540	402
65	0	1.734354	863	0.147942	402
	5	1.735217	—863	0.148344	—402
	10	1.736080	863	0.148748	404
	15	1.736943	863	0.149152	404
	20	1.737805	862	0.149556	404
	25	1.738668	863	0.149962	406
	30	1.739530	862	0.150368	406
	35	1.740393	—863	0.150774	—406
	40	1.741255	862	0.151182	408
	45	1.742117	862	0.151590	408
	50	1.742979	862	0.151998	408
	55	1.743841	862	0.152407	409
66	0	1.744703	862	0.152817	410
	5	1.745565	—862	0.153228	—411
	10	1.746427	862	0.153639	411
	15	1.747288	861	0.154051	412
	20	1.748150	862	0.154463	412
	25	1.749012	862	0.154876	413
	30	1.749873	861	0.155290	414
	35	1.750734	—861	0.155705	—415
	40	1.751596	862	0.156120	415
	45	1.752457	861	0.156536	416
	50	1.753318	861	0.156952	416
	55	1.754179	861	0.157369	417
67	0	1.755040	861	0.157787	418
	5	1.755902	—862	0.158205	—418
	10	1.756763	861	0.158624	419
	15	1.757623	860	0.159044	420
	20	1.758484	861	0.159465	421
	25	1.759345	861	0.159886	421
	30	1.760206	861	0.160307	421
			—861		—423

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
67	35	1.761067	—861	0.160730	—423
	40	1.761928	861	0.161153	423
	45	1.762788	860	0.161576	423
	50	1.763649	861	0.162001	425
	55	1.764510	861	0.162426	425
68	0	1.765371	861	0.162852	426
	5	1.766231	—860	0.163278	—426
	10	1.767092	861	0.163705	427
	15	1.767953	861	0.164133	428
	20	1.768813	860	0.164561	428
	25	1.769674	861	0.164990	429
	30	1.770535	861	0.165420	430
	35	1.771395	—860	0.165850	—430
	40	1.772256	861	0.166281	431
	45	1.773116	860	0.166713	432
	50	1.773977	861	0.167146	433
	55	1.774838	861	0.167579	433
69	0	1.775698	860	0.168013	434
	5	1.776559	—861	0.168447	—434
	10	1.777420	861	0.168882	435
	15	1.778281	861	0.169318	436
	20	1.779141	860	0.169754	436
	25	1.780002	861	0.170192	438
	30	1.780863	861	0.170630	438
	35	1.781724	—861	0.171068	—438
	40	1.782584	860	0.171507	439
	45	1.783445	861	0.171947	440
	50	1.784306	861	0.172388	441
	55	1.785167	861	0.172829	441
70	0	1.786028	861	0.173271	442
	5	1.786889	—861	0.173714	—443
	10	1.787751	862	0.174157	443
	15	1.788612	861	0.174601	444
	20	1.789473	861	0.175046	445
	25	1.790334	861	0.175491	445
	30	1.791195	861	0.175937	446
	35	1.792057	—862	0.176384	—447
	40	1.792918	861	0.176831	447
	45	1.793780	862	0.177279	448
	50	1.794642	862	0.177728	449
	55	1.795503	861	0.178178	450
71	0	1.796365	862	0.178628	450
	5	1.797227	—862	0.179079	—451
	10	1.798089	862	0.179530	451
	15	1.798951	862	0.179983	453
	20	1.799813	862	0.180436	453
	25	1.800675	862	0.180889	453
	30	1.801537	862	0.181344	455
	35	1.802400	—863	0.181799	—455
	40	1.803262	862	0.182255	456
	45	1.804124	862	0.182711	456
	50	1.804987	863	0.183168	457
	55	1.805850	863	0.183626	458
72	0	1.806713	863	0.184085	459
			—863		—459

Angle. °	'	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. °	'	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
72	5	1.807576	—863	0.184544	—459	76	35	1.854410	—873	0.210408	—498
	10	1.808439	863	0.185004	460		40	1.855283	873	0.210907	499
	15	1.809302	863	0.185465	461		45	1.856156	873	0.211407	500
	20	1.810165	863	0.185926	461		50	1.857029	873	0.211908	501
	25	1.811029	864	0.186388	462		55	1.857903	874	0.212409	501
	30	1.811892	863	0.186851	463	77	0	1.858777	874	0.212911	502
	35	1.812756	—864	0.187314	—463		5	1.859651	—874	0.213414	—503
	40	1.813620	864	0.187779	465		10	1.860526	875	0.213918	504
	45	1.814484	864	0.188244	465		15	1.861400	874	0.214422	504
	50	1.815348	864	0.188709	465		20	1.862275	875	0.214927	505
	55	1.816212	864	0.189176	467		25	1.863151	876	0.215433	506
73	0	1.817077	865	0.189643	467		30	1.864026	875	0.215939	506
	5	1.817941	—864	0.190110	—467		35	1.864902	—876	0.216447	—508
	10	1.818805	864	0.190579	469		40	1.865778	876	0.216955	508
	15	1.819670	865	0.191048	469		45	1.866655	877	0.217464	509
	20	1.820535	865	0.191518	470		50	1.867532	877	0.217973	509
	25	1.821400	865	0.191988	470		55	1.868408	876	0.218484	511
	30	1.822266	866	0.192460	472	78	0	1.869286	878	0.218995	511
	35	1.823131	—865	0.192932	—472		5	1.870163	—877	0.219507	—512
	40	1.823997	866	0.193405	473		10	1.871041	878	0.220019	512
	45	1.824862	865	0.193878	473		15	1.871919	878	0.220533	514
	50	1.825728	866	0.194352	474		20	1.872798	879	0.221047	514
	55	1.826594	866	0.194827	475		25	1.873677	879	0.221562	515
74	0	1.827460	866	0.195303	476		30	1.874556	879	0.222078	516
	5	1.828327	—867	0.195779	—476		35	1.875435	—879	0.222594	—516
	10	1.829193	866	0.196256	477		40	1.876315	880	0.223111	517
	15	1.830060	867	0.196734	478		45	1.877195	880	0.223629	518
	20	1.830927	867	0.197213	479		50	1.878075	880	0.224148	519
	25	1.831794	867	0.197692	479		55	1.878956	881	0.224668	520
	30	1.832661	867	0.198172	480	79	0	1.879837	881	0.225188	520
	35	1.833529	—868	0.198652	—480		5	1.880718	—881	0.225709	—521
	40	1.834396	867	0.199134	482		10	1.881600	882	0.226231	522
	45	1.835264	868	0.199616	482		15	1.882482	882	0.226753	522
	50	1.836132	868	0.200099	483		20	1.883364	882	0.227277	524
	55	1.837000	868	0.200582	483		25	1.884247	883	0.227801	524
75	0	1.837869	869	0.201067	485		30	1.885130	883	0.228326	525
	5	1.838737	—868	0.201552	—485		35	1.886013	—883	0.228852	—526
	10	1.839606	869	0.202038	486		40	1.886897	884	0.229378	526
	15	1.840475	869	0.202524	486		45	1.887781	884	0.229906	528
	20	1.841344	869	0.203011	487		50	1.888665	884	0.230434	528
	25	1.842214	870	0.203499	488		55	1.889550	885	0.230962	528
	30	1.843083	869	0.203988	489	80	0	1.890435	885	0.231492	530
	35	1.843953	—870	0.204477	—489		5	1.891320	—885	0.232022	—530
	40	1.844823	870	0.204968	491		10	1.892206	886	0.232554	532
	45	1.845694	871	0.205459	491		15	1.893092	886	0.233086	532
	50	1.846564	870	0.205950	491		20	1.893979	887	0.233618	532
	55	1.847435	871	0.206443	493		25	1.894866	887	0.234152	534
76	0	1.848306	871	0.206936	493		30	1.895753	887	0.234686	534
	5	1.849177	—871	0.207430	—494		35	1.896640	—887	0.235221	—535
	10	1.850049	872	0.207924	494		40	1.897528	888	0.235757	536
	15	1.850920	871	0.208420	496		45	1.898417	889	0.236294	537
	20	1.851792	872	0.208916	496		50	1.899305	888	0.236832	538
	25	1.852664	872	0.209412	496		55	1.900194	889	0.237370	538
	30	1.853537	873	0.209910	498	81	0	1.901084	890	0.237909	539
			—873		—498				—890		—540

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
81	5	1.901974	—890	0.238449	—540
	10	1.902864	890	0.238990	541
	15	1.903755	891	0.239531	541
	20	1.904646	891	0.240073	542
	25	1.905537	891	0.240616	543
	30	1.906429	892	0.241160	544
	35	1.907321	—892	0.241705	—545
	40	1.908214	893	0.242250	545
	45	1.909107	893	0.242797	547
	50	1.910001	894	0.243344	547
	55	1.910895	894	0.243892	548
82	0	1.911789	894	0.244440	548
	5	1.912684	—895	0.244990	—550
	10	1.913579	895	0.245540	550
	15	1.914475	896	0.246091	551
	20	1.915371	896	0.246643	552
	25	1.916267	896	0.247196	553
	30	1.917164	897	0.247749	553
	35	1.918061	—897	0.248304	—555
	40	1.918959	898	0.248859	555
	45	1.919857	898	0.249415	556
	50	1.920756	899	0.249972	557
	55	1.921655	899	0.250529	557
83	0	1.922555	900	0.251088	559
	5	1.923455	—900	0.251647	—559
	10	1.924355	900	0.252207	560
	15	1.925256	901	0.252768	561
	20	1.926157	901	0.253330	562
	25	1.927059	902	0.253892	562
	30	1.927962	903	0.254456	564
	35	1.928865	—903	0.255020	—564
	40	1.929768	903	0.255585	565
	45	1.930671	903	0.256151	566
	50	1.931575	904	0.256717	566
	55	1.932480	905	0.257285	568
84	0	1.933385	905	0.257853	568
	5	1.934291	—906	0.258422	—569
	10	1.935197	906	0.258992	570
	15	1.936104	907	0.259563	571
	20	1.937011	907	0.260135	572
	25	1.937918	907	0.260707	572
	30	1.938826	908	0.261281	574
	35	1.939735	—909	0.261855	—574
	40	1.940644	909	0.262430	575
	45	1.941554	910	0.263006	576
	50	1.942464	910	0.263582	576
	55	1.943374	910	0.264160	578
85	0	1.944285	911	0.264738	578
	5	1.945197	—912	0.265317	—579
	10	1.946109	912	0.265897	580
	15	1.947022	913	0.266478	581
	20	1.947935	913	0.267060	582
	25	1.948849	914	0.267643	583
	30	1.949763	914	0.268226	583
			—915		—585

