A NEW SYSTEM OF PRACTICAL

ASTRONOMY,

MADE PLAIN AND EASY TO THOSE WHO HAVE NOT STUDIED MATHEMATICS.

CONTAINING

THE ELEMENTARY PRINCIPLES OF THE SCIENCE;

ALL THE

RULES AND TABLES

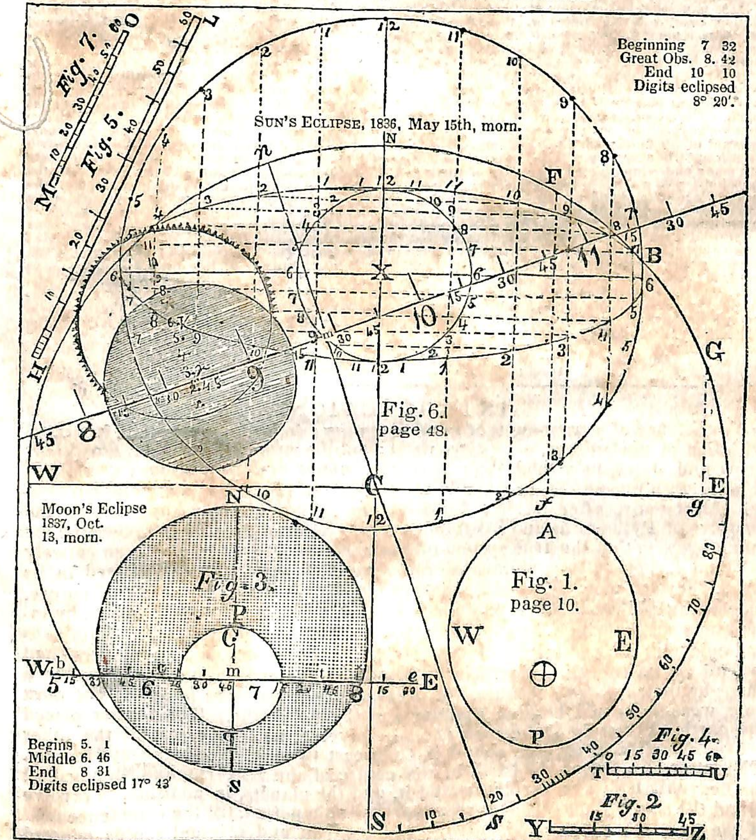
NECESSARY FOR MAKING ALL THE

CALCULATIONS FOR AN ALMANAC;

And for the solution of more than one hundred Astronomical and Chronological Problems; with sketches of Geometry, Trigonometry, Surveying, Levelling, and other branches of Mathematics, depending on the principles of Geometry: also the construction and use of Logarithms; a Table of the Logarithms of Numbers, of Logarithmic Sines, Tangents, and Secants, and of Logistical Logarithms; and an Explanation of the manner of constructing the Tables, &c. &c.

BY THOMAS SPOFFORD.

SECOND EDITION WITH ADDITIONS AND CORRECTIONS.



SUN'S ECLIPSE, 1836, May 15th, morn.

Beginning 7 32
Great Obs. 8. 42
End 10 10
Digits eclipsed 8° 20'.

Moon's Eclipse 1837, Oct. 13, morn.

Begins 5. 1
Middle 6. 46
End 8 31
Digits eclipsed 17° 43'

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PREFACE.

All unacquainted with mathematics, who have wished to pursue the study of Astronomy, have always experienced the want of a concise work, containing the elementary principles of the science, with the rules and tables necessary for solving its most useful and interesting Problems. It was this that induced the author, a long time ago, to undertake the following: but it would not even now be presented to the public, were several of the late publications on the same subject, what their titles and prefaces purport. With the exception of Gummere's excellent treatise, (to understand which, a thorough knowledge of the most abstruse branches of mathematics is required,) there has no work been produced in America, containing the precepts and TABLES necessary for making the calculations of a common Almanac. 'Tis true, within a few years, several systems, purporting to be such, have made their appearance; but they are only compilations from Ferguson and others, containing little or nothing new, and all the radical ERRORS in the TABLES of those excellent and now obsolete works. A knowledge of Algebra, Conic Sections, and several other branches of mathematics, has generally been considered indispensable for any one who would know any thing of Astronomy: but the following Treatise is designed to render the science perfectly intelligible, and easy to be understood, by those who have no further knowledge of mathematics, than the simple rules of Arithmetic; and it is believed that the problems may all be readily solved by any person of common intellect, without the aid of a teacher. Many of the rules and tables are entirely *new;* those for the CALCULATION of ECLIPSES save more than NINE TENTHS of the time and trouble required to solve the problem in the usual tedious and intricate way of calculating by parallaxes, and are sufficiently accurate for common purposes. For the last seven years, the author has used no other rules or tables in making the calculations for his Almanac, and for several of the most popular Registers and Almanacs in the United States and the British Colonies. By these rules and tables, he has calculated all the eclipses that will happen for ONE HUNDRED YEARS; which could hardly be done by the old method, (parallaxes,) in the lifetime of a man, should he live to that age.

To render the work more useful, enough of Geometry, Trigonometry, and several other branches of mathematics, is given, to enable the reader to solve understandingly the most important and useful Problems in those studies. As the principles of Geometry are general and abstract truths, and exist in nature, independently of lines and figures, it is thought that the learner may acquire a far better, and more lasting idea of these principles, by reasoning abstractly, and then making his own diagrams for illustration and demonstration, than by having figures first presented to the eye. For this reason, the Geometrical definitions and propositions are given in general terms, and without reference to, or the aid of diagrams; which leads the learner so to pursue the study of Geometry, as to improve that mental faculty, which enables the mind to comprehend general propositions, and to pursue trains of thought disconnected with sensible objects. For the same reason, examples are omitted in several Problems; for if the learner is able by the rule alone to solve the Problem, without any visible illustration, he will be much more likely to remember the solution, than if it was illustrated by an example wrought out. But in difficult Problems, examples are wrought at length. The erroneous opinion which has hitherto prevailed, that none could learn Astronomy without previously studying a tedious course of mathematics, has undoubtedly prevented many from beginning a study, the want of which they have severely felt, when, in after life, they have been engaged in business wherein this science was necessary. That any art or science may be made of most service to mankind, it is requisite that many understand it; for the united strength of numbers will readily accomplish what far exceeds the limited ability of a few. If means could be devised to extend and increase the knowledge of Astronomy, the advantages resulting to the community would be immensely great. The discoveries and improvements in the science have of late been many and great; but a dissemination of astronomical knowledge has not been commensurate with these. Could one object more be obtained, (which at first might seem easy,) the means of ascertaining longitude with the same facility that latitude is determined, this single discovery would be of more value to mankind, than the richest gold mine in the world. The government of Great Britain has frequently paid premiums of 10,000 pounds sterling, for only improvements in the method of determining longitude; and a reward of 50,000 pounds sterling is now offered by the same government, to any person who shall obtain this grand desideratum in Nautical Astronomy. That a competent knowledge of Astronomy for all common practical purposes, may be obtained without any previous knowledge of mathematics, except Arithmetic, is designed to be proved by this Treatise. How far the author has succeeded, is left to the judgment of the candid.

INTRODUCTION.

The science of astronomy is of great antiquity; indeed, we may date its origin with that of agriculture, or society itself: but the arts and sciences, like kingdoms and states, have had their various changes and revolutions; sometimes shining with uncommon lustre, and at others involved in obscurity and barbarity. Astronomy, after having flourished for a considerable time, under the auspices of Pythagoras and his followers, was again neglected and obscured for many ages, so that the true system of the universe seems to have been entirely lost and forgotten, and whimsical and erroneous ones were substituted in its place. Instead of consulting the heavens, and collecting the history of nature, succeeding philosophers were ambitious of gratifying their own vanity, by inventing systems, which had no conformity to fact and experiment. Solid orbs and epicycles were multiplied to answer every appearance, till the universe had lost all its native beauty in their descriptions, and seemed again reduced to a chaos by their unhappy labours. The erroneous hypotheses or systems of most note, were those of Claudius Ptolemy and Tycho Brahe. The former placed the earth at rest in the centre of the universe, and supposed all the other heavenly bodies to revolve round it, from east to west, once in about 24 hours. The latter also placed the earth in the centre of the universe, and supposed all the heavenly bodies to revolve round it, and the planets, in addition, to revolve round the sun. These systems were severally supported, till the commencement of the sixteenth century, when Copernicus, a bold and original genius, adopted the Pythagorean, or true system of the universe, and published it to the world in

the year 1530, with new and demonstrative arguments in its favour. Animated with daring enthusiasm, he laid his hands on the cycles and crystal orbs of Ptolemy, and dashed them to pieces. And, with the same noble frenzy, he took the unwieldly earth, and sent her far from the centre of the system, to move round the sun with the rest of the planets; so that, of all the celestial equipage, with which she had been formerly dignified, there only remained the moon to attend and accompany her in her journey. This system is particularly described as the Solar System. As Europe, however, was still immersed in barbarism and ignorance, it was a long time before it was accepted as the true system: but the discoveries of Kepler and Galileo, (by means of the telescope, which was the invention of the latter,) confirmed it; and it has since, by Sir Isaac Newton, been established upon such an immoveable and everlasting basis of mathematical demonstration, as can never be shaken, while the present frame of nature exists.

With regard to some scripture expressions, which, if taken in their literal sense, seem to contradict some of the principles of this system, it may be observed, that men of sense, in all ages, when not treating of the sciences, have adapted their language to the capacity of their hearers; and in this manner, no doubt, those passages are to be understood. Moses and Joshua might have been acquainted with the motion of the earth; but if they had said that the sun was at rest in the firmament, and that the rising and setting of the heavenly bodies were caused by the revolution of the earth on its axis, the Israelites, who were unskilled in human science, would rather have considered them as impostors, than as leaders commissioned by the Almighty to conduct them from bondage and servitude to the promised land. The moon is known to be a dark body, shining only by reflecting the light of the sun: it is also known to be the smallest body visible in the heavens; but it would be idle to tell the common people this, for it appears larger and more luminous than any other, except the sun. Moses, therefore, calls the moon, as well as the sun, a Great Luminary, because he adapted his language to the ideas and conceptions of the people whom he addressed. We cannot suppose that the scriptures were intended to instruct in the sciences, yet many parts clearly prove that their authors were eminent in human learning, as well as divine. The writer, for instance, of the book of Job, whoever he might be, was a profound scholar and philosopher, as well as theologian. Nothing human can in any way compare with the majestic grandeur, beauty, and sublimity of the language of that book—with the exalted ideas and conceptions it gives of the Supreme Being. And it is not in Job only, but in every other part of the Bible, that the most magnificent descriptions of the divine nature, and the works of creation, are given with such majestic beauty and brevity, as it is in vain to look for in any human composition.