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
85	35	1.950678	—915	0.268811	—585
	40	1.951593	915	0.269396	585
	45	1.952509	916	0.269982	586
	50	1.953426	917	0.270569	587
	55	1.954343	917	0.271156	587
86	0	1.955260	917	0.271745	589
	5	1.956178	—918	0.272335	—590
	10	1.957097	919	0.272925	590
	15	1.958016	919	0.273516	591
	20	1.958936	920	0.274108	592
	25	1.959856	920	0.274701	593
	30	1.960777	921	0.275295	594
	35	1.961698	—921	0.275889	—594
	40	1.962620	922	0.276485	596
	45	1.963543	923	0.277081	596
	50	1.964466	923	0.277678	597
	55	1.965390	924	0.278277	599
87	0	1.966314	924	0.278876	599
	5	1.967239	—925	0.279475	—599
	10	1.968164	925	0.280076	601
	15	1.969090	926	0.280678	602
	20	1.970017	927	0.281280	602
	25	1.970944	927	0.281884	604
	30	1.971872	928	0.282488	604
	35	1.972801	—929	0.283093	—605
	40	1.973730	929	0.283699	606
	45	1.974659	929	0.284306	607
	50	1.975589	930	0.284914	608
	55	1.976520	931	0.285522	608
88	0	1.977452	932	0.286132	610
	5	1.978384	—932	0.286742	—610
	10	1.979317	933	0.287354	612
	15	1.980250	933	0.287966	612
	20	1.981184	934	0.288579	613
	25	1.982119	935	0.289193	614
	30	1.983054	935	0.289808	615
	35	1.983990	—936	0.290424	—616
	40	1.984926	936	0.291040	616
	45	1.985864	938	0.291658	618
	50	1.986801	937	0.292276	618
	55	1.987740	939	0.292896	620
89	0	1.988679	939	0.293516	620
	5	1.989619	—940	0.294137	—621
	10	1.990559	940	0.294759	622
	15	1.991500	941	0.295382	623
	20	1.992442	942	0.296006	624
	25	1.993384	942	0.296631	625
	30	1.994327	943	0.297257	626
	35	1.995271	—944	0.297883	—626
	40	1.996216	945	0.298511	628
	45	1.997161	945	0.299139	628
	50	1.998107	946	0.299769	630
	55	1.999053	946	0.300399	630
90	0	2.000000	947	0.301030	631
			—948		—632

Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
90 5	2.000948	—948	0.301662	—632	94 35	2.053239	—989	0.337199	—684
10	2.001897	949	0.302295	633	40	2.054230	991	0.337884	685
15	2.002846	949	0.302929	634	45	2.055221	991	0.338570	686
20	2.003796	950	0.303564	635	50	2.056213	992	0.339257	687
25	2.004746	950	0.304200	636	55	2.057206	993	0.339944	687
30	2.005697	951	0.304837	637	95 0	2.058200	994	0.340633	689
35	2.006649	—952	0.305474	—637	5	2.059195	—995	0.341323	—690
40	2.007602	953	0.306113	639	10	2.060191	996	0.342014	691
45	2.008556	954	0.306752	639	15	2.061188	997	0.342706	692
50	2.009510	954	0.307393	641	20	2.062185	997	0.343399	693
55	2.010465	955	0.308034	641	25	2.063184	999	0.344093	694
91 0	2.011420	955	0.308676	642	30	2.064183	999	0.344787	694
5	2.012377	—957	0.309320	—644	35	2.065183	—1000	0.345483	—696
10	2.013334	957	0.309964	644	40	2.066184	1001	0.346180	697
15	2.014292	958	0.310609	645	45	2.067186	1002	0.346878	698
20	2.015250	958	0.311255	646	50	2.068189	1003	0.347577	699
25	2.016209	959	0.311902	647	55	2.069193	1004	0.348277	700
30	2.017169	960	0.312550	648	96 0	2.070198	1005	0.348978	701
35	2.018130	—961	0.313199	—649	5	2.071204	—1006	0.349680	—702
40	2.019091	961	0.313849	650	10	2.072211	1007	0.350383	703
45	2.020054	963	0.314499	650	15	2.073218	1007	0.351087	704
50	2.021017	963	0.315151	652	20	2.074226	1008	0.351793	706
55	2.021981	964	0.315804	653	25	2.075236	1010	0.352499	706
92 0	2.022945	964	0.316457	653	30	2.076246	1010	0.353206	707
5	2.023910	—965	0.317112	—655	35	2.077257	—1011	0.353914	—708
10	2.024876	966	0.317768	656	40	2.078270	1013	0.354623	709
15	2.025843	967	0.318424	656	45	2.079283	1013	0.355334	711
20	2.026811	968	0.319081	657	50	2.080297	1014	0.356045	711
25	2.027779	968	0.319740	659	55	2.081312	1015	0.356757	712
30	2.028748	969	0.320399	659	97 0	2.082328	1016	0.357471	714
35	2.029718	—970	0.321060	—661	5	2.083345	—1017	0.358185	—714
40	2.030689	971	0.321721	661	10	2.084363	1018	0.358901	716
45	2.031660	971	0.322383	662	15	2.085382	1019	0.359617	716
50	2.032633	973	0.323046	663	20	2.086402	1020	0.360335	718
55	2.033606	973	0.323710	664	25	2.087423	1021	0.361054	719
93 0	2.034580	974	0.324376	666	30	2.088445	1022	0.361773	719
5	2.035554	—974	0.325042	—666	35	2.089468	—1023	0.362494	—721
10	2.036530	976	0.325709	667	40	2.090492	1024	0.363216	722
15	2.037506	976	0.326377	668	45	2.091517	1025	0.363939	723
20	2.038483	977	0.327046	669	50	2.092542	1025	0.364663	724
25	2.039461	978	0.327716	670	55	2.093569	1027	0.365388	725
30	2.040440	979	0.328387	671	98 0	2.094597	1028	0.366114	726
35	2.041419	—979	0.329059	—672	5	2.095626	—1029	0.366841	—727
40	2.042400	981	0.329732	673	10	2.096656	1030	0.367570	729
45	2.043381	981	0.330406	674	15	2.097687	1031	0.368299	729
50	2.044363	982	0.331081	675	20	2.098719	1032	0.369029	730
55	2.045346	983	0.331757	676	25	2.099752	1033	0.369761	732
94 0	2.046330	984	0.332433	676	30	2.100785	1033	0.370493	732
5	2.047314	—984	0.333111	—678	35	2.101820	—1035	0.371227	—734
10	2.048299	985	0.333790	679	40	2.102856	1036	0.371962	735
15	2.049286	987	0.334470	680	45	2.103893	1037	0.372697	735
20	2.050273	987	0.335151	681	50	2.104931	1038	0.373434	737
25	2.051261	988	0.335833	682	55	2.105971	1040	0.374172	738
30	2.052250	989	0.336515	682	99 0	2.107011	1040	0.374911	739
		—989		—684			—1041		—740

Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
99 5	2.108052	—1041	0.375651	—740	103 35	2.165946	—1104	0.417289	—802
10	2.109094	1042	0.376392	741	40	2.167051	1105	0.418092	803
15	2.110138	1044	0.377135	743	45	2.168158	1107	0.418896	804
20	2.111182	1044	0.377878	743	50	2.169265	1107	0.419701	805
25	2.112227	1045	0.378623	745	55	2.170374	1109	0.420508	807
30	2.113274	1047	0.379368	745	104 0	2.171484	1110	0.421316	808
35	2.114322	—1048	0.380115	—747	5	2.172596	—1112	0.422125	—809
40	2.115370	1048	0.380863	748	10	2.173709	1113	0.422935	810
45	2.116420	1050	0.381612	749	15	2.174823	1114	0.423747	812
50	2.117471	1051	0.382362	750	20	2.175938	1115	0.424560	813
55	2.118523	1052	0.383113	751	25	2.177055	1117	0.425374	814
100 0	2.119576	1053	0.383865	752	30	2.178173	1118	0.426189	815
5	2.120630	—1054	0.384618	—753	35	2.179292	—1119	0.427005	—816
10	2.121685	1055	0.385373	755	40	2.180413	1121	0.427823	818
15	2.122742	1057	0.386128	755	45	2.181535	1122	0.428642	819
20	2.123799	1057	0.386885	757	50	2.182658	1123	0.429462	820
25	2.124857	1058	0.387643	758	55	2.183783	1125	0.430283	821
30	2.125917	1060	0.388402	759	105 0	2.184909	1126	0.431106	823
35	2.126978	—1061	0.389162	—760	5	2.186036	—1127	0.431930	—824
40	2.128040	1062	0.389923	761	10	2.187165	1129	0.432755	825
45	2.129103	1063	0.390685	762	15	2.188295	1130	0.433581	826
50	2.130167	1064	0.391449	764	20	2.189427	1132	0.434408	827
55	2.131232	1065	0.392213	764	25	2.190560	1133	0.435237	829
101 0	2.132299	1067	0.392979	766	30	2.191694	1134	0.436067	830
5	2.133367	—1068	0.393746	—767	35	2.192830	—1136	0.436899	—832
10	2.134435	1068	0.394514	768	40	2.193967	1137	0.437731	832
15	2.135505	1070	0.395283	769	45	2.195105	1138	0.438565	834
20	2.136576	1071	0.396053	770	50	2.196245	1140	0.439400	835
25	2.137648	1072	0.396824	771	55	2.197386	1141	0.440236	836
30	2.138722	1074	0.397597	773	106 0	2.198528	1142	0.441074	838
35	2.139796	—1074	0.398371	—774	5	2.199672	—1144	0.441913	—839
40	2.140872	1076	0.399146	775	10	2.200817	1145	0.442753	840
45	2.141949	1077	0.399922	776	15	2.201964	1147	0.443594	841
50	2.143027	1078	0.400699	777	20	2.203112	1148	0.444437	843
55	2.144106	1079	0.401477	778	25	2.204262	1150	0.445281	844
102 0	2.145187	1081	0.402256	779	30	2.205413	1151	0.446126	845
5	2.146268	—1081	0.403037	—781	35	2.206565	—1152	0.446973	—847
10	2.147351	1083	0.403819	782	40	2.207719	1154	0.447821	848
15	2.148435	1084	0.404602	783	45	2.208875	1156	0.448670	849
20	2.149520	1085	0.405386	784	50	2.210031	1156	0.449520	850
25	2.150607	1087	0.406171	785	55	2.211189	1158	0.450372	852
30	2.151695	1088	0.406957	786	107 0	2.212349	1160	0.451225	853
35	2.152783	—1088	0.407745	—788	5	2.213510	—1161	0.452079	—854
40	2.153873	1090	0.408534	789	10	2.214673	1163	0.452935	856
45	2.154965	1092	0.409324	790	15	2.215837	1164	0.453792	857
50	2.156057	1092	0.410115	791	20	2.217003	1166	0.454650	858
55	2.157151	1094	0.410907	792	25	2.218170	1167	0.455509	859
103 0	2.158246	1095	0.411701	794	30	2.219338	1168	0.456370	861
5	2.159342	—1096	0.412496	—795	35	2.220508	—1170	0.457232	—862
10	2.160440	1098	0.413292	796	40	2.221680	1172	0.458096	864
15	2.161539	1099	0.414089	797	45	2.222853	1173	0.458960	864
20	2.162639	1100	0.414887	798	50	2.224027	1174	0.459826	866
25	2.163740	1101	0.415686	799	55	2.225203	1176	0.460694	868
30	2.164842	1102	0.416487	801	108 0	2.226381	1178	0.461563	869
		—1104		—802			—1179		—870

Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
		—1179		—870			—1270		— 946
108 5	2.227560	1180	0.462433	871	112 35	2.293634	1271	0.511468	948
10	2.228740	1182	0 463304	873	40	2.294 05	1272	0.512416	949
15	2.229922	1184	0.464177	874	45	2.296177	1275	0.513365	950
20	2 231106	1185	0 465051	875	50	2.297452	1276	0.514315	952
25	2.232291	1187	0.465926	877	55	2.298728	1279	0.515267	954
30	2.233478	—1188	0.466803	—878	113 0	2.300007	—1280	0.516221	— 955
35	2.234666	1190	0.467681	880	5	2.301287	1282	0.517176	957
40	2.235856	1192	0.468561	880	10	2.302569	1284	0.518133	958
45	2 237048	1193	0.469441	883	15	2.303853	1286	0.519091	959
50	2.238241	1194	0.470324	883	20	2.305139	1287	0.520050	962
55	2.239435	1196	0.471207	885	25	2.306426	1290	0 521012	962
109 0	2 240631	—1198	0.472092	—886	30	2.307716	—1291	0.521974	— 964
5	2.241829	1199	0.472978	888	35	2.309007	1293	0.522938	966
10	2.243028	1201	0.473866	889	40	2.310300	1296	0.523904	967
15	2.244229	1203	0.474755	890	45	2.311596	1297	0.524871	969
20	2 245432	1204	0.475645	892	50	2.312893	1299	0.525840	971
25	2.246636	1206	0.476537	893	55	2.314192	1301	0 526811	971
30	2 247842	—1207	0.477430	—894	114 0	2.315493	—1303	0.527782	— 974
35	2.249049	1209	0.478324	896	5	2.316796	1305	0.528756	975
40	2.250258	1210	0 479220	897	10	2.318101	1306	0.529731	976
45	2.251468	1212	0.480117	899	15	2.319407	1309	0.530707	979
50	2.252680	1214	0 481016	900	20	2.320716	1311	0.531686	979
55	2.253894	1216	0.481916	901	25	2.322027	1312	0.532665	981
110 0	2.255110	—1217	0 482817	—903	30	2.323339	—1315	0.533646	— 983
5	2.256327	1219	0.483720	904	35	2.324654	1316	0.534629	985
10	2.257546	1220	0 484624	906	40	2.325970	1319	0.535614	986
15	2.258766	1222	0.485530	907	45	2.327289	1320	0.536600	987
20	2.259988	1224	0.486437	908	50	2.328609	1323	0.537587	989
25	2.261212	1225	0.487345	910	55	2.329932	1325	0.538576	991
30	2.262437	—1227	0.488255	—911	115 0	2.331257	—1326	0.539567	— 992
35	2.263664	1229	0.489166	913	5	2.332583	1329	0.540559	994
40	2.264893	1231	0.490079	914	10	2.333912	1330	0.541553	996
45	2.266124	1232	0.490993	916	15	2.335242	1333	0.542549	997
50	2.267356	1234	0.491909	917	20	2.336575	1334	0.543546	999
55	2.268590	1236	0.492826	918	25	2.337909	1337	0 544545	1000
111 0	2.269826	—1237	0.493744	—920	30	2.339246	—1339	0.545545	—1002
5	2.271063	1239	0.494664	921	35	2.340585	1340	0.546547	1003
10	2.272302	1241	0.495585	923	40	2.341925	1343	0.547550	1005
15	2.273543	1242	0.496508	924	45	2.343268	1345	0.548555	1007
20	2.274785	1244	0.497432	925	50	2.344613	1347	0.549562	1009
25	2.276029	1246	0.498357	927	55	2.345960	1349	0.550571	1010
30	2.277275	—1248	0.499284	—929	116 0	2.347309	—1351	0.551581	—1[illegible]
35	2.278523	1249	0.500213	930	5	2.348660	1354	0.552592	1014
40	2.279772	1251	0.501143	931	10	2.350014	1355	0.553606	1015
45	2.281023	1253	0.502074	933	15	2.351369	1357	0.554621	1016
50	2.282276	1255	0.503007	934	20	2.352726	1360	0.555637	1018
55	2.283531	1257	0.503941	936	25	2.354086	1362	0.556655	1020
112 0	2.284788	—1258	0.504877	—937	30	2.355448	—1364	0.557675	—1022
5	2.286046	1260	0.505814	939	35	2.356812	1365	0.558697	1023
10	2.287306	1262	0.506753	940	40	2.358177	1368	0.559720	1025
15	2.288568	1264	0.507693	941	45	2.359545	1371	0.560745	1027
20	2.289832	1265	0.508634	943	50	2.360916	1372	0.561772	1028
25	2.291097	1267	0.509577	945	55	2.362288	1375	0.562800	1030
30	2.292364	—1270	0 510522	—946	117 0	2.363663	—1377	0.563830	—1032

Angle. °	'	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
117	5	2.365040	—1377	0.564862	—1032
	10	2.366418	1378	0.565895	1033
	15	2.367799	1381	0.566930	1035
	20	2.369183	1384	0.567966	1036
	25	2.370568	1385	0.569005	1039
	30	2.371956	1388	0.570045	1040
	35	2.373346	—1390	0.571087	—1042
	40	2.374738	1392	0.572130	1043
	45	2.376132	1394	0.573175	1045
	50	2.377529	1397	0.574222	1047
	55	2.378928	1399	0.575271	1049
118	0	2.380329	1401	0.576321	1050
	5	2.381732	—1403	0.577373	—1052
	10	2.383138	1406	0.578427	1054
	15	2.384546	1408	0.579483	1056
	20	2.385956	1410	0.580540	1057
	25	2.387369	1413	0.581599	1059
	30	2.388784	1415	0.582660	1061
	35	2.390201	—1417	0.583723	—1063
	40	2.391620	1419	0.584787	1064
	45	2.393042	1422	0.585853	1066
	50	2.394466	1424	0.586921	1068
	55	2.395892	1426	0.587991	1070
119	0	2.397321	1429	0.589062	1071
	5	2.398752	—1431	0.590136	—1074
	10	2.400186	1434	0.591211	1075
	15	2.401622	1436	0.592287	1076
	20	2.403060	1438	0.593366	1079
	25	2.404500	1440	0.594446	1080
	30	2.405943	1443	0.595529	1083
	35	2.407389	—1446	0.596613	—1084
	40	2.408836	1447	0.597698	1085
	45	2.410287	1451	0.598786	1088
	50	2.411739	1452	0.599876	1090
	55	2.413194	1455	0.600967	1091
120	0	2.414652	1458	0.602060	1093
	5	2.416112	—1460	0.603155	—1095
	10	2.417574	1462	0.604252	1097
	15	2.419039	1465	0.605350	1098
	20	2.420507	1468	0.606451	1101
	25	2.421977	1470	0.607553	1102
	30	2.423449	1472	0.608658	1105
	35	2.424924	—1475	0.609764	—1106
	40	2.426401	1477	0.610872	1108
	45	2.427881	1480	0.611982	1110
	50	2.429363	1482	0.613093	1111
	55	2.430848	1485	0.614207	1114
121	0	2.432336	1488	0.615322	1115
	5	2.433826	—1490	0.616440	—1118
	10	2.435318	1492	0.617559	1119
	15	2.436813	1495	0.618680	1121
	20	2.438311	1498	0.619803	1123
	25	2.439811	1500	0.620928	1125
	30	2.441314	1503	0.622055	1127
			—1506		—1129

Angle. °	'	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
121	35	2.442820	—1506	0.623184	—1129
	40	2.444328	1508	0.624315	1131
	45	2.445839	1511	0.625448	1133
	50	2.447352	1513	0.626582	1134
	55	2.448868	1516	0.627719	1137
122	0	2.450387	1519	0.628858	1139
	5	2.451908	—1521	0.629998	—1140
	10	2.453432	1524	0.631141	1143
	15	2.454959	1527	0.632285	1144
	20	2.456488	1529	0.633431	1146
	25	2.458020	1532	0.634580	1149
	30	2.459555	1535	0.635730	1150
	35	2.461092	—1537	0.636882	—1152
	40	2.462632	1540	0.638037	1155
	45	2.464175	1543	0.639193	1156
	50	2.465721	1546	0.640351	1158
	55	2.467269	1548	0.641512	1161
123	0	2.468821	1552	0.642674	1162
	5	2.470375	—1554	0.643839	—1165
	10	2.471931	1556	0.645005	1166
	15	2.473491	1560	0.646173	1168
	20	2.475053	1562	0.647344	1171
	25	2.476618	1565	0.648516	1172
	30	2.478186	1568	0.649691	1175
	35	2.479756	—1570	0.650867	—1176
	40	2.481330	1574	0.652046	1179
	45	2.482907	1577	0.653227	1181
	50	2.484486	1579	0.654410	1183
	55	2.486068	1582	0.655594	1184
124	0	2.487653	1585	0.656781	1187
	5	2.489241	—1588	0.657970	—1189
	10	2.490832	1591	0.659162	1192
	15	2.492425	1593	0.660355	1193
	20	2.494022	1597	0.661550	1195
	25	2.495621	1599	0.662747	1197
	30	2.497224	1603	0.663947	1200
	35	2.498829	—1605	0.665149	—1202
	40	2.500437	1608	0.666352	1203
	45	2.502049	1612	0.667558	1206
	50	2.503663	1614	0.668766	1208
	55	2.505280	1617	0.669977	1211
125	0	2.506901	1621	0.671189	1212
	5	2.508524	—1623	0.672403	—1214
	10	2.510150	1626	0.673620	1217
	15	2.511780	1630	0.674839	1219
	20	2.513412	1632	0.676060	1221
	25	2.515047	1635	0.677283	1223
	30	2.516686	1639	0.678508	1225
	35	2.518327	—1641	0.679736	—1228
	40	2.519972	1645	0.680965	1229
	45	2.521620	1648	0.682197	1232
	50	2.523270	1650	0.683432	1235
	55	2.524924	1654	0.684668	1236
126	0	2.526581	1657	0.685906	1238
			—1660		—1241