To the noble science of astronomy we are indebted for what we know of the most wonderful works of the Deity. In the heavens it is, that the All-wise Creator has chiefly manifested his greatness and power. It is here that sovereign wisdom shines with the greatest lustre and majesty, and that the most sublime ideas of order and harmony reign. In this innumerable host of celestial orbs, all is magnificence, proportion, and regularity. Yet this grand spectacle is not continually exhibited to our view as an object of idle admiration; it is much more connected with the wants and conveniences of man. Unassisted by astronomy, even the least instructed is aware that he would be ignorant even of his own age; as without it, we should have no chronology, and no calendar. It is in the heavens that are found the means of arresting time in its eagle flight, of determining those interesting eras from which we date the most important events, and of regulating the seasons of the year. We are indebted to the science of astronomy for the means by which we now traverse the unfathomable ocean with so much skill and security, and determine at any time our situation on this trackless element. By the interposition of the heavens, immense deserts and vast and unknown countries are explored, and their treasures transported to other regions destitute of these resources; and by this means also, the most distant nations hold their correspondence. It is not only by the knowledge of astronomy that we learn by what means or laws the Almighty carries on and continues the wonderful order, connexion, and harmony, that pervades the planetary system; but our very faculties are enlarged, our minds are exalted above the grovelling conceptions and prejudices of the ignorant, and our understandings clearly convinced of the immutability and omnipotence of the Supreme Being. And besides enlarging the sphere of human knowledge, and contributing to the wants and conveniences of man, astronomy has also been greatly useful in dissipating the alarm and dread occasioned by extraordinary appearances in the heavens. The portentous advents of comets, formerly considered the sure forerunners of some direful catastrophe, either in the moral or physical world, are now witnessed without consternation or fear, all the phenomena attending them being rationally explained and accounted for. Total eclipses also, which were in ancient times deemed ominous of dreadful evils, now cease to excite alarm or terror, as they are known to be produced by natural causes, and to be regular in their returns as the seasons of the year, or the morning and evening. Indeed, the benefits this sublime science has conferred on society are so great and numerous, that it justly claims a right to our esteem and respect; and there is not, without doubt, another science more deserving our attention, or worthy to occupy and amuse our leisure moments. The study and investigation of the objects of the visible heavens is a delightful and innocent amusement for the evening, or the most lonely and silent hours of night. But what is far more, by observation and meditation on the celestial canopy, we are irresistibly led, from the beauty and grandeur of the scenery, to the contemplation of the immensity and infinite goodness of the great *Author*.

By astronomy we learn that the sun is more than a million times larger than our earth, and at such a distance, that, seen from the sun, our earth would appear no larger than a star appears to us. We also learn, that the stars are at such an immense distance from us, that a cannon ball, flying at the same rate as when first discharged, would not pass from the earth to the nearest fixed star in less than seven hundred thousand years; and that being visible from this vast distance, they cannot be less luminous, or less in size, than our sun: each is therefore, probably, a sun to another system, and has a retinue of worlds revolving round it, and enlightened and warmed by its influence: so that instead of *one* world, and *one* sun, in the universe, as many imagine, "astronomy discovers to us such an inconceivable number of suns, systems, and worlds, dispersed through boundless space, that if our sun, with all the planets, moons, and comets, belonging to it, were annihilated, they would be no more missed by an eye that could take in the whole creation, than a grain of sand from the sea-shore—the space they possess being comparatively so small, that it would scarcely be a sensible blank in the universe."

The magnificence and grandeur which we every where behold in the universe, is worthy the Great Being who created and sustains it; yet all this magnificence is one day to pass away; and hence, by His example, He would point out the vanity of all sublunary things, and call our attention to higher destinies and regions. It is not, then, the immensity or multiplicity of these vast orbs that should challenge our attention; they may excite our astonishment, and produce an awful respect for their Creator; but they are nothing more than inanimate heaps of matter, incapable of knowing that Being that called them into existence, and destined one day to perish. Of all created beings, we find only man possessed of that immortal principle destined to survive the wreck of matter, and capable of knowing, serving, and enjoying that Great Being that called it into existence. One immortal soul, therefore, is of more value in the sight of its Creator, than all those vast orbs that roll their immense masses through the expanse of heaven; and hence, we need not wonder that He has done so much for its preservation.

NAMES AND CHARACTERS OF THE SIGNS, PLANETS, AND ASPECTS.

Aries, ♈; Taurus, ♉; Gemini, ♊; Cancer, ♋; Leo, ♌; Virgo, ♍; Libra, ♎; Scorpio, ♏; Sagittarius, ♐; Capricorn, ♑; Aquarius, ♒; Pisces, ♓; Sun, ☉ or ☉; Moon, ● ○ ☽ ☾; Mercury, ☿; Venus, ♀; Earth, ⊕; Mars, ♂; Vesta, ⚶; Juno, ⚵; Ceres, ⚳; Pallas, ⚴; Jupiter, ♃; Saturn, ♄; Herschel, ♅; Conjunction, ☌; Sextile, ✱; Quartile, □; Trine, △; Opposition, ☍; Ascending Node, ☊; Descending Node, ☋.

PRACTICAL ASTRONOMY.

CHAPTER I.—THE EARTH.

[*When any astronomical word or term occurs that is not understood, the Reader may turn to the GLOSSARY, and find it explained.*]

The term *astronomy* is compounded of two Greek words, which signify the *law*, or the *knowledge* of the stars.

It is a mixed branch of the science of mathematics: it treats of the heavenly bodies.

The heavenly bodies are the *Sun*; the *Primary Planets*; the *Secondary Planets*, which are called *Moons* and sometimes *Satellites*; the Comets; and the *Fixed Stars*.

All these bodies are worlds, supposed to be inhabited. Many of them are larger, and some of them are smaller, than our earth.

The earth is the first object to be considered in astronomy.

The earth, or this world which we inhabit, is one of the primary planets: it is a globe, sphere, or ball, a round body, about 8000 miles in diameter, and 25,000 in circumference. This has been proved by incontestable evidence, and will appear plain and rational to any one who obtains but a slight knowledge of astronomy. The earth has been travelled or sailed round many times. The masts of a ship, at a distance at sea, are seen, while the hull is hid by the convexity of the water.

The earth being so large a body, the irregularities of its surface, the hills and valleys, take off no more, and in fact not a tenth part as much in comparison, from its circular figure, as the little dents and bunches do from the roundness of an orange; or as grains of sand do from the roundness of an artificial four inch globe.

All animals, bodies, or things, on whatever side of the earth, are kept on its surface by attraction or gravitation: the earth attracts, or draws to its surface, or towards its centre, all substances, or objects, or things, that are on or about it.

The terms *up*, and *down*, refer only to the centre of the earth: *up* means *from* the centre, and *down* means towards the centre of the earth.

To the people who are on the opposite side of the earth, *up*, as regards space, or the heavens, is in a direction exactly contrary from what it is to us; for a right line which is *down* to us, if continued through, and beyond the opposite side of the earth, would be *up* to the inhabitants of the opposite side. The earth turns round on its axis from *west* to *east* once in 24 hours, and thus by turning one part of its surface *to* the sun, and another part of its surface *from* the sun, makes *day* and *night*.

This motion of the earth round its axis from west to east, makes the heavenly bodies, the sun, moon, stars, &c. *appear* to move round the earth from east to west once in 24 hours.

In 12 hours from now, (if we are near the equator,) to us as regards space, or the heavens, *up* will be in the same direction that *down* now is, because the earth will then have turned half round, and our heads will point in the same direction that our feet now do.

We now think that we are on the *top* part, or *upper* side of the earth, (*in reality, the earth has no top or bottom part, or one part is as much the upper side as any other*,) and in 12 hours, we shall also think that we are then on the *upper* side of the earth, when our situation will be what the *under*, or *bottom* part, or side of the earth opposite to us, now is; because the earth will have turned half round, and that part of the heavens, or that part of space, and those stars that are now directly under our feet on the opposite side of the earth, (if we are at, or near the equator,) will then be directly over our heads. *Up* and *down*, therefore, are only relative terms; they relate exclusively to the centre of the earth.

In whatever part, or on whatever side of the earth we are, we have the sky over our heads, and our feet towards the centre of the earth: we call it *up*, over our heads, and *down* under our feet: that is, towards the centre of the earth is *down*, and proceeding from the centre, is *up*.

The apparent circles of motion of the heavenly bodies, caused by the motion of the earth round its axis, are very different, in different places. The celestial sphere is called *right*, *parallel*, or *oblique*, as the plane of the equator is perpendicular or at right angles to the plane of the horizon, or, as it is parallel or oblique thereto.

The inhabitants of the earth at the equator, are in a *Right Sphere*, because here the plane of the equator is perpendicular, or at right angles to the plane of the horizon; the poles being in the horizon, and the plane of the equator passing through the zenith and nadir, all the apparent circles of motion of the heavenly bodies are perpendicular or at right angles to the horizon; that is, all these bodies rise from the horizon, and descend to it, at right angles, and are just as long above, as they are below it; and the days and nights are always equal.

The poles are in a *Parallel Sphere*, because here, the plane of the equator is parallel to the plane of the horizon; the poles are in the zenith and nadir; all the apparent circles of motion of the heavenly bodies are parallel to the horizon, that is, they all revolve round without setting or without rising: those stars above the horizon never set, and those below it never rise: the sun revolves parallel to the horizon without setting for six months; and then revolves in the same manner as long below it, without rising, making but one day and one night, of six months each, in the year. At the summer solstice the sun is highest above the horizon, his altitude being always equal to his declination. At the equinoxes the sun is in the horizon for more than 30 hours, revolving with his lower limb below, and his upper limb above the horizon.

All places between the poles and the equator are in an *Oblique Sphere*, because the plane of the equator is oblique to the plane of the horizon; the pole is between the zenith and the horizon; the apparent circles of motion of the heavenly bodies are oblique to the horizon, that is, these bodies rise and go down obliquely to the horizon; all at a distance from the equator, are not the same time above, that they are below the horizon; and the days and nights are never equal except when the sun is in the equator.

Note—The elevation of the pole above the horizon at any place is always as many degrees as the place is from the equator; that is, the altitude of the pole is always equal to the latitude of the place.

The earth is 95 millions of miles from the sun, and besides revolving round its own axis once a day, the earth moves round the sun once a year, similar to a top that leans a little sideways and spins round itself, or its axis, and at the same time moves in a circle round a nail or pin on the floor.

This leaning of the earth's axis, 23° 28′ from an erect position, causes the different seasons and the different length of the days and nights. If the earth's axis were perpendicular to the plane of the ecliptic, that is, if the earth moved round the sun with its axis upright, similar to a top that stands erect and spins round itself or its axis, and at the same time moves round a nail or pin on the floor, there would be no difference of seasons, and the days and nights would always be equal, 12 hours each.

This may be made plain by taking a small artificial globe, or any ball, with a wire through it, to represent the axis and poles of the earth, and carrying the ball which represents the earth round a light which represents the sun: thus, if you have no globe or other ball, take a common ball of yarn 2 or 3 inches in diameter, or larger, or smaller than this; take a straight wire, as long, or longer than the diameter of the ball: pass the wire through the ball, so that the centre of the wire shall be in the centre of the ball; tie a string round the ball so that every part of the string shall be equally distant from the ends of the wire. Now call the ball the earth; the wire its axis and poles; and the string the equator: call the flame of a candle on a table the sun: place the south pole of the earth on or over the table 2 or 3 feet south of the sun, (the centre of the earth being just as much above the table as the centre of the sun is,) let the axis or the north pole lean a little, (that is, 23° 28′) from a perpendicular line towards the north. The earth will now be shown at the Summer Solstice, that is, at June 21st; keeping the axis in this position, turn the earth round its axis, turning the part next the sun from east to west; that is, turn the earth contrary to the way the hands of a watch move; to all the places the sun shines on, it is day; and to all the places the sun does not shine on, it is night; as the places come into the light of the sun, the sun rises to those places, and as they go out of the light of the sun into the dark, the sun sets to them. As the earth turns on its axis, it will be seen that all places north of the equator are longer in the light than they are in the dark; therefore the days at those places are longer than the nights; and at the pole there will be no night, as the sun shines on the earth beyond the pole: and places near the pole, as the earth turns on its axis, will not go into the dark at all, but have constant day; and places near the south pole will have constant night. Now remove the earth, and place it 2 or 3 feet east of the sun, keeping the axis leaning in the same manner to the north, and the earth will be shown at the Autumnal Equinox, Sept. 23d. Again, place the earth 2 or 3 feet north of the sun, and it will be represented at the Winter Solstice, Dec. 21st.; and if it be placed west of the sun, it will be shown at the Vernal Equinox. March 21st.

The earth's axis always keeps its parallelism; that is, the axis in any one part of its orbit, is always parallel to what it was in any other part; or the axis always leans towards the same part of space, or the heavens; or the variation is so little that it cannot be perceived in many years.

On one side of the sun, the north pole leans *towards* the sun; and when the earth has moved half round the sun, or half through its orbit to the other side of the sun, the north pole leans *from* the sun. When the earth is on one side of the sun, and the north pole leans *towards* the sun and the south pole leans *from* the sun, the north pole is enlightened by the sun and the south pole is in the dark; and when the earth is on the other side of the sun, and the south pole leans towards the sun and the north pole leans from it, the south pole is enlightened by the sun and the north pole is in the dark.

When the earth has moved from either of these sides or points of its orbit one quarter round the sun, or through one quarter of its orbit, neither pole leans *towards* or *from* the sun, but the axis and poles lean sideways to the sun, and both poles are enlightened.

While the earth is moving through one half of its orbit, the north pole is constantly enlightened by the sun, and the south pole is in the dark; and in all places in north latitude, or north of the equator, the days are longer than the nights; and in all places

south of the equator, or in south latitude, the days are shorter than the nights: and while the earth is moving through the other half of its orbit, the south pole is constantly enlightened by the sun, and the north pole is in the dark; and in all places south of the equator the days are longer than the nights; and in all places north of the equator, the days are shorter than the nights.

When the earth is at either equinox, both poles are just in the edge of the light, and the days and nights are equal all over the world.

As regards a spectator at the sun, the earth moves round the sun from the right hand to the left. It is generally said the earth moves from west to east; but it is evident that if in one part of its orbit, it moves from west to east, in the opposite part it moves from east to west, as regards space, or the heavens. And as regards a spectator at the sun, as the earth moves round its axis, the side of the earth next the sun moves from the left hand towards the right, and consequently the side opposite the sun moves from the right hand to the left: that is, the diurnal motion of the side of the earth next the sun, is in an opposite direction to the annual motion of the earth in its orbit round the sun; and the diurnal motion of the side of the earth opposite the sun is in the same direction as the motion of the earth in its orbit.

The annual motion of the earth round the sun, makes the sun appear to move round the earth once a year. And the diurnal motion of the earth round its axis, makes the sun and other heavenly bodies appear to move round the earth once a day.

We say the diurnal motion of the earth is from west to east, because the apparent motion of the sun and moon from rising till setting is from east to west; but it is evident that when one side of any globe or ball that turns round its axis, is moving from west to east, the opposite side, in turning round the axis, is moving from east to west: but we are as insensible of this with regard to our own motion as we are that the direction of our feet at six o'clock in the morning is opposite to their direction at six o'clock in the evening. So if we should set out from any place, and travel directly forward without turning either to the right or to the left, we should in time travel entirely round the earth, and arrive at the place we started from; and this would be the case, in whatever direction we started. When at half the distance round the earth, *up*, to us, would be exactly the opposite direction it was when we started; and we should be travelling towards the opposite part of the heavens to that we were when we started; but we should not be sensible of this, but should think we were always travelling towards the same part of the heavens, and that up was always in the same direction.

East and west are only relative, or local terms; at the poles, there is no such thing as east or west, but every direction from the north pole, is south; and every direction from the south pole, is north. When it is said that the earth moves in its orbit from west to east, the meaning is, that it moves from right hand to left as seen from the sun.* And when it is said that the earth revolves round its axis from west to east, the meaning is, that as seen from the sun, the side of the earth next the sun, moves from left hand to right, and the side opposite the sun moves from right hand to left; but the motions of the earth have already been explained with a ball representing the earth, and a light representing the sun; by carrying the ball round the light from south to east and north, &c.

Though the earth is a globe, yet seen from the sun or moon, or from a distant point between us and the sun or moon, it appears like a flat round surface, as the sun or moon appears to us. This appearance is called the earth's disk.

By the motion of the earth round its axis, places on its surface describe, in 24 hours, circles or paths parallel to the equator. These circles or paths, are the parallels of latitude of those places. As seen from the sun, these paths or parallels on the earth's disk, appear different; they vary with the sun's declination. When the sun is in the plane of the equator, all the parallels of latitude on the earth appear to a spectator at the sun to be straight lines across the earth's disk, because the earth appears so small that the spectator may be considered in the plane of each parallel. But when the sun is not in the plane of the equator, that is, when he has north or south declination, the spectator at the sun being not in the planes of the parallels, they appear to him to be curve lines or ellipses on the earth's disk. As seen from the sun from sunrise till sunset, or from 6 in the morning till 6 afternoon, places on the earth describe paths from west to east across its disk. These paths are the parts of the parallels of latitude of the places which are described in the daytime.

The sun appears to rise from behind the eastern part of the earth, and to set behind the western; because we look towards the east to see the sun rise, and towards the west, to see it set: but it is only from behind the eastern part of that very small portion of the earth which we can see, that the sun rises from behind; and it sets behind the western part of the same small portion. The diameter of the earth's disk is nearly 8000 miles, that is, it is nearly 8000 miles from the eastern to the western part of the earth. The earth being round, we can see only that part of it which is within a few miles of us. At sunset, near the equator the whole portion of the earth which we can see, together with what the sun sets behind, is nearly 8000 miles east of the western part of the earth: for by the motion of the earth on its axis from sunrise till

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* In the northern hemisphere, but in the southern the contrary way.

sunset, we have been carried nearly 8000 miles from west to east. The sun, therefore, in reality, rises from behind the western part of the earth, and sets behind the eastern; for we can see that part of the earth which the sun sets behind, and we can see only the part where we are, or within a few miles of us.

The sun, the source of light and heat to the earth, and other planets, and their centre of motion, and centre of gravity, is an immense globe, more than a million of times larger than this world. The moon is of itself, a dark body, and shines only by reflecting the light of the sun. It is a globe 2180 miles in diameter, being about 49 times smaller than the earth, and 240,000 miles distant from the earth.

The moon is a satellite to the earth, its centre of motion, and centre of gravity. The moon moves round the earth from the sun to the sun again once in about 29½ days; and is carried with the earth round the sun once a year. The motion of the moon round the earth once in 29½ days, is in the same direction, and nearly in the same plane, in which the sun appears to move round the earth once a year.

The bright part of the moon, that is, the part visible, is what the sun shines on. At *full* moon, the sun being on one side of the earth, and the moon nearly on the other, we see nearly all that part which the sun shines on, the enlightened part being towards us.

At *new* moon, the moon being nearly between the earth and the sun, the enlightened part is wholly turned from us, we can see no part that the sun shines on, and of course we can see no part of the moon, it is entirely invisible.

At the *Quarters*, or *Quadratures*, we can see only half of what the sun shines on.

Note.—When the moon, or any other planet, is said to be in the ecliptic or in the equator, &c. the meaning is, that it is in the *plane* of the ecliptic, or in the *plane* of the equator, &c.

The moon is eclipsed when the sun does not shine on it. An eclipse of the moon, which can only happen at the *full* moon, when the sun is on one side of the earth, and the moon on the opposite side, is caused by the moon's being in the earth's shadow; that is, the earth being directly between the sun and moon, prevents the sun from shining on the moon.

An eclipse of the sun, which can happen only at the time of *new* moon, is caused by the moon's coming between the earth and the sun, and hiding the whole, or a part of the sun, from those parts of the earth to which the sun is eclipsed: that is, the moon's shadow falls upon those parts of the earth to which the sun is eclipsed.

If the moon's orbit coincided exactly with the plane of the ecliptic, that is, if the moon moved in this plane, she would be eclipsed at every full, and the sun would be eclipsed at every new moon. But the plane of the moon's orbit makes an angle with the plane of the ecliptic of about 5°; one half of the moon's orbit being elevated about 5° above the plane of the ecliptic, and the other half depressed as much below it. The plane of the ecliptic, therefore, cuts or intersects the moon's orbit in two points diametrically opposite to each other: these points are called the moon's nodes. The moon is never in the ecliptic, or in a right line with the earth and sun, except when she is in one of her nodes; consequently she can never be eclipsed, or eclipse the sun, but when she is in or near one of her nodes. That node from which the moon ascends northward, or above the plane of the ecliptic in north latitude, is called the *Ascending Node*; and the other the *Descending Node*, because the moon, when she passes it, descends below the ecliptic to the south.

These things may be made plain, by taking a small ball, as a small marble or bullet about half an inch in diameter, for the earth; a smaller ball, as a pea or a buck shot, for the moon, and the flame of a candle for the sun.

As the sun is so much larger than the earth, to give these their proper proportions as to size and distance, if the flame representing the sun, is 2 inches long, or 2 inches in diameter, the ball to represent the earth should not be the hundredth part of an inch in diameter, or it would not be as large as a mustard seed; and the ball to represent the moon would be 49 times less. The distance of the earth from the sun would be about 17 feet, and the distance of the moon from the earth would be about half an inch. But we cannot well preserve the just proportion in representing the sun, moon, and earth, by machinery.

Place the earth 2 or 3 feet north of the sun, on a level with the sun; place the moon 4 or 5 inches east of the earth, on a level with the earth and sun; carry the moon round the earth, keeping it at about the same distance from the earth, carrying it from east to north, then to west, and then to south, &c. but not keeping it on a level, or in the same plane with the earth and sun; when the moon is north of the earth, and in this case in opposition to the sun, let it be above the level, or plane, in which the earth and sun are, and 3 or 4 times its diameter above the earth's shadow: when it is south of the earth, and in this case in conjunction with the sun, and nearly between the earth and sun, let it be below the level or plane in which the earth and sun are, so that its shadow may fall 3 or 4 times its diameter below the earth. This is the manner in which the moon moves round the earth, and in this case it is plain, there could be no eclipse either at the new or full moon. When the moon is on a level with the sun and earth, that is, when it is in the same plane, or in the plane of the ecliptic, it is in one of its nodes. In this case, it was in its ascending node when it was east of the earth; and in its descending node when it was west of the earth; it was in the highest part of its orbit when it was north, and in the lowest part, when it was south of the earth. The nodes, or places in its orbit, where the moon is, when it is on a level with the earth and sun, are continually moving at the rate of about 19° in a year contrary to the way the moon moves in her orbit.

When the nodes have moved so far that one is between or nearly between the earth and sun, it is evident that the moon in moving round the earth from south to east, and then to north and west, &c. is in or near one node at the new moon, and in or near the other at the full moon; and in the highest part of her orbit when she is east of the earth at the first quarter, and in the lowest when she is west of the earth at the last quarter; and in this case, there will be an eclipse both at the New and Full Moon, for the moon will then be nearly on a level, or in the same plane with the earth and sun. At new moon, the sun and moon, as seen from the earth, always have the same longitude and are always at the same distance from the moon's node. If at new moon, the sun and moon are not more that 16° from one of the nodes, there will be an eclipse of the sun.

At the full moon, the moon is always at the same distance from one node that the sun is from the other, because the sun and moon are in opposition. If at the full moon, therefore, the sun is not more than 10° from one of the nodes, there will be an eclipse of the moon.

In calculating eclipses, the *sun's* distance from the node is used instead of the moon's; because the sun's place is much easier to find than the moon's; and at eclipses of the sun, the sun's distance from the node is the same as the moon's; and at eclipses of the moon, the sun's distance from one node is the same as the moon's distance from the other.

A right or straight line joining the nodes, or from one node to the other, is called the *line* of the *nodes*. When the sun at new or full moon, is in this line, the sun, moon and earth are all in a right line, and if it be *new* moon, the moon's shadow falls upon the earth, and makes an eclipse of the sun: if it be *full* moon, the earth's shadow falls upon the moon, and makes an eclipse of the moon.

At new moon, if the sun and moon are more than 16° from the nearest node, the moon is too high or too low in her orbit to cast any part of her shadow upon the earth, and there will be no eclipse of the sun.

At full moon, if the sun is more than 10° from the nearest node, the moon of course is the same distance from the other node, and consequently the moon is too high or too low in her orbit to go through any part of the earth's shadow, and there will be no eclipse of the moon.

By the motion of the earth round its axis in 24 hours, the sun and moon appear to move round the earth in the same time: and by the motion of the earth round the sun in a year, the sun appears to move round the earth in the same time: and every appearance is the same, whether we suppose the sun moves, and the earth remains at rest, or whether we suppose, (as is the case,) the earth moves, and the sun is at rest.