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
126	5	2.528241	—1660	0.687147	—1241	130	35	2.622869	—1847	0.757649	—1371
	10	2.529905	1664	0.688390	1243		40	2.624720	1851	0.759023	1374
	15	2.531571	1666	0.689636	1246		45	2.626575	1855	0.760400	1377
	20	2.533241	1670	0.690883	1247		50	2.628434	1859	0.761779	1379
	25	2.534914	1673	0.692133	1250		55	2.630296	1862	0.763161	1382
	30	2.536590	1676	0.693385	1252	131	0	2.632162	1866	0.764546	1385
	35	2.538269	—1679	0.694639	—1254		5	2.634032	—1870	0.765933	—1387
	40	2.539951	1682	0.695896	1257		10	2.635907	1875	0.767324	1391
	45	2.541637	1686	0.697155	1259		15	2.637785	1878	0.768716	1392
	50	2.543326	1689	0.698416	1261		20	2.639667	1882	0.770112	1396
	55	2.545018	1692	0.699679	1263		25	2.641553	1886	0.771510	1398
127	0	2.546714	1696	0.700945	1266		30	2.643443	1890	0.772911	1401
	5	2.548412	—1698	0.702213	—1268		35	2.645336	—1893	0.774314	—1403
	10	2.550114	1702	0.703484	1271		40	2.647234	1898	0.775721	1407
	15	2.551819	1705	0.704756	1272		45	2.649136	1902	0.777130	1409
	20	2.553528	1709	0.706031	1275		50	2.651042	1906	0.778541	1411
	25	2.555240	1712	0.707309	1278		55	2.652952	1910	0.779956	1415
	30	2.556955	1715	0.708588	1279	132	0	2.654866	1914	0.781373	1417
	35	2.558674	—1719	0.709870	—1282		5	2.656784	—1918	0.782794	—1421
	40	2.560395	1721	0.711155	1285		10	2.658706	1922	0.784217	1423
	45	2.562121	1726	0.712442	1287		15	2.660632	1926	0.785642	1425
	50	2.563849	1728	0.713731	1289		20	2.662562	1930	0.787071	1429
	55	2.565581	1732	0.715022	1291		25	2.664497	1935	0.788502	1431
128	0	2.567316	1735	0.716316	1294		30	2.666435	1938	0.789936	1434
	5	2.569055	—1739	0.717612	—1296		35	2.668378	—1943	0.791373	—1437
	10	2.570798	1743	0.718911	1299		40	2.670325	1947	0.792813	1440
	15	2.572544	1746	0.720212	1301		45	2.672276	1951	0.794255	1442
	20	2.574293	1749	0.721516	1304		50	2.674231	1955	0.795701	1446
	25	2.576045	1752	0.722822	1306		55	2.676191	1960	0.797149	1448
	30	2.577801	1756	0.724130	1308	133	0	2.678155	1964	0.798601	1452
	35	2.579561	—1760	0.725441	—1311		5	2.680123	—1968	0.800055	—1454
	40	2.581324	1763	0.726754	1313		10	2.682095	1972	0.801512	1457
	45	2.583090	1766	0.728070	1316		15	2.684071	1976	0.802972	1460
	50	2.584860	1770	0.729388	1318		20	2.686052	1981	0.804435	1463
	55	2.586634	1774	0.730708	1320		25	2.688037	1985	0.805900	1465
129	0	2.588411	1777	0.732031	1323		30	2.690027	1990	0.807369	1469
	5	2.590192	—1781	0.733357	—1326		35	2.692021	—1994	0.808841	—1472
	10	2.591976	1784	0.734685	1328		40	2.694019	1998	0.810316	1475
	15	2.593764	1788	0.736015	1330		45	2.696022	2003	0.811793	1477
	20	2.595556	1792	0.737348	1333		50	2.698029	2007	0.813274	1481
	25	2.597351	1795	0.738684	1336		55	2.700040	2011	0.814757	1483
	30	2.599150	1799	0.740022	1338	134	0	2.702056	2016	0.816244	1487
	35	2.600952	—1802	0.741363	—1341		5	2.704077	—2021	0.817734	—1490
	40	2.602758	1806	0.742706	1343		10	2.706101	2024	0.819226	1492
	45	2.604568	1810	0.744051	1345		15	2.708131	2030	0.820722	1496
	50	2.606381	1813	0.745399	1348		20	2.710165	2034	0.822221	1499
	55	2.608198	1817	0.746750	1351		25	2.712203	2038	0.823722	1501
130	0	2.610019	1821	0.748103	1353		30	2.714246	2043	0.825227	1505
	5	2.611843	—1824	0.749459	—1356		35	2.716293	—2047	0.826735	—1508
	10	2.613671	1828	0.750818	1359		40	2.718345	2052	0.828246	1511
	15	2.615503	1832	0.752179	1361		45	2.720401	2056	0.829760	1514
	20	2.617339	1836	0.753543	1364		50	2.722463	2062	0.831277	1517
	25	2.619179	1840	0.754909	1366		55	2.724528	2065	0.832797	1520
	30	2.621022	1843	0.756278	1369	135	0	2.726599	2071	0.834321	1524
			—1847		—1371				—2075		—1526

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
135	5	2.728674	—2075	0.835847	—1526
	10	2.730754	2080	0.837377	1530
	15	2.732838	2084	0.838910	1533
	20	2.734927	2089	0.840446	1536
	25	2.737021	2094	0.841985	1539
	30	2.739120	2099	0.843527	1542
	35	2.741224	—2104	0.845073	—1546
	40	2.743332	2108	0.846622	1549
	45	2.745445	2113	0.848174	1552
	50	2.747563	2118	0.849729	1555
	55	2.749686	2123	0.851287	1558
136	0	2.751814	2128	0.852849	1562
	5	2.753946	—2132	0.854414	—1565
	10	2.756084	2138	0.855983	1569
	15	2.758226	2142	0.857554	1571
	20	2.760373	2147	0.859129	1575
	25	2.762526	2153	0.860707	1578
	30	2.764683	2157	0.862289	1582
	35	2.766845	—2162	0.863874	—1585
	40	2.769012	2167	0.865462	1588
	45	2.771185	2173	0.867054	1592
	50	2.773362	2177	0.868649	1595
	55	2.775544	2182	0.870247	1598
137	0	2.777732	2188	0.871849	1602
	5	2.779925	—2193	0.873454	—1605
	10	2.782123	2198	0.875063	1609
	15	2.784326	2203	0.876675	1612
	20	2.786534	2208	0.878291	1616
	25	2.788748	2214	0.879910	1619
	30	2.790966	2218	0.881533	1623
	35	2.793190	—2224	0.883159	—1626
	40	2.795419	2229	0.884788	1629
	45	2.797654	2235	0.886421	1633
	50	2.799894	2240	0.888058	1637
	55	2.802139	2245	0.889698	1640
138	0	2.804389	2250	0.891342	1644
	5	2.806645	—2256	0.892989	—1647
	10	2.808907	2262	0.894640	1651
	15	2.811174	2267	0.896294	1654
	20	2.813446	2272	0.897953	1659
	25	2.815723	2277	0.899614	1661
	30	2.818006	2283	0.901280	1666
	35	2.820295	—2289	0.902949	—1669
	40	2.822589	2294	0.904621	1672
	45	2.824889	2300	0.906298	1677
	50	2.827195	2306	0.907978	1680
	55	2.829506	2311	0.909662	1684
139	0	2.831822	2316	0.911349	1687
	5	2.834145	—2323	0.913041	—1692
	10	2.836473	2328	0.914736	1695
	15	2.838806	2333	0.916435	1699
	20	2.841146	2340	0.918137	1702
	25	2.843491	2345	0.919844	1707
	30	2.845842	2351	0.921554	1710
			—2357		—1714

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
139	35	2.848199	—2357	0.923268	—1714
	40	2.850561	2362	0.924986	1718
	45	2.852930	2369	0.926708	1722
	50	2.855304	2374	0.928434	1726
	55	2.857684	2380	0.930163	1729
140	0	2.860070	2386	0.931897	1734
	5	2.862462	—2392	0.933634	—1737
	10	2.864860	2398	0.935375	1741
	15	2.867265	2405	0.937121	1746
	20	2.869675	2410	0.938870	1749
	25	2.872091	2416	0.940623	1753
	30	2.874513	2422	0.942381	1758
	35	2.876941	—2428	0.944142	—1761
	40	2.879376	2435	0.945907	1765
	45	2.881816	2440	0.947677	1770
	50	2.884263	2447	0.949450	1773
	55	2.886716	2453	0.951228	1778
141	0	2.889175	2459	0.953009	1781
	5	2.891641	—2466	0.954795	—1786
	10	2.894113	2472	0.956585	1790
	15	2.896591	2478	0.958379	1794
	20	2.899075	2484	0.960178	1799
	25	2.901566	2491	0.961980	1802
	30	2.904063	2497	0.963787	1807
	35	2.906567	—2504	0.965598	—1811
	40	2.909077	2510	0.967413	1815
	45	2.911594	2517	0.969232	1819
	50	2.914117	2523	0.971056	1824
	55	2.916647	2530	0.972884	1828
142	0	2.919183	2536	0.974716	1832
	5	2.921726	—2543	0.976553	—1837
	10	2.924276	2550	0.978394	1841
	15	2.926832	2556	0.980239	1845
	20	2.929394	2562	0.982089	1850
	25	2.931964	2570	0.983943	1854
	30	2.934540	2576	0.985802	1859
	35	2.937124	—2584	0.987665	—1863
	40	2.939714	2590	0.989532	1867
	45	2.942310	2596	0.991404	1872
	50	2.944914	2604	0.993281	1877
	55	2.947525	2611	0.995162	1881
143	0	2.950142	2617	0.997047	1885
	5	2.952767	—2625	0.998937	—1890
	10	2.955398	2631	1.000832	1895
	15	2.958037	2639	1.002731	1899
	20	2.960682	2645	1.004635	1904
	25	2.963335	2653	1.006544	1909
	30	2.965994	2659	1.008457	1913
	35	2.968661	—2667	1.010375	—1918
	40	2.971336	2675	1.012297	1922
	45	2.974017	2681	1.014225	1928
	50	2.976706	2689	1.016157	1932
	55	2.979402	2696	1.018094	1937
144	0	2.982105	2703	1.020035	1941
			—2711		—1947