The orbit or path, in which the moon moves round the earth once a month, is not an exact circle, but an ellipse or oval, and the earth is in one of the foci. Also the ecliptic, or orbit or path in which the earth moves round the sun once a year, is an ellipse, and the sun is in one of the foci.

Each orbit is divided into 12 equal parts called signs; each sign into 30 equal parts called degrees; each degree into 60 equal parts called minutes; each minute into 60 seconds; each second into 60 thirds, &c.

Beginning at that part of the ecliptic where the sun is, at the vernal equinox, that is, where the plane of the equator crosses the ecliptic, the names and characters representing the signs, going round in the order the sun moves, are as follows:—

1st, Aries, ♈; 2d, Taurus, ♉; 3d, Gemini, ♊; 4th, Cancer, ♋; 5th, Leo, ♌; 6th, Virgo, ♍; 7th, Libra, ♎; 8th, Scorpio, ♏; 9th, Sagittarius, ♐; 10th, Capricorn, ♑; 11th, Aquarius, ♒; 12th, Pisces, ♓.

As every appearance is the same, whether the earth moves, or the sun moves; and as the earth in moving round the sun, makes the sun appear to move through the signs of the ecliptic, as there is frequent occasion to speak of the sun's place in the ecliptic, which place is always the opposite point to that in which the earth is; in constructing tables of motion, the sun is considered to move in the ecliptic round the earth once a year; though the fact is otherwise, yet every appearance is the same as if this were really the case; the sun, therefore, and not the earth, is considered the moving body.

The orbits being ellipses, and not circles, the sun and moon are continually changing their distances from the earth. The mean, or average distance of the sun from the earth, is 95 millions of miles, but at the nearest point of the orbit, it is only about 93 millions; and at the farthest point about 97 millions.

The mean distance of the moon from the earth is 240,000 miles; but in that part of her orbit which is farthest from the earth, her distance is 253,000 miles; and in the part nearest the earth, the moon is only 227,000 miles from the earth. The *farthest* point of each orbit from the earth, is called the APOGEE; and the *nearest* point the PERIGEE. These points are diametrically opposite to each other, six signs apart; a right line from one to the other is called the *Line of the Apsides*.

When the Creator launched the planets from his hand, he gave them their *centrifugal* and *centripetal* forces, and adjusted the one force to the other, so that the planets should move between them, neither flying off in right lines, nor descending to their centres of gravity, but moving round them in circles or ellipses.

The nearer any object is to the eye of the spectator, the larger it appears, or the greater is the angle under which it is seen,—the farther from the eye, the less.

The sun and moon appear larger when they are in perigee than when they are in apogee; that is, their diameters subtend larger angles in perigee than in apogee; and the differences of these angles agree exactly with elliptic orbits, supposing the lower focus of each orbit to be the earth's centre. The motions of the sun and moon are observed to become continually swifter while they are moving from their apogee to the perigee; and to become continually slower from the perigee to the apogee; being slowest of all in the apogee, and swiftest of all in the perigee. The reason of this is, the nearer any body is to the sun or earth, the more it is attracted by the sun or earth; and this attraction increases as the distance becomes less.

While the sun and moon are moving from their apogee to their perigee, they are continually approaching nearer and nearer to the earth, which causes the moon to be more and more attracted by the earth; and the earth more and more attracted by the sun: and this greater attraction causes the motion of the sun and moon to become swifter. But while the sun and moon are moving from their perigee to their apogee, their distance from the earth is continually increasing, and of course the attraction is constantly growing less, which causes the sun's and moon's motion to become slower.

The distance of the sun or moon from its apogee, perigee, or any other given point of its orbit, is reckoned in signs, degrees, minutes, seconds, &c. Here the distance the luminary has moved through from any given point, is meant, and not the space it is short of it, in coming round again.

The point of the orbit in which the sun or moon is, at any time, is called the *place* of the sun or moon at that time.

The distance of the sun or moon from its apogee, at any time, is called its *anomaly;* so that in the apogee the anomaly is nothing; and in the perigee the anomaly is six signs. When the sun or moon is in apogee or perigee, its place is the same as it would be if its motion were equal and uniform in all parts of its orbit.

The supposed *equal* motions are called *mean;* the *unequal* are justly called the *true.*

The *mean* place of the sun or moon is always before the *true* place, while the luminary is moving from its apogee to its perigee; and the *true* place is always before the *mean,* while the luminary is moving from its perigee to its apogee. In the former case the anomaly is always less than six signs; and in the latter case, more. These things may be made plain by a figure: thus,—Let ⊕ (Fig. 1) be the earth; AWPE the orbit of the moon; A its apogee, and P its perigee. While the moon moves from A by W, towards P, it is continually getting nearer and nearer to the earth, and of course it is more and more attracted by the earth; and its motion becomes continually swifter, till it arrives at P, its least distance from the earth, where the attraction is greatest, and the moon's motion swiftest. While it moves from P by E, towards A, it is continually getting farther and farther from the earth, the attraction becomes constantly less, and the moon's motion slower, till it arrives at A, its farthest distance from the earth, when the earth's attraction is least and the moon's motion slowest.

Tables of the motion of the heavenly bodies are made as if their orbits were perfect circles, and their motion uniform; and the place of any heavenly body found from these tables is called the *mean* place, which is reduced to the *true,* or *real* place, by equations.

CHAP. II.—EXPLANATION OF THE TABLES.

To make tables of the motions of the sun, moon, and planets, in order to compute their places at any given instant, the first thing to be done, is to determine, from careful observations, the exact time required by the sun and moon to perform a complete revolution in their orbits, or to describe the space of 360°.

Some of the stars may be seen at any time of the day with a good telescope, and particularly at the time of an eclipse of the sun, if there are no clouds in the way. Note the exact time of the conjunction of a particular star with one of the limbs of the sun or moon; and then note how much time elapses before its next conjunction: the time thus elapsed is the time of one revolution of the sun or moon. This time may be more accurately determined by dividing the time required for several revolutions by the number of revolutions. When this important element is exactly ascertained, it can easily be found, by multiplication or division, through how much of their orbits, or how many times through their orbits, the sun and moon move in any given time; or in any number of years, days, hours, minutes, seconds, &c. It has been found, by a long series of observations, that the sun goes through the ecliptic from any fixed star to the same star again in 365d. 6h. 9m. 11.5s., which is called the Sideral year; from its apogee to its apogee again, in 365d. 6h. 13m. 58.8s., which is called the Anomalistic year; and from either equinox or solstice to the same again, in 365d. 5h. 48m. 49s., which is called the Solstitial or Tropical year. This latter period is the true solar year, as on it the seasons depend. The reason the two first periods are longer than the solar year, is the combined attraction of the sun, and moon, and planets, upon the earth.—explained under the article, Precession of the Equinoxes.

As the sun, each year, performs its revolution from the equinox to the equinox again, 20 minutes 22.5 seconds sooner than from a fixed star to the same star again, it shows, that with respect to the fixed stars, the equinoxes have a slow annual backward motion, or from east to west, contrary to the motion of the sun and moon, and contrary to the order of the signs of the ecliptic, which is called the "Precession of the Equinoxes."

And as the sun, each year, moves round from any fixed star to the same star again 4m. 47.3 seconds sooner than from its apogee or perigee to the same again, it shows that the apogee and perigee have a small annual forward motion, or from west to east.

It is observed that the moon goes through her orbit, from either node to the same again, in 27d. 5h. 5m. 36s.; from any point of the ecliptic to the same again, in 27d. 7h. 42m. 59.803s.; from any fixed star to the same star again, in 27d. 7h. 43m. 4.7652s.; from its apogee or perigee to the same again, in 27d. 13h. 18m. 34.882s.; and from the sun to the sun again, in 29d. 12h. 44m. 2.8283s. This last period is called a lunation, and it

would always be of this length, if the motions of the sun and moon were always uniform and equal in one part of their orbit to what they were in any other part. But this is not the case; and the strong attraction of the earth and sun upon the moon varies her motion, and makes the above *mean* periods sometimes longer and sometimes shorter: but all the variations of the moon's motion may be accurately ascertained, and tables of them constructed; as may also the variation of the motion of the sun, or rather of the earth, caused by the attraction of the sun.

The difference between the three first of the above periods of the moon's motion, viz., her revolution with regard to the node, to a fixed star, and to her apogee, is caused by the attraction of the sun and earth; but the reason the *lunation* is so much longer than either of the other periods, is, that while the moon goes round the earth, from the sun to the sun again, the earth goes almost a sign forward, causing the sun to appear to go through almost a sign in the ecliptic; consequently, the moon must go almost a sign more than round the earth before she can overtake the sun. The time of the lunation is found as follows: viz.—find the time from the middle of one eclipse, to the middle of another of the same kind, many years after; divide this time by the number of lunations between the two eclipses, and the time of a mean lunation will be had.

When the moon or a planet is said to be in such a sign, degree, &c., or in such a part of the ecliptic, the meaning is, that the moon or planet is in the same direction from the centre of the earth that this part of the ecliptic is.

It is frequently said, that the moon or a planet is in, or crosses, the ecliptic or the equator,—when the meaning is, that it is in, or crosses, the *plane* of the ecliptic or of the equator.

The moon moves round from either node to the same again, 2h. 37m. 23 803s. sooner than from any point of the ecliptic to the same again; therefore the nodes, each revolution, move backwards, or as much from east to west in the ecliptic, as the moon moves in 2h. 37m. 23.803s. This motion of the nodes in the ecliptic is about 19° 29′ 26″ in a year, which carries the nodes quite through, or round the ecliptic, in 18 years, 224 days, 12 hours, 57 minutes, and 52 52-125 seconds,—4 of the 18 years being leap-years. The moon, in going round from her apogee or perigee to the same again, is 5h. 35m. 35.079s. longer than in going round from any point of the ecliptic to the same again; consequently the apogee and perigee, each revolution, move as much forward as the moon moves in 5h. 35m. 35.079s. This motion of the apogee and perigee is about 40° 39′ 49″ in a year, by which the apogee moves quite round from any point in the ecliptic to the same again, in 8y. 309d. 11h. 24m. 8 16-25s.,—2 of the 8 years being leap-years.

If the motions of the sun and moon were always uniform, and equal in one part of their orbits to what they are in any other part, it would be quite an easy thing to make tables of their motions, and compute their places at any time; but it has already been shown that their places are never what they would be if their motions were uniform, except when they are in apogee or perigee; which is when their anomalies are either nothing, or six signs: and that their *mean* places are always before their *true* places, while the anomaly is less than 6 signs; and the true places are before the mean, while the anomaly is more.

The anomalies of the sun and moon, and the sun's distance from the moon's ascending node, are the arguments for finding the equations by which the mean places are reduced to the true.

To construct tables of their anomalies, &c., begin by finding through how much anomaly, or how far from their apogee, the sun and moon move, and the distance the sun and moon's ascending node move from each other, while the moon completes a lunation.

Knowing the time the sun requires to move from his apogee to his apogee again; or knowing that in this time his mean motion in anomaly is 360°, it is easy to find his mean motion, in anomaly, for any other time. The same may be said of the moon. If the sun, in 365d. 6h. 13m. 58.8s., moves in anomaly 360°; how far, in anomaly, will he move in 29d. 12h. 44m. 2.8283s.? And if the sun, in 365d. 5h. 48m. 49s., moves 360° in longitude; how far, in longitude, does he move in 29d. 12h. 44m. 2.8283s.? Thus the sun's mean motion, in anomaly, in the time of one mean lunation, is found by multiplying this time by 360, and dividing the product by the time required by the sun to move from his apogee to his apogee again. And the moon's mean anomaly, for one lunation, is found by dividing the same product by the time required by the moon to move from her apogee to her apogee again. The sun's mean motion in longitude, for one lunation, is found by dividing the same product by the time required by the sun to move from one equinox to the same again. The distance the node moves in one lunation, is found by dividing the same product by the time required by the node to move entirely round through the moon's orbit from some point to the same again; which is 6793 days, 4h. 52m. 52s. The distance the sun and node move from each other in one lunation, (as the node moves backwards,) is found by adding the distance the node moves, to the sun's mean motion in longitude for one lunation. Thus, Table 1. is made as follows:—first set down the time of one mean lunation; then set down the sun and moon's mean motion in anomaly, and the distance the sun and moon's ascending node move from each other in this time: multiply all these numbers by 2, then the same numbers by 3, by 4, and so on to 13, and then by 24, and all the other numbers in this column,—and the time, and the sun and moon's mean motion in anomaly, and the mean distance the sun and moon's ascending node move from each other in so many lunations, will be had. The whole number of days in the time up to 9 years, is inserted; after that, only the excess over complete centuries of Julian years. In making these calculations, when the signs amount to more than 12, divide them by 12, and set down only the remainder as the proper quantity. The numbers for the half lunation are found by dividing those for one lunation by two.

The sun and moon's mean anomalies, and the sun's mean distance from the moon's ascending node, at the time of mean new moon, have many times been determined; from which, the same at the time of any other mean new moon may be easily found.

To make Table 2, fix upon some particular year and month to begin at; and observe, calculate, or take from tables already calculated, the astronomical time of mean new moon for this year and month, and the sun and moon's mean anomalies, and the sun's mean distance from the moon's ascending node at this time.

Table 2, is begun with the month of March of the year 1800; and the time of mean new moon for that month and year, and the mean anomalies of the sun and moon, and the sun's mean distance from the moon's ascending node at the said time, were found to be as put down at the head of the table.

Now, to find the time of mean new moon, and the sun and moon's mean anomalies, and the sun's mean distance from the moon's ascending node, for March, 1801, add the numbers from Table 1 for 12 lunations, to the numbers for March, 1800; and rejecting 12 signs when they occur, and setting down the remainder, and subtracting 365 from the days,—the time of mean new moon, and the sun and moon's mean anomalies, and the sun's mean distance from the moon's ascending node for March, 1801, will be had. Again, add in the same manner the numbers for 12 lunations, to the numbers for March, 1801, and subtract 365 days,—and the numbers for March, 1802, will be obtained. To get the numbers for 1803, add 13 lunations to 1802; for if but 12 lunations be added, the numbers for only February will be obtained. Add 12 lunations to 1803, and subtract 366 days instead of 365, as 1804 is a leap-year,—and the numbers for March, 1804, will be obtained. In this manner the table may be continued as far as you please, adding 12 lunations when the new moon happens after the 11th day of the month, and 13 when it happens before, always subtracting 365 days for common years and 366 for leap-years. Thus the table was constructed, and then written out to every tenth year.

Table 3, similar to 2; only calculated for the Old Style.

Table 4, page 19, is merely the number of days from the beginning of March to the beginning of each of the other months.

The *mean* new or full moon never coincides with the *true,* except when the anomalies of both the sun and moon are either nothing or six signs, and the sun is then in conjunction with one of the moon's nodes but this does not take place twice in a thousand years.

As has been before observed, the unequal motion of the sun and moon, is the reason their *mean* and *true* places differ: for the same reason, the time of *mean* syzygy differs from the time of *true* syzygy.

The first difference, or equation, between the *mean* and *true* syzygy, is caused by the sun's unequal motion, and the variation of his distance from the earth and moon; this depends on his anomaly.

When the sun's anomaly is less than six signs, that is, while he is moving from his apogee to his perigee, his *mean* place being before his *true* place, it is evident that the moon will overtake him, or be opposite to him, *sooner*, or in less time, than she could if his motion were uniform and equal; and when his anomaly is more than six signs, that is, while he is moving from his perigee to his apogee, his true place being before his mean place, the moon will require more time to overtake him, or be in opposition to him, than she would if his motion were uniform.

The greatest difference that can happen between the time of mean and true new or full moon, on account of the sun's unequal motion, and unequal distance from the earth and moon, is 4h. 10m. 57s. This takes place when the sun's anomaly is either 3 signs 1 degree, or 8 signs 29 degrees. The *true* syzygy is sooner than the *mean* in the first case, and later in the last. In all other signs and degrees of anomaly, the difference or equation is gradually less, and vanishes when the anomaly is either nothing, or six signs. This equation is computed in Table 5, page 16, for every sign and degree of the sun's anomaly, by putting 4h. 10m. 57s. against 3 signs 1 degree, and 8 signs 29 degrees. Against every other degree the equation is proportionably less; and is nothing against 0 signs 0 degrees. It is called the annual or first equation of the mean to the true syzygy. 0, 1, 2, 3, 4, and 5 signs, are at the top of the table, and their degrees are at the left hand, and are reckoned downward. 6, 7, 8, 9, 10, 11 signs are at the bottom of this table, and their degrees are at the right hand, and are reckoned upwards. This is the case with several other tables.

Another, and the greatest difference, between the mean and true syzygy, is caused by the unequal motion of the moon in her eccentric orbit, and depends on her anomaly; and as her anomaly is affected by the sun's, before it is used to find this difference it must be equated by a quantity or equation depending on the sun's mean anomaly, and calculated in Table 6, page 17.

The moon's motion is more unequal than the sun's, as her orbit is more eccentric. Like the sun, while she is moving from her apogee to her perigee, her motion being continually accelerated, her mean place is before her true place; and this causes the *mean* syzygy to happen before the true. While she is moving from her perigee to her apogee, her motion becomes continually slower, and her true place is before her mean place; and the *mean* syzygy is after the true.

This difference between the mean and true syzygy caused by the eccentricity of the moon's orbit, and the moon's unequal motion, at greatest, is 9h. 47m. 54s.; this is when the moon's equated anomaly is either 2 signs 26 degrees, or 9 signs 4 degrees; at all other signs and degrees of anomaly, it is gradually less, and is nothing when the moon's anomaly is 0, or 6 signs.

This difference is computed for every sign and degree of the moon's equated anomaly, in Table 7, page 17, and is called the second equation of the mean to the true syzygy. It is to be added to the mean syzygy, when the moon's equated anomaly is less than 6 signs, and subtracted when more.

Another small difference or equation between the mean and true syzygy, depends on the difference between the sun's and moon's anomaly; at greatest it is 4m. 58s.: this is when the remainder found by subtracting the moon's equated anomaly from the sun's mean anomaly, is either 3, or 9 signs. If the moon's anomaly to be subtracted, exceeds the sun's, add 12 signs to the sun's anomaly, and then a remainder will be had. This remainder is the argument for the equation. For every 5 degrees of this argument, the equation is calculated in Table 8, page 19: it is called the third equation of the mean to the true syzygy, and is to be subtracted from the mean syzygy, when the argument is less than 6 signs, and added when more.

The fourth and last equation of the mean to the true syzygy, depends on the sun's distance from the moon's ascending node at the time. At greatest, it is only 1m. 34s.; this is when the sun's distance from the moon's ascending node is either 1 sign 15 deg., or 7 signs 15 deg.; or 4 signs 15 deg,; or 10 signs 15 deg.; to be added to the mean syzygy in the two first cases, and subtracted in the two latter. This equation is calculated for every 5 degrees of the sun's distance from the moon's ascending node in Table 9, page 21.

Table 10, page 18, for finding the sun's Lon. and anomaly, at any time, is formed as follows:—Knowing the time the sun requires to move from one equinox to the same again; or knowing that in this time the sun moves 360d. in longitude, multiply 365 by 360, and divide the product by 365d. 5h. 48m. 49s., (the solar or solsticial year,) and the quotient will be the sun's mean motion in longitude for a common year of 365 days; which, divided by 365, will give his mean motion for one day. The mean motion for one year, multiplied by 2, gives the same for 2 years; and the mean motion for 1 year added to that of 2 years, gives the same for 3 years; but to find the mean motion for 4 years, as every fourth year has one day more than a common year, the mean motion for 1 year and 1 day must be added to that for 3 years: thus, the table may be carried on at pleasure. Having the mean motion for one day, the same for any number of days may be found by multiplication; and for any part of a day, as an hour, a minute, or a second, by division. The motions for months are found by taking 0 for the motions for January for common years, because January is the beginning of the year; by taking the motions for 31 days for the motions for February for common years; by taking the motions for 59 days for the motions for March; 90 days for April; 120 days for May; 151 days for June; 181 for July; 212 for August; 243 for September; 273 for October; 304 for November, and 334 for December, either common or leap years. From the motions for January, (or from 12 signs,) subtract the motions for one day, and the motions for January of leap year will be had; from the motions for February, subtract the motions for one day, and the motions for February of leap year will be had. The motions for January and February are taken thus for leap years, because the additional day does not come in till the last of February; but the motions for this day are added to the motions for leap years, as if the day came in at the beginning of the year.

To find the sun's mean anomaly, proceed in the same manner as to find his mean longitude, only instead of 365d. 5h. 48m. 49s. take 365d. 6h. 13m. 58.8s. the anomalistic year.

The distance of the equinox and apogee from any particular star, and the sun's longitude and anomaly at any time, may easily be found by any person having accurate instruments, and knowing how to use them. Having the mean longitude and anomaly at any particular time, the same may be found for any other time, by adding or subtracting the mean motion in longitude and anomaly for the interval.

The longitude and anomaly for the noon of the last day of any year, is taken for the longitude and anomaly of the next year; because to find the longitude and anomaly for any particular month and day of any year, it is convenient to add the longitude and anomaly for that month and day to the longitude and anomaly for the year. Thus to find the longitude and anomaly for the noon of January 1st, of any year, it is plain that the longitude and anomaly for one day, must be added to the longitude and anomaly for the noon of the 31st December preceding: that is, for the longitude and anomaly for the year, add the longitude and anomaly for one day, and the longitude and anomaly for Jan. 1st will be had. So to the longitude and anomaly for the year add the longitude and anomaly for 15 days, and the longitude and anomaly for Jan. 15th will be had. And to the longitude and anomaly for the year, add the longitude and anomaly for February, and for 20 days, and the longitude and anomaly for the noon of February 20th of that year will be had; and so on for any other month, day, &c. of any year.

As a leap year has one more day than a common year, the longitude and anomaly for the leap years are given for the 1st day of January instead of for the day before, (the 31st of December preceding;) therefore in finding the longitude and anomaly for any time in either the month of January or February of a leap year, the rule for Problem 6 may be followed, or the longitude and anomaly for the given month of a common

year, and for a number of days one less than the given day of the month, may be added to the longitude and anomaly for the given year.

The distance the sun and moon's ascending node move from each other in hours, minutes, and seconds, is annexed to this Table; being used in calculating eclipses.

Table 11, page 22, is an equation depending on the sun's mean anomaly, used to reduce the sun's *mean* place to the true place. The principle has already been explained.

Table 12, page 15, is on the same principle as Table 11. It is formed by adding the annual equation of the Moon's Node, to the equation of the Sun's centre; that is, the numbers in Table 32, to those in Table 11.

Table 13, page 22, shows the sun's declination to every degree of his true longitude.

Table 14, page 17. Angle of the moon's orbit with the ecliptic in eclipses; which depends on her distance from her Node, and her hourly motion from the sun.

Table 15, page 23; The moon's latitude in eclipses; depending on her distance from her Node, and the angle of her orbit with the ecliptic.

Table 16, page 16. The horizontal parallax of the moon; and the semidiameters and hourly motions of the sun and moon, depending on their respective anomalies.

Table 17, p. 18; Reduction of the ecliptic to the equator; or difference between the sun's longitude and right ascension; or between the longitude and right ascension of any point of the ecliptic, found by the sun's longitude, or the longitude of the points of the ecliptic. The reason of this difference may readily be seen, and the difference found by an artificial globe, in which it will appear that while the longitude is between 0 and 3, and between 6 and 9 signs, the longitude is *greater* than the right ascension, and at all other times, *less*.