Angle. ° '	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
144 5	2.984816	—2711	1.021982	—1947
10	2.987534	2718	1.023933	1951
15	2.990259	2725	1.025889	1956
20	2.992992	2733	1.027850	1961
25	2.995732	2740	1.029816	1966
30	2.998480	2748	1.031787	1971
35	3.001236	—2756	1.033763	—1976
40	3.003999	2763	1.035743	1980
45	3.006770	2771	1.037729	1986
50	3.009548	2778	1.039720	1991
55	3.012334	2786	1.041716	1996
145 0	3.015128	2794	1.043716	2000
5	3.017930	—2802	1.045722	—2006
10	3.020739	2809	1.047733	2011
15	3.023557	2818	1.049749	2016
20	3.026382	2825	1.051771	2022
25	3.029215	2833	1.053797	2026
30	3.032056	2841	1.055829	2032
35	3.034906	—2850	1.057866	—2037
40	3.037763	2857	1.059908	2042
45	3.040628	2865	1.061955	2047
50	3.043502	2874	1.064008	2053
55	3.046384	2882	1.066066	2058
146 0	3.049273	2889	1.068129	2063
5	3.052171	—2898	1.070198	—2069
10	3.055078	2907	1.072272	2074
15	3.057993	2915	1.074352	2080
20	3.060916	2923	1.076437	2085
25	3.063847	2931	1.078527	2090
30	3.066787	2940	1.080623	2096
35	3.069736	—2949	1.082725	—2102
40	3.072693	2957	1.084832	2107
45	3.075658	2965	1.086945	2113
50	3.078632	2974	1.089063	2118
55	3.081615	2983	1.091187	2124
147 0	3.084607	2992	1.093316	2129
5	3.087607	—3000	1.095452	—2136
10	3.090616	3009	1.097593	2141
15	3.093634	3018	1.099739	2146
20	3.096661	3027	1.101892	2153
25	3.099697	3036	1.104050	2158
30	3.102742	3045	1.106215	2165
35	3.105796	—3054	1.108385	—2170
40	3.108859	3063	1.110561	2176
45	3.111931	3072	1.112742	2181
50	3.115012	3081	1.114930	2188
55	3.118102	3090	1.117124	2194
148 0	3.121202	3100	1.119324	2200
5	3.124311	—3109	1.121530	—2206
10	3.127429	3118	1.123742	2212
15	3.130557	3128	1.125960	2218
20	3.133694	3137	1.128184	2224
25	3.136840	3146	1.130414	2230
30	3.139996	3156	1.132651	2237
		—3166		—2243

Angle. ° '	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
148 35	3.143162	—3166	1.134894	—2243
40	3.146338	3176	1.137143	2249
45	3.149523	3185	1.139398	2255
50	3.152718	3195	1.141660	2262
55	3.155922	3204	1.143928	2268
149 0	3.159137	3215	1.146202	2274
5	3.162361	—3224	1.148483	—2281
10	3.165595	3234	1.150771	2288
15	3.168840	3245	1.153064	2293
20	3.172094	3254	1.155365	2301
25	3.175359	3265	1.157672	2307
30	3.178633	3274	1.159985	2313
35	3.181918	—3285	1.162306	—2321
40	3.185214	3296	1.164633	2327
45	3.188519	3305	1.166966	2333
50	3.191835	3316	1.169306	2340
55	3.195162	3327	1.171654	2348
150 0	3.198499	3337	1.174008	2354
5	3.201846	—3347	1.176368	—2360
10	3.205204	3358	1.178736	2368
15	3.208573	3369	1.181111	2375
20	3.211952	3379	1.183492	2381
25	3.215342	3390	1.185881	2389
30	3.218744	3402	1.188277	2396
35	3.222156	—3412	1.190679	—2402
40	3.225579	3423	1.193089	2410
45	3.229013	3434	1.195506	2417
50	3.232458	3445	1.197930	2424
55	3.235914	3456	1.200362	2432
151 0	3.239382	3468	1.202801	2439
5	3.242861	—3479	1.205247	—2446
10	3.246351	3490	1.207700	2453
15	3.249853	3502	1.210161	2461
20	3.253366	3513	1.212630	2469
25	3.256890	3524	1.215105	2475
30	3.260427	3537	1.217589	2484
35	3.263975	—3548	1.220080	—2491
40	3.267534	3559	1.222578	2498
45	3.271106	3572	1.225084	2506
50	3.274689	3583	1.227598	2514
55	3.278285	3596	1.230120	2522
152 0	3.281892	3607	1.232650	2530
5	3.285512	—3620	1.235187	—2537
10	3.289143	3631	1.237732	2545
15	3.292787	3644	1.240285	2553
20	3.296443	3656	1.242847	2562
25	3.300112	3669	1.245416	2569
30	3.303793	3681	1.247993	2577
35	3.307486	—3693	1.250579	—2586
40	3.311192	3706	1.253172	2593
45	3.314911	3719	1.255774	2602
50	3.318643	3732	1.258384	2610
55	3.322387	3744	1.261003	2619
153 0	3.326145	3758	1.263629	2626
		—3770		—2636

Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
153 5	3.329915	—3770	1.266265	—2636	157 35	3.555279	—4611	1.422710	—3181
10	3.333698	3783	1.268909	2644	40	3.559908	4629	1.425904	3194
15	3.337495	3797	1.271561	2652	45	3.564556	4648	1.429110	3206
20	3.341305	3810	1.274222	2661	50	3.569223	4667	1.432328	3218
25	3.345128	3823	1.276891	2669	55	3.573910	4687	1.435559	3231
30	3.348964	3836	1.279569	2678	158 0	3.578615	4705	1.438802	3243
35	3.352814	—3850	1.282256	—2687	5	3.583340	—4725	1.442058	—3256
40	3.356678	3864	1.284952	2696	10	3.588085	4745	1.445327	3269
45	3.360555	3877	1.287657	2705	15	3.592849	4764	1.448608	3281
50	3.364445	3890	1.290370	2713	20	3.597633	4784	1.451903	3295
55	3.368350	3905	1.293092	2722	25	3.602437	4804	1.455210	3307
154 0	3.372268	3918	1.295824	2732	30	3.607260	4823	1.458530	3320
5	3.376201	—3933	1.298564	—2740	35	3.612105	—4845	1.461864	—3334
10	3.380147	3946	1.301314	2750	40	3.616969	4864	1.465211	3347
15	3.384108	3961	1.304073	2759	45	3.621855	4886	1.468571	3360
20	3.388083	3975	1.306841	2768	50	3.626760	4905	1.471945	3374
25	3.392072	3989	1.309619	2778	55	3.631687	4927	1.475333	3388
30	3.396076	4004	1.312405	2786	159 0	3.636635	4948	1.478734	3401
35	3.400094	—4018	1.315202	—2797	5	3.641604	—4969	1.482149	—3415
40	3.404127	4033	1.318007	2805	10	3.646595	4991	1.485578	3429
45	3.408175	4048	1.320823	2816	15	3.651607	5012	1.489021	3443
50	3.412237	4062	1.323648	2825	20	3.656640	5033	1.492478	3457
55	3.416314	4077	1.326482	2834	25	3.661696	5056	1.495950	3472
155 0	3.420406	4092	1.329326	2844	30	3.666774	5078	1.499436	3486
5	3.424514	—4108	1.332181	—2855	35	3.671873	—5099	1.502936	—3500
10	3.428636	4122	1.335045	2864	40	3.676995	5122	1.506451	3515
15	3.432774	4138	1.337919	2874	45	3.682140	5145	1.509981	3530
20	3.436927	4153	1.340802	2883	50	3.687308	5168	1.513525	3544
25	3.441096	4169	1.343696	2894	55	3.692499	5191	1.517085	3560
30	3.445280	4184	1.346601	2905	160 0	3.697713	5214	1.520660	3575
35	3.449480	—4200	1.349515	—2914	5	3.702950	—5237	1.524249	—3589
40	3.453696	4216	1.352440	2925	10	3.708210	5260	1.527855	3606
45	3.457928	4232	1.355375	2935	15	3.713495	5285	1.531476	3621
50	3.462175	4247	1.358320	2945	20	3.718803	5308	1.535112	3636
55	3.466439	4264	1.361276	2956	25	3.724135	5332	1.538764	3652
156 0	3.470719	4280	1.364242	2966	30	3.729492	5357	1.542432	3668
5	3.475016	—4297	1.367219	—2977	35	3.734873	—5381	1.546116	—3684
10	3.479329	4313	1.370207	2988	40	3.740279	5406	1.549816	3700
15	3.483658	4329	1.373205	2998	45	3.745710	5431	1.553533	3717
20	3.488004	4346	1.376215	3010	50	3.751166	5456	1.557266	3733
25	3.492367	4363	1.379235	3020	55	3.756647	5481	1.561015	3749
30	3.496747	4380	1.382266	3031	161 0	3.762154	5507	1.564782	3767
35	3.501144	—4397	1.385309	—3043	5	3.767687	—5533	1.568565	—3783
40	3.505558	4414	1.388362	3053	10	3.773246	5559	1.572365	3800
45	3.509989	4431	1.391427	3065	15	3.778831	5585	1.576182	3817
50	3.514438	4449	1.394503	3076	20	3.784442	5611	1.580017	3835
55	3.518904	4466	1.397590	3087	25	3.790080	5638	1.583869	3852
157 0	3.523388	4484	1.400689	3099	30	3.795745	5665	1.587738	3869
5	3.527889	—4501	1.403800	—3111	35	3.801437	—5692	1.591626	—3888
10	3.532408	4519	1.406922	3122	40	3.807157	5720	1.595531	3905
15	3.536946	4538	1.410056	3134	45	3.812904	5747	1.599454	3923
20	3.541501	4555	1.413201	3145	50	3.818679	5775	1.603396	3942
25	3.546075	4574	1.416359	3158	55	3.824483	5804	1.607356	3960
30	3.550668	4593	1.419529	3170	162 0	3.830315	5832	1.611335	3979
		—4611		—3181			—5860		—3998