Table 18, p. 20; Equation of time. This is computed by finding for every degree of the sun's longitude, the corresponding anomaly, and taking the equation for this anomaly from Table 11, and changing it into time, which gives one part of the equation; then change Table 17 into time for the other part; the sum or difference of these parts is the equation. Thus Table 18 is formed; every equation in it being the sum or difference of two other equations.

Table 19, page 19, is formed by reckoning four minutes of time to one degree of longitude; and in this proportion for any greater or less quantity.

Table 20, p. 16, is formed by observing through a lunar month how much the tide is accelerated or retarded by the action of the sun: as the sun, when it passes the meridian from 0 to 8 hours before the moon, (that is, when the moon passes the meridian before 8 o'clock, either morning or evening,) accelerates the time of high water, and retards it at other times. The equation in this table depends also in part upon the moon's distance from the earth; the time of high water happening earliest when the moon is nearest the earth; and the moon is nearest the earth when her horizontal parallax is greatest.

Table 21, page 19, shows the time (found by observation) to be added to the time the moon is on the meridian, to find the time of high water as unaltered by the sun. The perpendicular rise of the water in feet at some of the places is also given; and also the latitude and longitude of the places from Greenwich observatory.

Table 22, page 19, the right ascension and declination of some of the principal fixed stars.

Table 23, page 24, dip, or depression of the horizon, at different heights above it: that is, this table contains the angle between a level line, and a line from the eye of the observer to the visible unobstructed horizon; when the eye is at different heights in feet above the horizon.

Table 24, page 18, dip or angle between a level line, and a line to the surface of the earth, or water, at different distances from the observer.

Table 25, p. 20, augmentation of the altitude of a celestial body, caused by the refraction of the earth's atmosphere at different altitudes of the body above the horizon. The state of the atmosphere affects this a little, the refraction being greatest when the thermometer is lowest. This Table is calculated for 55 deg. of Fahrenheit; but it is within a few seconds of the truth at any state of the thermometer.

Table 26, p. 20, the semi-diurnal or semi-nocturnal arc of the sun at different declinations and at different latitudes on the earth: if the declination and latitude are of the same name, this Table shows the semi-*diurnal* arc; but if the declination and latitude are of different names, it shows the semi-*nocturnal* arc. By correcting, it also answers for the semi-diurnal or semi-nocturnal arc of any other celestial body, or rather for half the time of continuance of a celestial body above or below the horizon. But the semi-diurnal arc may be more accurately found by trigonometry, as follows, viz.: to the tangent of the latitude of the place, add the tangent of the declination of the sun: subtract the radius from the sum, the remainder is the cosine of the semi-diurnal arc, when the latitude of the place and the declination are of different names, that is, one north, and the other south: and the remainder is the cosine of the semi-*nocturnal* arc, when the latitude and declination are of the same name; that is, both north, or both south. Subtract the semi-*nocturnal* arc from 12 hours, and the remainder is the semi-*diurnal* arc. When the declination of a planet, star, or the moon, is more than 23 deg. 28m. its semi-diurnal arc, or half time of its continuance above the horizon, must be calculated in the latter way, changed into time and corrected.*

Table 27, p. 21, change of the moon's right ascension from the sun's; a correction to be applied to the time the moon is on the meridian at any place, to find the time she is on the meridian of any other place. This Table also contains the correction to be added to the sun's semi-diurnal arc, to find the moon's semi-diurnal arc.

Table 28, p. 23, time answering to a change of 33m. of altitude at the horizon; or the time the sun, or any heavenly body, (on account of the refraction of the earth's atmosphere,) appears in the horizon, before it is actually there; corresponding to the declination of the sun, or body, at the head of the Table, and the latitude of the place in the left hand column.

TABLES of the moon's mean motion are made in the same manner as those of the sun. The moon's *period*, or time in which she makes one complete revolution being known. To find her mean motion in longitude for one year of 365 days, multiply 360 degrees by 365, and divide the product by the time of her tropical revolution, the quotient is her mean motion in longitude for 365 days; divide this by 365, and her mean motion in longitude for one day will be had. Her mean motion in anomaly for 365 days, is found by multiplying 360 deg. by 365, and dividing the product by the time of her anomalistic period, or revolution; divide this quotient by 365, and her mean motion in anomaly for one day will be had. The retrograde motion of the moon's node in 365 days, is found by multiplying 360 deg. by 365, and dividing the product by the time of the revolution of the node; divide this quotient by 365, and the motion of the node in one day will be had.

The mean motions for one year multiplied by 2, give the same for 2 years; and the mean motions for one year, multiplied by 3, give the same for 3 years; to the mean motions for 3 years, (because every 4th year is leap year,) add the mean motions for one year and one day, and the mean motions for 4 years will be had. In this manner a table may be made and carried as far as you please.

The motion in longitude and anomaly, and the motion of the node for one hour, is found by dividing the motions for one day by 24. Divide the motions for one hour by 60, and the motions for one minute will be had; divide the motion for one minute by 60, and the motion for one second will be had, and so on. The mean motions for any number of years, days, hours, minutes, seconds, &c. are found by multiplying the mean motions for *one*, by that *number*. The mean motions for months are found in the same manner as those of the sun. Thus Table 29, page 21, is formed.

Table 30, page 18, is formed by observing or calculating the moon's mean Lon. and anomaly, and the mean longitude of the node at noon on the 31st day of December 1799; these are taken for her mean longitude and

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* It is better to make a table of semi-diurnal arcs for the latitude of the place, and declination for every 15' to 30 or 40°; which by correcting may be used for the moon, a planet or star.

anomaly, and the mean longitude of her node at the beginning of the year 1800 ; because it is convenient in
finding her mean longitude, &c. on any given day of any month, to add her longitude, &c. for that month and
day to her longitude, &c. at the beginning of that year. And it is plain, that to find the longitude, &c. on
the 1st day of January, the same for one day must be added to that of December 31st ; and to find the lon-
gitude, &c. on the 15th of January, add the same for 15 days to that of December 31st ; or to that of the be-
ginning of January. And also to find it for the 20th of February, and the same for February, and for 20 days
to that of December 31st, and so on. Having the longitude and anomaly at the beginning of 1800, the same
at the beginning of *any number* of years after, may be found by adding the motion in longitude and anomaly
for that number of years. But having the longitude of the node, at the beginning of 1800, to find the same
at the beginning of *any number* of years after, *subtract* the motion of the node for *that number* of years,
because the motion of the node is retrograde. Thus the Table is made, and continued at pleasure.

The moon's motions are affected with many inequalities, and many equations are necessary to reduce
her mean place to the true. The ecliptic orbits of the earth and moon, and the attraction of the sun and
earth, it has already been observed, are the cause of these inequalities ; and any further investiga-
tion or explanation of them, belongs to physical astronomy, and is not here necessary. The equations are
contained in Tables 31, 32, 33, 34, 35, 36, and 37, pages 19, 21, 16, 18, 21, and 17 ; and the method of finding
the arguments for these equations, and of taking out and applying them, is described in Problem 29.

Tables 38 and 39, page 24 and 22, are for the moon's latitude, which depends principally upon her distance
from her node.

Table 40, page 24, is the moon's hourly motion in latitude, depending on her distance from her node.

Table 41, page 18, reduction of the latitude of places on the earth. This reduction is necessary on account
of the spheroidal figure of the earth.

Table 42, page 17, an equation to be applied to the ecliptic right ascension, in order to find the right ascen-
sion of the moon or a star, whose latitude does not exceed 6 degrees.

Table 43, page 24, an equation for finding the declination of the moon, or a planet, or star, whose latitude
does not exceed 6 degrees.

Table 44, page 24 ; Mean new moons from 1724 to 1799, inclusive.

Table 45, p. 24, the number of days difference between the Old Style and the New Style, at different periods
of time. The number of days against any year, belongs to every year between that year and the next year in
the table; thus, 11, the number against the year 1700, belongs to every year from 1700 to 1800 ; and 12 be-
longs to every year between 1800 and 2000. The days are to be subtracted from the Old Style to find the
New, till the year 200 after Christ, then they are to be added. All the years in the Table are leap years by
the Old Style, but none of them by the new.

Table 46, page 25. The Dominical Letter.

Table 47, page 19, shews the Golden Number for 3800 years after Christ ; and is the same in the Old as in
the New Style.

Table 48, page 24, shows (by the Dominical Letter and Golden Number) the number of direction, or num-
ber of days to be added to the 21st of March, to find on what day of either March or April EASTER SUNDAY
happens, New Style.

Table 49, page 23, shows, by the Dominical Letters, on what days of the week the days of the months fall,
and on what days of the months the days of the weeks fall.

Table 50, page 21. The moon's mean angular distance from the sun.

Table 51, page 16. The moon's mean angular motion from the sun.

Table 52, page 25. The Solar system.

Table 53, page 20. An equation or reduction, (found by the moon's true distance from her ascending Node,)
to be applied to the time of true syzygy, to find the time of orbit syzygy.

Table 54, page 25, the Constellations, with the degrees of right ascension and declination of the middle of
each ; the number of stars in each distinctly visible to the naked eye, and also the number that are of the sixth
magnitude. The ancient constellations are in Roman letters ; the modern, made out of unformed stars and
parts of other constellations, are in *italics*. N. and S. show whether the declination is north or south.

Table 55, p. 22. Logarithms of Numbers. The index of the logarithm of any number, being always known,
is not put down in the Table. To find the logarithm of any number less than 1000 ; if the number is less than
100, find the number in the left hand column, and next to it is its logarithm ; if more than 100, look for the two
left hand figures of the number in the column on the left or right, and the other figure at the top ; against the
two left hand figures, and under the other, is the logarithm. And having any given logarithm, to find its cor-
responding number, find the given logarithm or the nearest to it, in the table, and the number against it in
the right or left column, together with the figure at the top, form the corresponding number : whether whole,
mixed, or decimals, is determined by the index. Thus the logarithm for the number 397, is found to be
59879, whose index is 2, as there are three figures in the number ; and the number corresponding to the loga-
rithm 2,67486, is found to be 473 ; if the index had been 1, the number would have been 47,3 To find the lo-
garithm of any given number that has in it more than three figures, find the logarithm of the three left hand
figures of the number as just taught, subtract this logarithm from the next greater logarithm in the table,
multiply the difference by the remaining part of the number, cut off as many of the right hand figures of the
product as are in the multiplier ; add the left hand part of the product to the logarithm of the three left
hand figures of the given number, and the sum will be the logarithm required, to which prefix the proper in-
dex. Thus the logarithm of the number 7624 is found to be 3,88218. Having the logarithm of a number that
has in it more than three figures, to find that number, or the nearest to it ;—divide, (according to division of
decimals,) the difference between the given logarithm and the next less logarithm in the table, by the dif-
ference between the two nearest logarithms in the table to the given logarithm ; annex the quotient to the
number corresponding to the logarithm in the table next less than the given logarithm, and the required num-
ber will be had ; whether it is whole, mixed, or decimal, will be determined by the index of the given loga-
rithm. Thus the number corresponding to the logarithm 3.88218, is found to be 7624.