Angle.	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
° ′				
162 5	3.836175	—5860	1.615333	—3998
10	3.842065	5890	1.619349	4016
15	3.847983	5918	1.623385	4036
20	3.853931	5948	1.627440	4055
25	3.859909	5978	1.631514	4074
30	3.865917	6008	1.635608	4094
35	3.871955	—6038	1.639722	—4114
40	3.878024	6069	1.643856	4134
45	3.884124	6100	1.648010	4154
50	3.890255	6131	1.652185	4175
55	3.896417	6162	1.656380	4195
163 0	3.902611	6194	1.660596	4216
5	3.908837	—6226	1.664833	—4237
10	3.915095	6258	1.669091	4258
15	3.921386	6291	1.673371	4280
20	3.927710	6324	1.677672	4301
25	3.934068	6358	1.681996	4324
30	3.940460	6392	1.686341	4345
35	3.946885	—6425	1.690709	—4368
40	3.953344	6459	1.695099	4390
45	3.959838	6494	1.699512	4413
50	3.966368	6530	1.703948	4436
55	3.972933	6565	1.708407	4459
164 0	3.979533	6600	1.712889	4482
5	3.986170	—6637	1.717396	—4507
10	3.992843	6673	1.721926	4530
15	3.999553	6710	1.726481	4555
20	4.006300	6747	1.731060	4579
25	4.013085	6785	1.735663	4603
3	4.019908	6823	1.740292	4629
35	4.026769	—6861	1.744946	—4654
40	4.033669	6900	1.749626	4680
45	4.040609	6940	1.754331	4705
50	4.047588	6979	1.759062	4731
55	4.054607	7019	1.763820	4758
165 0	4.061667	7060	1.768605	4785
5	4.068768	—7101	1.773416	—4811
10	4.075910	7142	1.778255	4839
15	4.083095	7185	1.783121	4866
20	4.090322	7227	1.788015	4894
25	4.097591	7269	1.792938	4923
30	4.104904	7313	1.797888	4950
35	4.112261	—7357	1.802868	—4980
40	4.119662	7401	1.807877	5009
45	4.127108	7446	1.812915	5038
50	4.134599	7491	1 817984	5069
55	4.142136	7537	1.823082	5098
166 0	4.149720	7584	1.828211	5129
5	4.157350	—7630	1.833371	—5160
10	4.165028	7678	1.838562	5191
15	4.172755	7727	1.843785	5223
20	4.180530	7775	1.849040	5255
25	4.188354	7824	1.854328	5288
30	4.196228	7874	1.859648	5320
		—7924		—5353
166 35	4.204152	—7924	1.865001	—5353
40	4.212128	7976	1.870389	5388
45	4.220155	8027	1.875810	5421
50	4.228235	8080	1.881266	5456
55	4.236367	8132	1.886756	5490
167 0	4.244553	8186	1.892282	5526
5	4.252794	—8241	1.897844	—5562
10	4.261090	8296	1.903443	5599
15	4.269442	8352	1.909078	5635
20	4.277850	8408	1.914750	5672
25	4.286315	8465	1.920460	5710
30	4.294838	8523	1.926208	5748
35	4.303420	—8582	1.931996	—5788
40	4.312062	8642	1.937822	5826
45	4.320763	8701	1.943688	5866
50	4.329526	8763	1.949595	5907
55	4.338351	8825	1.955542	5947
168 0	4.347239	8888	1.961531	5989
5	4.356190	—8951	1.967562	—6031
10	4.365206	9016	1.973635	6073
15	4.374288	9082	1.979752	6117
20	4.383435	9147	1.985913	6161
25	4.392650	9215	1.992118	6205
30	4.401934	9284	1.998368	6250
35	4.411286	—9352	2.004664	—6296
40	4.420709	9423	2.011006	6342
45	4.430203	9494	2.017396	6390
50	4.439770	9567	2.023833	6437
55	4.449410	9640	2.030319	6486
169 0	4.459124	9714	2.036854	6535
5	4.468914	—9790	2.043439	—6585
10	4.478781	9867	2.050075	6636
15	4.488726	9945	2.056763	6688
20	4.498750	10024	2.063503	6740
25	4.508854	10104	2.070295	6792
30	4.519040	10186	2.077142	6847
35	4.529309	10269	2.084044	—6902
40	4.539662	10353	2.091002	6956
45	4.550100	10438	2.098016	7014
50	4.560626	10526	2.105088	7072
55	4.571240	10614	2.112218	7130
170 0	4.581944	10704	2.119408	7190
5	4.592740	10796	2.126658	—7250
10	4.603628	10888	2.133970	7312
15	4.614610	10982	2.141344	7374
20	4.625689	11079	2.148782	7438
25	4.636865	11176	2.156285	7503
30	4.648141	11276	2.163853	7568
35	4.659518	11377	2.171489	—7636
40	4.670998	11480	2.179192	7703
45	4.682583	11585	2.186965	7773
50	4.694274	11691	2.194809	7844
55	4.706073	11799	2.202725	7916
171 0	4.717983	11910	2.210713	7988
		12023		—8064

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Dist.
171	5	4.730006	12023	2.218777	—8064
	10	4.742144	12138	2.226916	8139
	15	4.754398	12254	2.235133	8217
	20	4.766771	12373	2.243429	8296
	25	4.779266	12495	2.251806	8377
	30	4.791884	12618	2.260264	8458
	35	4.804629	12745	2.268806	—8542
	40	4.817502	12873	2.277433	8627
	45	4.830506	13004	2.286148	8715
	50	4.843645	13139	2.294951	8803
	55	4.856919	13274	2.303845	8894
172	0	4.870333	13414	2.312831	8986
	5	4.883890	13557	2.321912	—9081
	10	4.897591	13701	2.331089	9177
	15	4.911441	13850	2.340364	9275
	20	4.925443	14002	2.349740	9376
	25	4.939599	14156	2.359219	9479
	30	4.953913	14314	2.368803	9584
	35	4.968389	14476	2.378494	—9691
	40	4.983031	14642	2.388295	9801
	45	4.997842	14811	2.398209	9914
	50	5.012826	14984	2.408237	10028
	55	5.027986	15160	2.418383	10146
173	0	5.043328	15342	2.428649	10266
	5	5.058856	15528	2.439039	10390
	10	5.074574	15718	2.449555	10516
	15	5.090486	15912	2.460200	10645
	20	5.106598	16112	2.470978	10778
	25	5.122914	16316	2.481891	10913
	30	5.139440	16526	2.492944	11053
	35	5.156181	16741	2.504140	11196
	40	5.173143	16962	2.515483	11343
	45	5.190331	17188	2.526976	11493
	50	5.207752	17421	2.538624	11648
	55	5.225412	17660	2.550430	11806
174	0	5.243317	17905	2.562400	11970
	5	5.261474	18157	2.574537	12137
	10	5.279890	18416	2.586847	12310
	15	5.298574	18684	2.599334	12487
	20	5.317532	18958	2.612004	12670
	25	5.336772	19240	2.624862	12858
	30	5.356304	19532	2.637913	13051
	35	5.376136	19832	2.651165	13252
	40	5.396278	20142	2.664621	13456
	45	5.416738	20460	2.678290	13669
	50	5.437527	20789	2.692179	13889
	55	5.458657	21130	2.706293	14114
175	0	5.480137	21480	2.720641	14348
	5	5.501980	21843	2.735230	14589
	10	5.524199	22219	2.750069	14839
	15	5.546806	22607	2.765167	15098
	20	5.569815	23009	2.780532	15365
	25	5.593240	23425	2.796174	15642
	30	5.617097	23857	2.812104	15930
			24304		16227

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Dist.
175	35	5.641401	24304	2.828331	16227
	40	5.666171	24770	2.844868	16537
	45	5 691424	25253	2.861727	16859
	50	5.717178	25754	2.878919	17192
	55	5.743454	26276	2.896459	17540
176	0	5.770274	26820	2.914362	17903
	5	5.797661	27387	2.932641	18279
	10	5.825639	27978	2.951314	18673
	15	5.854233	28594	2.970398	19084
	20	5.883472	29239	2.989911	19513
	25	5.913384	29912	3.009872	19961
	30	5.944003	30619	3.030304	20432
	35	5.975361	31358	3.051229	20925
	40	6.007496	32135	3.072670	21441
	45	6.040446	32950	3.094655	21985
	50	6.074254	33808	3.117211	22556
	55	6.108965	34711	3.140369	23158
177	0	6.144629	35664	3.164162	23793
	5	6.181299	36670	3.188625	24463
	10	6.219035	37736	3.213798	25173
	15	6.257900	38865	3.239723	25925
	20	6.297962	40062	3.266446	26723
	25	6.339298	41336	3.294018	27572
	30	6.381991	42693	3.322494	28476
	35	6.426134	44143	3.351936	29442
	40	6.471828	45694	3.382412	30476
	45	6.519185	47357	3.413996	31584
	50	6.568332	49147	3.446773	32777
	55	6.619409	51077	3.480836	34063
178	0	6.672573	53164	3.516289	35453
	5	6.728001	55428	3.553253	36964
	10	6.785896	57895	3.591860	38607
	15	6.846486	60590	3.632263	40403
	20	6.910035	63549	3.674638	42375
	25	6.976847	66812	3.719188	44550
	30	7.047273	70426	3.766148	46960
	35	7.121727	74454	3.815792	49644
	40	7.200699	78972	3.868447	52655
	45	7.284771	84072	3.924502	56055
	50	7.374647	89876	3.984427	59925
	55	7.471189	96542	4.048794	64367
179	0	7.575464	104275	4.118316	69522
	5	7.688819	113355	4.193892	75576
	10	7.812987	124168	4.276675	82783
	15	7.950251	137264	4.368189	91514
	20	8.103703	153452	4.470494	102305
	25	8.277670	173967	4.586475	115981
	30	8.478504	200834	4.720368	133893
	35	8.716043	237539	4.878730	158362
	40	9.006769	290726	5.072549	193819
	45	9.381582	374813	5.322426	249877
	50	9.909853	528271	5.674608	352182
	55	10.812942	903089	6.276668	602060
180	0				

TABLE III. *Errors in taking Proportional Parts of the above Parabolick Table.*

Ang. from Per.			Log. M.M.	Ang. by Pro. Par.			Log. of Distance True.	FromM.M.	Equal Div.	Error.	Dist. too great.
45°	2′	30″	1.516934	45°	2′	30″	0.068900	900	900	.000000	
154	57	30	3.418358	154	57	29.9	1.327903	903	904	.000001	
159	57	30	3.695102	159	57	29.8	1.518870	870	872	.000002	
169	57	30	4.576581	169	57	29.7	2.115806	806	813	.000007	1.00002
173	57	30	5.234333	173	57	29.5	2.556394	394	415	.000021	1.00005
174	57	30	5.469352	174	57	29.4	2.713437	437	467	.000030	1.00007
178	57	30	7.522283	178	57	27.0	4.082860	859	3555	.000695	1.00108
179	52	30	10.284669	179	52	4.5	5.924485	486	75638	.051153	1.12500

TABLE IV. *Equation of the Sun's Place, from the Menstrual Parallax.*

Add.				☉'s Per. ☽'s Per.	☉'s Per. ☽'s Ap.	☉'s Ap. ☽'s Per.	☉'s Ap. ☽'s Ap	Substract.			
s	°	s	°	″	″	″	″	s	°	s	°
0	0	6	0	0	0	0	0	6	0	12	0
	5		25						5		25
	10		20	3	3	2	3		10		20
	15		15						15		15
	20		10	5	6	5	6		20		10
	25		5						25		5
1	0	5	0	8	9	7	8	7	0	11	0
	5		25						5		25
	10		20	10	12	10	11		10		20
	15		15						15		15
	20		10	12	14	11	13		20		10
	25		5						25		5
2	0	4	0	13	15	13	14	8	0	10	0
	5		25						5		25
	10		20	14	16	14	15		10		20
	15		15						15		15
	20		10	15	17	14	16		20		10
	25		5						25		5
3	0	3	0	15	17	15	17	9	0	9	0

TABLE V. *Increase or Decrease of the Earth's Dist. from the Sun, from the Menstrual Parallax.*

Add.				☽'s Par. 54′	55′	56′	57′	58′	59′	60′	61′	Substract.			
s	°	s	°									s	°	s	°
0	0	12	0	0.0000795	780	766	753	740	727	715	703	6	0	6	0
	5		25	0.0000791	777	763	750	737	724	712	701		5		25
	10		20	0.0000783	768	755	741	729	716	704	693		10		20
	15		15	0.0000767	753	740	727	714	702	691	679		15		15
	20		10	0.0000747	733	720	707	695	683	672	661		20		10
	25		5	0.0000720	707	694	682	671	659	648	638		25		5
1	0	11	0	0.0000688	675	663	652	641	630	619	609	7	0	5	0
	5		25	0.0000651	639	628	617	606	596	586	576		5		25
	10		20	0.0000609	598	587	577	567	557	548	539		10		20
	15		15	0.0000562	552	542	532	523	514	506	497		15		15
	20		10	0.0000511	501	492	484	476	467	460	452		20		10
	25		5	0.0000456	447	439	432	424	417	410	403		25		5
2	0	10	0	0.0000397	390	383	376	370	364	358	352	8	0	4	0
	5		25	0.0000336	330	324	318	313	307	302	297		5		25
	10		20	0.0000272	267	262	257	253	249	245	241		10		20
	15		15	0.0000206	202	198	195	191	188	185	182		15		15
	20		10	0.0000138	135	133	131	128	126	124	122		20		10
	25		5	0.0000069	068	067	066	064	063	062	061		25		5
3	0	9	0	0.0000000	000	000	000	000	000	000	000	9	0	3	0

Tables IV. and V. are to be thus used: From the moon's place substract the sun's, and against the remainder in table IV. is the angle CSE (fig. 6.) to be added to, or substracted from the sun's place as found by the common tables. Against the remainder in table V. is given the length of the line ED in parts of the earth's mean distance, to be added to, or substracted from the distance of the earth from the sun, which the tables of the sun give.

TAB. VI. *Decimals of a Degree reduced to Minutes and Seconds.*

	″		′	″		′	″
.001	3.6	.01	0	36	.1	6	0
.002	7.2	.02	1	12	.2	12	0
.003	10.8	.03	1	48	.3	18	0
.004	14.4	.04	2	24	.4	24	0
.005	18.0	.05	3	0	.5	30	0
.006	21.6	.06	3	36	.6	36	0
.007	25.2	.07	4	12	.7	42	0
.[illegible]8	28.8	.08	4	48	.8	48	0
[illegible]	[illegible]4	.09	5	24	.9	54	0

TABLE VII. *Decimals of a Day reduced to Hours, Minutes, and Seconds.*

	″		′	″		′	″		h	′	″		h	′	″
.00001	0.864	.0001	0	8.64	.001	1	26.4	.01	0	14	24	.1	2	24	0
.00002	1.728	.0002	0	17.28	.002	2	52.8	.02	0	28	48	.2	4	48	0
.00003	2.592	.0003	0	25.92	.003	4	19.2	.03	0	43	12	.3	7	12	0
.00004	3.456	.0004	0	34.56	.004	5	45.6	.04	0	57	36	.4	9	36	0
.00005	4.320	.0005	0	43.20	.005	7	12.0	.05	1	12	0	.5	12	0	0
.00006	5.184	.0006	0	51.84	.006	8	38.4	.06	1	26	24	.6	14	24	0
.00007	6.048	.0007	1	0.48	.007	10	4.8	.07	1	40	48	.7	18	48	0
.00008	6.912	.0008	1	9.12	.008	11	31.2	.08	1	55	12	.8	19	12	0
.00009	7.776	.0009	1	17.76	.009	12	57.6	.09	2	9	36	.9	21	36	0

TABLE VIII.

Days Mot.	Comet 1680. Ang. from Per. ° ′ ″	Dist. fr. ☉	Ordinate.	Comet 1682. Ang. from Per. ° ′ ″	Dist. fr. ☉
$\frac{1}{4}$	132 58 6	0.03847	0.02815		
$\frac{1}{2}$	143 53 13	0.06375	0.03757		
1	151 56 38	0.10425	0.04903		
2	158 1 52	0.16874	0.06312		
3	160 54 58	0.22289	0.07287		
4	162 42 52	0.27124	0.08059	12 26 46	0.59022
8	166 21 18	0.43402	0.10239	24 16 54	0.61027
12	168 6 23	0.57059	0.11760	35 10 54	0.64192
16	169 12 25	0.69249	0.12968	44 54 55	0.68294
20	59 19	0.80453	0.13986	53 27 18	0.73117
24	170 35 4	0.90929	0.14875	60 53 1	0.78470
28	171 3 36	1.00836	0.15670	67 20 5	0.84204
32	27 7	1.10281	0.16392	72 56 25	0.90196
36	47 0	1.19339	0.17055	77 50 28	0.96361
40	172 4 8	1.28067	0.17671	82 8 50	1.02634
44	19 6	1.36508	0.18247	85 57 18	1.08969
48	32 21	1.44697	0.18789	89 20 35	1.15334
52	44 12	1.52661	0.19301	92 22 36	1.21703
56	55 7	1.60424	0.19777	95 6 32	1.28059
60	173 4 36	1.68003	0.20251	97 34 58	1.34390
64	13 28	1.75416	0.20696	99 50 6	1.40686
68	21 39	1.82676	0.21120	101 53 41	1.46943
72	29 12	1.89796	0.21529	103 47 13	1.53154
76	36 13	1.96783	0.21923	105 31 54	1.59316
80	42 44	2.03651	0.22304	107 8 50	1.65430
84	48 51	2.10403	0.22672	108 38 53	1.71491
88	54 35	2.17050	0.23028	110 2 49	1.77501
92	59 59	2.23597	0.23373	111 21 16	1.83461
96	174 5 4	2.30049	0.23709	112 34 48	1.89368
100	9 53	2.36413	0.24036	113 43 54	1.95225
104	14 27	2.42692	0.24354	114 49 0	2.01032
108	18 46	2.48892	0.24665	115 50 27	2.06791
112	22 54	2.55005	0.24965	116 48 35	2.12501
116	26 50	2.61065	0.25261	117 43 42	2.18163
120	30 35	2.67046	0.25550	118 36 2	2.23779

TABLE IX. *Abscissa and Ordinate of a Parabola at different Angles from the Vertex.*

Angle	Abscissa.	Ordinate.	Angle	Abscissa.	Ordinate.
10°	0.00765	0.17498	130°	4.59891	4.28901
20	0.03109	0.35265	140	7.54863	5.49495
30	0.07180	0.53590	150	13.92821	7.46410
40	0.13247	0.72794	160	32.16343	11.34254
50	0.21744	0.93261	170	130.64610	22.86011
60	0.33333	1.15470	175	524.58248	45.80752
70	0.49029	1.40042	176	820.03500	57.27250
80	0.70409	1.67820	177	1458.35842	76.37693
90	1.00000	2.00000	178	3282.13970	114.57992
100	1.42028	2.38351	179	13130.55876	229.17730
110	2.03961	2.85630	$179\frac{1}{2}$	52524.23496	458.36332
120	3.00000	3.46410	$179\frac{3}{4}$	210098.93985	916.73103

TABLE X.

Hourly Motion of Comets.

Perih. Dist.	Parts of M. O.	Miles.
Comet 1680	.012952	997000
0.1	.003205	247000
0.2	.002267	175000
0.3	.001851	143000
0.4	.001603	123000
0.5	.001434	110000
0.6	.001309	101000
0.7	.001212	93000
0.8	.001133	87000
0.9	.001068	82000
1.0	.001014	78000
1.5	.000828	64000
2.0	.000717	55000
2.5	.000641	49000
3.0	.000585	45000
3.5	.000542	42000
4.0	.000507	39000

Time from Perih. to Lat. rect.

Comet	Dec. of Days.	d	h	′	″
1680	0.052545	0	1	15	40
0.1	3.46635	3	11	11	32
0.2	9.80430	9	19	18	12
0.3	18.01165	18	0	16	46
0.4	27.73076	27	17	32	16
0.5	38.75490	38	18	7	4
0.6	50.94464	50	22	40	17
0.7	64.19757	64	4	44	30
0.8	78.43440	78	10	25	33
0.9	93.59129	93	14	11	27
1.0	109.61543	109	14	46	13
1.5	201.3764	201	9	2	
2.0	310.0392	310	0	56	
2.5	433.2929	433	7	2	
3.0	569.5785	569	13	53	
3.5	717.7507	717	18	1	
4.0	876.9232	876	22	9	

TABLE XI.