Table 56, p. 26. Logarithmic, or artificial sines, co-sines tangents, co-tangents, secants, and co-secants. To
find the logarithmic sine, or co sine, &c. for any number of degrees and minutes in the table ; if the degrees
are less than 45, find them in the left hand column of one of the divisions of the table, and the minutes under
them ; against the minutes, and *under* the proper title, is the logarithm required ; but if the degrees are
more than 45, find them in the right hand column of one of the divisions of the table, and the minutes above
them ; against the minutes, and *over* the proper title, is the logarithm required. Thus, also, it is seen what
degrees and minutes belong or correspond to a *given* logarithmic sine, or co-sine, &c. If the exact given
logarithmic sine, or co-sine, &c. cannot be found in the table, take the nearest to it. When the logarithm for
more than 90 degrees is required, subtract the given number of degrees from 180 degrees, and make use of the
remainder. The Table is for only every 15m., but if greater accuracy is required, the logarithmic sine, or co-
sine, &c. for *any* number of minutes, may be found as follows : Take the difference between the two loga-
rithms in the Table that are for the minutes nearest the given number of minutes ; multiply this difference
by the excess of the given number of minutes above 0m. 15m. 30m. or 45m. ; divide the product by 15m. add
the quotient to the logarithm of the number of minutes next less than the given number of minutes, and the
sum will be the logarithm required. And to find the nearest minutes corresponding to a given logarithmic
sine, or co-sine, &c. multiply 15m. by the difference between the given logarithm and the next less loga-
rithm to it in the proper column of the table ; divide the product by the difference between the two nearest
logarithms (in the proper column of the Table) to the given logarithm ; add the quotient to the minutes cor-

responding to the next less logarithm (in the proper column of the Table) to the given logarithm, and the required minutes will be had.

Table 57, p. 23. Logistical or proportional logarithms to every 5th second for 60 minutes, or one degree or hour. To find the logistical logarithm for any number of minutes and seconds, find the minutes at the top of one of the divisions of the Table, and the seconds in the left hand column, against the seconds and under the minutes in the logarithm required ; and thus it may be seen what minutes and seconds belong to a given logarithm ; if the *exact* given logarithm cannot be found, take the nearest to it in the Table. A proportion by logistical logarithms, is solved as by other logarithms ; that is, by subtracting the logistical logarithm of the 1st term from the sum of the logistical logarithms of the 2d and 3d terms ; the remainder is the logistical logarithm required. The first term is frequently 1 degree, or 3600 seconds, whose logistical logarithm is 0 ; then, the sum of the 2d and 3d terms is the 4th term. If one or more of the terms exceed 60 minutes, divide all the terms by some number that will make the largest term 60 minutes ; then take out their logistical logarithms and work the proportion, and multiply the result by the number by which the terms were divided, and the answer or required term will be had. The Table is for only every 5th second, which is near enough in common cases ; but if great accuracy is required, the logistical logarithm for any intermediate number of seconds may be found as directed in Table 56 ; as may also the seconds corresponding to any given logistical logarithm.

Table 58, p. 23. The visible ECLIPSES in the United States during the remainder of the present century. The figures on the right of the months, are the days, hours and minutes of the middle apparent time of each eclipse at BOSTON : and the figures on the right of e. and m. show the digits eclipsed : e. stands for evening or afternoon, m. for morning, t. for total, and p. for partial.

Table 59, p. 17. Length of a Degree of Longitude on the earth, at different distances from the Equator.

TABLE 1.—Time in Mean Lunations ; from 1-2 a Lunation, to 74212 Lunations ; with the Sun's and Moon's Mean Motion in Anomaly, and the Distance the Sun and Moon's Ascending Node move from each other in these times.

Lunations.	Julian Years.	Time. D.	H.	M.	S.	☉'s anomaly. S.	°	'	"	☽'s anomaly. S.	°	'	"	☉ fr. ☽'s ☊ S.	°	'	"
½		14	18	22	1	0	14	33	10	6	12	54	31	0	15	20	7
1		29	12	44	3	0	29	6	19	0	25	49	1	1	0	40	14
2		59	1	28	6	1	28	12	39	1	21	38	2	2	1	20	28
3		88	14	12	9	2	27	18	58	2	17	27	2	3	2	0	42
4		118	2	56	11	3	26	25	17	3	13	16	3	4	2	40	56
5		147	15	40	14	4	25	31	36	4	9	5	4	5	3	21	10
6		177	4	24	17	5	24	37	56	5	4	54	5	6	4	1	24
7		206	17	8	19	6	23	44	15	6	0	43	5	7	4	41	38
8		236	5	52	22	7	22	50	34	6	26	32	6	8	5	21	52
9		265	18	36	25	8	21	56	53	7	22	21	7	9	6	2	5
10		295	7	20	27	9	21	3	13	8	18	10	8	10	6	42	19
11		324	20	4	30	10	20	9	32	9	13	59	8	11	7	22	33
12		354	8	48	33	11	19	15	51	10	9	48	9	0	8	2	47
13	1	383	21	32	36	0	18	22	10	11	5	37	10	1	8	43	1
24	2	708	17	37	6	11	8	31	42	8	19	36	18	0	16	5	34
25		738	6	21	9	0	7	38	1	7	15	25	19	1	16	45	48
37	3	1092	15	9	42	11	26	53	52	9	25	13	28	1	24	48	35
38		1122	3	53	45	0	26	0	11	10	21	2	29	2	25	28	49
49	4	1446	23	58	15	11	16	9	43	6	5	1	37	2	2	51	22
50		1476	12	42	18	0	15	16	2	7	0	50	38	3	3	31	36
61	5	1801	8	46	48	11	5	24	34	4	14	59	46	2	10	54	9
62		1830	21	30	51	0	4	31	53	5	10	38	47	3	11	34	23
74	6	2185	6	19	24	11	23	47	44	3	20	26	56	3	19	37	10
75		2214	19	3	27	0	22	54	3	4	16	15	57	4	20	17	24
86	7	2539	15	7	57	11	13	3	35	2	0	15	5	3	27	39	57
87		2569	3	52	0	0	12	9	54	2	26	4	6	4	28	20	11
98	8	2893	23	56	30	11	2	19	26	0	10	3	14	4	5	42	44
99		2923	12	40	33	0	1	25	45	1	5	52	15	5	6	22	58
111	9	3277	21	29	6	11	20	41	36	11	15	40	24	5	14	25	45
112		3307	10	13	9	0	19	47	55	0	11	29	25	6	15	5	59
1237	100	4	8	4	51	0	3	18	52	8	15	29	52	4	19	27	19
2474	200	8	16	9	42	0	6	37	44	5	0	59	44	9	8	54	38
3711	300	13	0	14	33	0	9	56	36	1	16	29	36	1	28	21	57
4948	400	17	8	19	24	0	13	15	28	10	1	59	28	6	17	49	16
6185	500	21	16	24	15	0	16	34	20	6	17	29	20	11	7	16	35
7422	600	26	0	29	6	0	19	53	12	3	2	59	12	3	26	43	54
8658	700	0	19	49	54	11	24	5	45	10	22	40	3	7	15	30	59
9895	800	5	3	54	45	11	27	24	37	7	8	9	55	0	4	58	18
11132	900	9	11	59	36	0	0	43	29	3	23	39	47	4	24	25	37
12369	1000	13	20	4	27	0	4	2	21	0	9	9	39	9	13	53	56
24738	2000	27	16	8	54	0	8	4	42	0	18	19	18	6	27	47	52
37106	3000	11	23	29	18	11	13	0	44	0	1	39	56	3	11	1	3
49475	4000	25	19	33	45	11	17	3	5	0	10	49	35	0	24	55	30
61843	5000	10	2	54	9	10	21	59	7	11	24	10	13	9	8	9	12
74212	6000	23	22	58	36	10	26	1	28	0	3	19	52	6	22	3	8

TABLE 2.—Time of Mean New Moon in March, with the Sun's and Moon's mean Anomalies, and the Sun's mean Distance from the Moon's Ascending Node, at the time, at the Greenwich Observatory.

New ☽ in March. Yr.	D.	H.	M.	S.	☉'s anomaly. S.	°	'	"	☽'s anomaly. S.	°	'	"	☉ fr. ☽'s ☊ S.	°	'	"
1800	25	0	19	13	8	23	13	34	10	7	57	35	11	3	53	45
1810	5	6	36	52	8	3	11	1	8	3	26	10	4	26	22	19
1820	14	1	38	34	8	12	14	48	6	24	43	45	11	19	31	7
1830	23	20	40	16	8	21	18	35	5	16	1	24	6	12	39	56
1834	9	20	38	29	8	7	28	18	11	21	2	55	8	15	31	26
1835	28	18	11	5	8	25	50	30	10	26	40	5	9	24	14	27
1836	17	2	59	38	8	15	6	22	9	6	28	14	10	2	17	14
1837	6	11	48	11	8	4	22	13	7	16	16	23	10	10	20	1
1838	25	9	20	47	8	22	44	23	6	21	53	33	11	19	3	2
1839	14	18	9	20	8	12	0	14	5	1	41	42	11	27	5	49
1840	3	2	57	55	8	1	16	3	3	11	29	51	0	5	8	36
1850	12	21	59	37	8	10	19	50	2	2	47	29	6	28	17	21
1860	21	17	1	19	8	19	23	37	0	24	5	7	1	21	26	6
1870	1	23	18	58	8	29	21	5	10	19	33	40	7	13	54	40
1880	10	18	20	40	8	8	24	52	9	10	51	16	2	7	3	29
1890	20	13	22	22	8	17	28	39	8	2	8	53	9	0	12	17
1900	30	8	24	4	8	26	32	26	6	23	27	27	3	23	21	4

TABLE 3.—Time of Mean New Moon, &c., in March, Old Style.

1800	13	0	19	13	8	23	13	34	10	7	57	35	11	3	53	45
1810	22	19	20	55	9	2	17	20	8	29	15	11	5	27	2	33
1820	2	1	38	34	8	12	14	48	6	24	43	45	11	19	31	7
1830	11	20	40	16	8	21	18	35	5	16	1	24	6	12	39	56
1840	20	15	41	58	9	0	22	22	4	7	18	52	1	5	48	50
1850	30	10	43	40	9	9	26	9	2	28	36	30	7	28	57	35
1860	9	17	1	19	8	19	23	37	0	24	5	7	1	21	26	6
1870	19	12	3	1	9	28	27	24	11	15	22	41	8	14	34	54
1880	28	7	4	43	9	7	31	11	10	6	40	17	3	7	43	43
1890	8	13	22	22	8	17	28	39	8	2	8	53	9	0	12	17
1900	17	8	24	4	8	26	32	26	6	23	27	27	3	23	21	4

TABLE 12.—Equation of the Sun from the moon's Ascending Node. *Argument.* Sun's Mean Anomaly.

Deg.	0 sig. — °	'	"	1 sig. — °	'	"	2 sig. — °	'	"	3 sig. — °	'	"	4 sig. — °	'	"	5 sig. — °	'	"	Deg.
0	0	0	0	1	1	10	1	46	46	2	4	35	1	49	4	1	3	28	30
5	0	10	38	1	10	14	1	51	55	2	4	21	1	43	19	0	53	41	25
10	0	21	12	1	18	48	1	56	14	2	3	9	1	36	46	0	43	29	20
15	0	31	36	1	26	47	1	59	40	2	1	0	1	29	27	0	32	55	15
20	0	41	46	1	34	9	2	2	14	1	57	56	1	21	25	0	22	6	10
25	0	51	40	1	40	50	2	3	53	1	53	56	1	12	44	0	11	5	5
30	1	1	10	1	46	46	2	4	35	1	49	4	1	3	23	0	0	0	0
—	11 sig. +			10 sig. +			9 sig. +			8 sig. +			7 sig. +			6 sig. +			—

TABLE 5.—The annual, or first Equation, of the mean, to the true Syzygy. *Argument.* Sun's mean Anomaly.