Apparent Motion of the Comet of 1682, at its next Return, whatever Month of the Year its Perihelion happens in.

Perihelion April 20.

Time.	Long.	Lat.	Curt. Dist.
Apr. 20	♈ 1.8°	N. 8.2°	1.18
30	3.3	9.1	0.80
May 10	11.9	9.8	0.41
20	♋ 2.2	1.5	0.17
30	♌ 26.5	S. 7.1	0.48
June 9	♍ 6.7	8.1	0.85

Perihelion May 21.

Time.	Long.	Lat.	Curt. Dist.
May 11	♈ 23.2	N. 8.5	1.29
21	26.2	10.8	0.90
31	♉ 12.3	14.4	0.50
June 10	♋ 15.1	12.1	0.32
20	♌ 28.3	0.4	0.60
30	♍ 10.8	S. 3.5	0.97

Perihelion June 21.

Time.	Long.	Lat.	Curt. Dist.
June 11	♉ 15.9	N. 10.7	1.01
21	♊ 1.2	15.3	0.62
July 1	♋ 20.4	17.0	0.42
11	♍ 4.7	6.0	0.65
21	19.1	0.2	1.02

Perihelion July 23.

Time.	Long.	Lat.	Curt. Dist.
July 3	♊ 2.6	N. 9.7	1.10
13	16.0	15.1	0.80
23	♋ 27.7	20.4	0.45
Aug. 2	♍ 15.9	11.1	0.56
12	♎ 1.5	3.9	1.03

Perihelion August 22.

Time.	Long.	Lat.	Curt. Dist.
July 23	♊ 12.9	N. 8.8	1.13
Aug. 2	26.3	13.9	0.75
12	♌ 0.7	22.8	0.45
22	♍ 26.0	16.5	0.58
Sept. 1	♎ 15.1	7.8	0.95

Perihelion September 23.

Time.	Long.	Lat.	Curt. Dist.
Aug. 14	♊ 23.9	N. 7.4	1.09
24	♋ 4.5	13.2	0.71
Sept. 3	♌ 8.3	25.4	0.39
13	♎ 12.3	22.0	0.47
23	♏ 4.1	11.4	0.85

Perihelion October 23.

Time.	Long.	Lat.	Curt. Dist.
Sept. 3	♊ 29.2°	N. 6.3°	1.01
13	♋ 7.6	13.0	0.62
23	♌ 9.3	31.0	0.28
Oct. 3	♏ 6.0	28.7	0.34
13	26.8	14.6	0.73
23	♐ 0.2	8.7	1.12

Perihelion November 22.

Time.	Long.	Lat.	Curt. Dist.
Sept. 13	♊ 27.7	N. 2.6	1.25
23	29.8	5.2	0.88
Oct. 3	♋ 1.9	12.6	0.50
13	12.	51.	0.11
15	♌ 7.	74.	0.04
16	♎ 16.	78.	0.03
23	♐ 23.	31.	0.28
Nov. 2	25.6	15.8	0.66
12	24.5	10.2	1.03

Perihelion December 21.

Time.	Long.	Lat.	Curt. Dist.
Oct. 2	♊ 26.7	N. 0.7	1.12
12	23.0	3.5	0.77
22	11.1	10.7	0.42
Nov. 1	♈ 16.6	28.3	0.21
11	♒ 12.2	20.2	0.39
21	♑ 26.5	13.4	0.70
Dec. 1	20.8	10.5	1.01
Feb. 19	♐ 16.4	S. 9.2	1.13
Mar. 1	3.8	13.8	0.98
11	♏ 19.0	19.1	0.88
21	0.2	23.0	0.83
31	♎ 12.4	23.8	0.91

Perihelion January 20.

Time.	Long.	Lat.	Curt. Dist.
Oct. 12	♊ 24.3	S. 2.3	1.31
22	18.7	1.1	0.99
Nov. 1	6.8	N. 1.2	0.71
11	♉ 6.4	5.2	0.51
21	♈ 4.2	9.2	0.50
Dec. 1	♓ 8.8	9.5	0.66
11	♒ 25.0	9.2	0.89
21	16.9	8.5	1.11

Time.	Long.	Lat.	Curt. Dist.
Mar. 1	♑ 9.5°	S. 3.4°	1.02
11	0.2	8.7	0.80
21	♐ 12.9	16.4	0.62
31	♏ 13.3	24.2	0.54
Apr. 10	♎ 13.0	25.6	0.63
20	♍ 24.9	22.5	0.85
30	16.7	19.5	1.13

Perihelion February 19.

Time.	Long.	Lat.	Curt. Dist.
Nov. 1	♊ 15.7	S. 4.1	1.21
11	4.6	3.1	0.98
21	♉ 18.6	1.3	0.83
Dec. 1	♈ 26.9	N. 1.0	0.78
11	8.0	3.2	0.86
21	♓ 24.8	4.6	1.00
Mar. 11	♒ 10.9	3.6	1.10
21	4.8	0.4	0.83
31	♑ 24.0	S. 6.3	0.54
Apr. 10	♐ 22.2	22.2	0.30
20	♎ 17.1	29.2	0.33
30	♍ 21.3	21.7	0.61
May 10	12.9	17.8	0.93

Perihelion March 20.

Time.	Long.	Lat.	Curt. Dist.
Nov. 30	♉ 21.2	S. 3.3	1.13
Dec. 10	7.2	2.7	1.09
20	♈ 24.3	1.0	1.14
Mar. 30	♓ 6.5	N. 7.0	1.18
Apr. 9	3.9	4.7	0.76
19	♒ 29.0	0.8	0.40
29	♑ 22.	S. 50.	0.05
30	♐ 11.	62.	0.04
May 9	♒ 10.8	20.1	0.33
19	8.6	14.8	0.70
29	9.0	13.8	1.07

TABLE XII.

Place where the Comet of 1682 may be first expected to appear any Month.

		Longitude.		Latitude.	Diſt. from Perihelion.	Bearing and Time.
January		Scarce to be ſeen.				
February	End	Retrog. between	30° and 15° of ♐	Small increaſing S.	7 weeks after its perih.	Low S. E. morning.
March	Beginning	——	30 and 15 of ♑	Small N. or S.	A month after perih.	
	End	——	30 and 0 of ♒	Small N. decreaſing		
April	Beginning	——	15 and 0 of ♓	Small N. decreaſing	2 or 3 weeks after.	Low E. morning.
	End	Stationary	10 ♈ and 20 ♓	Small N.		
May	Beginning	——	Middle of ♈	N.	About the perihelion.	
	End	Direct	Beginning of ♉		1, 2, or 3 weeks before.	
June	Beginning	——	Beginning of ♉	N. increaſing		E. morning.
	End	——	End of ♉			N. E. morning.
July	Beginning	——	Beginning of ♊		2, 3, 4, or 5 weeks.	Low N. E. morning.
	End	——	Middle of ♊			
Auguſt		——	End of ♊		5, 6, 7, or 8 weeks.	Riſes N. E. midnight.
September		Stationary	25 and 30 of ♊	Small increaſing N.	2 months before.	—— N. E. at 11.
October		Retrograde	End of ♊	Small S. or N.	2 or 3 months.	—— N. E. at 9
November,	Beginning	——	Beginning of ♊	Small S.	3 months before per.	—— N. E. at 7.
	Middle	——	5 ♊ and 20 ♉	Small S.		—— E. at 5.
	End	——	Beginning of ♉	Small S. or N.		Low E. evening.
December,	Beginning	——	Begin. of ♉, End of ♈	Small S. or N.	11, 12, 13, or 14 weeks.	E. evening.
	End	——	Beginning of ♈	Very faint.		S. E. evening.

E R R A T A.

			for	read				for	read
Page 1	Line 7	— —	them ſelves	themſelves	Tab. 1	1718	Col. 7	6° 28′ 50″	6° 28′ 44″
2	12	— —	aſtronomically	in ſome meaſure aſtronomically	2	64° 15′	2	1.726681	1.726581
10	N°. 22	Col. 2	BDD	BDD′	7	Line 7	10	$18^h\ 48'$	$16^h\ 48'$
24	Line 43	— —	I nor can	nor can I	10	0.4		$27^d\ 17^h\ 32'\ 16''$	$27^d\ 17^h\ 32'\ 18''$
					11	Perih. Mar. 20 Line 9		♒ 10.8°	♍ 10.8°

THE INDEX.

THE END.

Corrections and Improvements in BARKER's *Discoveries concerning Comets*; found out since it was published.

P. 10, N° 15 $BEb = HAC$

31 $BE'b' = H'A'C'$

32 $SE'I' = \text{suppl.} H'A'C' + \text{suppl.} SE'B$

41 for $\chi\psi\omega$, read $\chi\psi\omega \times \sqrt{2}$.

82 $HC' - Hc' \mp cp = Cp$.

83 for $C'g$ read $C'G$

51 Tab. VIII. 4. for 12° 26′ 46″ read 12° 25′ 5″.

for 0.59022 read 0.59018.

If in Page 9 and 10, N° 5, 6, and 37, are not correct enough, (as in a very oblique Comet perhaps they may not) SL N° 6, and SR N° 37, may be found more correctly thus:

Take SB, $S\mu$ and $B\gamma$ as found by a former construction or calculation; and omitting N° 5 and 6, say,

Former SB : former $S\mu$ :: present SB : present $S\mu$

Former $B\gamma$: present $B\gamma$ :: former $\mu\nu$: present $\mu\nu$. ν is the point in the orbit perpendicularly over μ; and found as below.

Then $S\mu : \mu\nu :: R : \text{tang.}\ \mu S\nu$

$\text{cos.}\ \mu S\nu : R :: S\mu + \frac{1}{3} I\mu : SL$

To find $\mu\nu$, omit N° 37, and having by N° 39 found $KM = AC$, and $KN = CN - AM$.

In the triangle $SB\mu'$, from SB, $BS\mu'$ ($= IS\mu' - I'SE' - BSE'$) and $S\mu'B$ ($= S\mu'I' + I'\lambda'i'$) find $B\mu'$.

$KM : KN :: B\mu' : x \qquad \therefore B\gamma - x = \mu\nu$.

Then $S\mu' : \mu\nu :: R : \text{tang}\ \mu S\nu$.

$\text{cos.}\ \mu S\nu : R :: S\varrho : SR$.