Deg.	0 sig. — H. M. S.	1 sig. — H. M. S.	2 sig. — H. M. S.	3 sig. — H. M. S.	4 sig. — H. M. S.	5 sig. — H. M. S.	Deg.
0	0 0 0	2 3 12	3 35 0	4 10 53	3 39 30	2 7 45	30
1	0 4 18	2 6 55	3 37 10	4 10 57	3 37 19	2 3 55	29
2	0 8 35	2 10 36	3 39 18	4 10 54	3 35 6	2 0 1	28
3	0 12 51	2 14 14	3 41 23	4 10 49	3 32 50	1 56 5	27
4	0 17 8	2 17 52	3 43 26	4 10 39	3 30 30	1 52 6	26
5	0 21 24	2 21 27	3 45 25	4 10 24	3 28 5	1 48 4	25
6	0 25 39	2 25 9	3 47 19	4 10 4	3 25 35	1 41 1	24
7	0 28 55	2 28 29	3 49 7	4 9 39	3 23 0	1 39 56	23
8	0 34 11	2 31 57	3 50 50	4 9 10	3 20 20	1 35 49	22
9	0 38 26	2 35 22	3 52 29	4 8 37	3 17 35	1 31 41	21
10	0 42 39	2 38 44	3 54 4	4 7 59	3 14 49	1 27 31	20
11	0 46 52	2 42 3	3 55 35	4 7 16	3 11 59	1 23 19	19
12	0 51 4	2 45 18	3 57 2	4 6 29	3 9 6	1 19 5	18
13	0 55 17	2 48 30	3 58 27	4 5 37	3 6 10	1 14 49	17
14	0 59 27	2 51 40	3 59 49	4 4 41	3 3 10	1 10 33	16
15	1 3 36	2 54 48	4 1 7	4 3 40	3 0 7	1 6 15	15
16	1 7 45	2 57 53	4 2 18	4 2 35	2 57 0	1 1 56	14
17	1 11 53	3 0 54	4 3 23	4 1 26	2 53 49	0 57 36	13
18	1 16 0	3 3 51	4 4 22	4 0 12	2 50 36	0 53 15	12
19	1 20 6	3 6 45	4 5 18	3 58 52	2 47 18	0 48 52	11
20	1 24 10	3 9 36	4 6 10	3 57 27	2 43 57	0 44 28	10
21	1 28 12	3 12 24	4 6 58	3 55 59	2 40 33	0 40 2	9
22	1 32 12	3 15 9	4 7 41	3 54 26	2 37 6	0 35 36	8
23	1 36 10	3 17 51	4 8 21	3 52 49	2 33 35	0 31 10	7
24	1 40 6	3 20 30	4 8 57	3 51 9	2 30 2	0 26 44	6
25	1 44 1	3 23 5	4 9 29	3 49 26	2 26 26	0 22 17	5
26	1 47 54	3 25 36	4 9 55	3 47 38	2 22 47	0 17 50	4
27	1 51 46	3 28 3	4 10 16	3 45 44	2 19 5	0 13 23	3
28	1 55 37	3 30 26	4 10 33	3 43 45	2 15 20	0 8 56	2
29	1 59 26	3 32 45	4 10 45	3 41 40	2 11 35	0 4 29	1
30	2 3 12	3 35 0	4 10 53	3 39 30	2 7 45	0 0 0	0
	11 sign. +	10 sign. +	9 sign. +	8 sign. +	7 sign. +	6 sign. +	

TABLE 51.—Moon's mean angular motion from the Sun, in Julian years, months, &c.

Yrs	s	°	'	"
1	4	9	37	24
2	8	19	14	49
3	0	28	52	14
4	5	20	41	6
5	10	0	18	30
6	2	9	55	51
7	6	19	33	19
8	11	11	22	10
9	3	20	59	36
10	8	0	37	0
20	4	13	25	26
40	8	26	50	52
60	1	10	16	18
80	5	23	41	44
100	10	7	7	10
200	8	14	14	20
300	6	21	21	30
400	4	28	28	40
500	3	5	35	50
1000	6	11	11	40
2000	0	22	23	20
3000	6	33	35	0
4000	1	14	46	40
5000	7	25	58	20
6000	2	7	10	0

For Months.

	s	°	'	"
Jan.	0	0	0	0
Feb.	0	17	54	48
Mar.	11	29	15	16
Apr.	0	17	10	3
May	0	22	53	23
June	1	10	48	11
July	1	16	31	22
Aug.	2	4	26	20
Sep.	2	22	21	8
Oct.	2	28	4	29
Nov.	3	15	59	16
Dec.	3	21	42	37

Moon's motion in Days.

	s	°	'	"
1	0	12	11	27
2	0	24	22	53
3	1	6	34	20
4	1	18	45	47
5	2	0	57	13
6	2	13	8	40
7	2	25	20	7
8	3	7	31	33
9	3	19	43	0
10	4	1	54	27
11	4	14	5	53
12	4	26	17	20
13	5	8	28	47
14	5	20	40	13
15	6	2	15	40
16	6	15	3	7
17	6	27	14	33
18	7	9	26	0
19	7	21	37	27
20	8	3	48	53
21	8	16	0	20
22	8	28	11	47
23	9	10	23	13
24	9	22	34	40
25	10	4	46	7
26	10	16	57	33
27	10	29	9	0
28	11	11	20	27
29	11	23	31	53
30	0	5	43	20
31	0	17	54	47

In Hours, in Minutes, and in Seconds.

H M S	° ' "	 " ‴	" " ⁗
1	0	30	29
2	1	0	57
3	1	31	26
4	2	1	54
5	2	32	23
6	3	2	52
7	3	33	20
8	4	3	49
9	4	34	18
10	5	4	46
11	5	35	15
12	6	5	43
13	6	36	12
14	7	6	41
15	7	37	9
16	8	7	38
17	8	38	6
18	9	8	35
19	9	39	4
20	10	9	32
21	10	40	1
22	11	10	30
23	11	40	59
24	12	11	28
25	12	41	56
26	13	12	25
27	13	42	51
28	14	13	22
29	14	43	51
30	15	14	19
31	15	44	48
32	16	15	17
33	16	45	45
34	17	16	13
35	17	46	42
36	18	17	10
37	18	47	39
38	19	18	7
39	19	48	36
40	20	19	5
41	20	49	33
42	21	20	2
43	21	50	31
44	22	20	59
45	22	51	28
46	23	21	56
47	23	52	25
48	24	22	54
49	24	53	22
50	25	23	51
51	25	54	19
52	26	24	48
53	26	55	7
54	27	25	45
55	27	56	14
56	28	26	43
57	28	57	12
58	29	27	40
59	29	58	9
60	30	28	37

TABLE 20.—Equation of the time of High Water. *Arguments.* The Moon's passage over the meridian, either morning or evening, and the Moon's Horizontal Parallax.

Moon on the Meridian. H. M.	Moon's Horizontal Parallax. 54'	55'	56'	57'	58'	59'	60'	61'
	—	—	—	—	—	—	—	—
0 0	0	0	0	0	0	0	0	0
0 20	5	5	5	6	6	6	6	6
0 40	10	10	10	11	11	11	12	12
1 0	15	15	16	15	16	17	17	18
1 20	20	20	21	21	22	22	23	24
1 40	25	25	26	27	27	28	29	30
2 0	30	30	31	32	32	33	34	35
2 20	35	35	36	37	38	39	40	41
2 40	39	40	41	42	43	44	46	48
3 0	43	44	45	47	48	50	52	54
3 20	46	48	49	51	53	55	57	59
3 40	49	51	53	55	57	59	61	63
4 0	52	54	56	58	60	62	64	66
4 20	53	55	57	59	61	64	66	68
4 40	54	56	58	61	63	66	68	70
5 0	55	58	60	63	65	68	70	72
5 20	54	56	58	61	63	66	68	70
5 40	52	54	56	58	60	62	64	66
6 0	49	51	53	55	57	58	60	61
6 20	44	45	47	48	50	52	54	55
6 40	38	38	40	41	42	43	44	46
7 0	30	30	31	32	32	33	34	35
7 20	18	19	19	20	20	21	21	22
7 40	6	7	7	8	8	8	9	9
	+	+	+	+	+	+	+	+
8 0	4	3	3	2	2	2	1	1
8 20	14	13	13	12	12	11	11	11
8 40	22	22	21	20	20	19	19	18
9 0	26	25	24	24	23	22	22	21
9 20	27	26	25	24	23	22	22	21
9 40	28	27	26	25	24	23	22	22
10 0	28	27	26	25	24	23	22	21
10 20	26	25	24	23	22	22	21	20
10 40	21	20	20	19	18	18	17	16
11 0	17	16	16	15	14	14	14	13
11 20	11	10	10	10	9	9	9	8
11 40	5	5	4	4	4	4	3	3
12 0	0	0	0	0	0	0	0	0

TABLE 34.—2d Equation of the Moon's Longitude. EVECTION. *Argument* 2d. The remainder found by subtracting the Moon's mean Anomaly from the double Distance of the Moon from the Sun.

°	0— ° ' "	1— ° ' "	2— ° ' "	3— ° ' "	4— ° ' "	5— ° ' "	°
0	0 0 0	0 39 44	1 9 11	1 20 28	1 10 12	0 40 45	30
10	0 13 46	0 51 9	1 15 15	1 19 27	1 2 13	0 27 54	20
20	0 27 9	1 1 4	1 19 3	1 16 0	0 52 18	0 14 10	10
30	0 39 44	1 9 11	1 20 28	1 10 12	0 40 45	0 0 0	0
	11+	10+	9+	8+	7+	6+	

TABLE 16.—The Moon's Horizontal Parallax, and the Sun's and Moon's Hourly Motions and Semidiameters, to every sign and tenth degree of their Mean Anomalies in the side columns.

Anom. S. °	☽ H. P. ' "	☉ H. M. ' "	☽ H. M. ' "	☉ S. D. ' "	☽ S. D. ' "	Anom. S. °
0 0	54 29	2 23	30 10	15 50	14 54	12 0
0 10	54 33	2 23	30 14	15 50	14 56	11 20
0 20	54 42	2 23	30 21	15 51	14 57	11 10
1 0	54 56	2 24	30 34	15 52	14 59	11 0
1 10	55 14	2 24	30 51	15 54	15 3	10 20
1 20	55 33	2 24	31 14	15 56	15 9	10 10
2 0	55 56	2 25	31 40	15 58	15 17	10 0
2 10	56 23	2 26	32 10	16 0	15 25	9 20
2 20	56 54	2 27	32 49	16 3	15 32	9 10
3 0	57 30	2 28	33 23	16 6	15 41	9 0
3 10	58 6	2 29	34 3	16 9	15 50	8 20
3 20	58 37	2 30	34 42	16 12	16 0	8 10
4 0	59 6	2 30	35 22	16 14	16 9	8 0
4 10	59 30	2 31	35 55	16 17	16 17	7 20
4 20	59 52	2 32	36 29	16 19	16 25	7 10
5 0	60 11	2 32	37 0	16 21	16 31	7 0
5 10	60 27	2 33	37 16	16 22	16 35	6 20
5 20	60 38	2 33	37 34	16 22	16 38	6 10
6 0	60 45	2 33	37 40	16 23	16 39	6 00

TABLE 6.—Equation of the Moon's Mean Anomaly. *Argument.* Sun's Mean Anomaly.

Deg.	0 si. — ° ' "	1 si. — ° ' "	2 si. — ° ' "	3 si. — ° ' "	4 si. — ° ' "	5 si. — ° ' "	Deg.
0	0 0 0	0 46 45	1 21 32	1 35 1	1 23 4	0 48 19	30
1	0 1 37	0 48 10	1 22 21	1 35 2	1 22 14	0 46 51	29
2	0 3 13	0 49 34	1 23 10	1 35 1	1 21 24	0 45 23	28
3	0 4 52	0 50 53	1 23 57	1 35 0	1 20 32	0 43 54	27
4	0 6 28	0 52 19	1 24 41	1 34 57	1 19 38	0 42 24	26
5	0 8 6	0 53 40	1 25 24	1 34 50	1 18 42	0 40 53	25
6	0 9 42	0 55 0	1 26 6	1 34 43	1 17 45	0 39 21	24
7	0 11 20	0 56 21	1 26 48	1 34 33	1 16 48	0 37 49	23
8	0 12 56	0 57 38	1 27 23	1 34 22	1 15 47	0 36 15	22
9	0 14 33	0 58 56	1 28 6	1 34 9	1 14 44	0 34 40	21
10	0 16 10	1 0 13	1 28 43	1 33 53	1 13 41	0 33 5	20
11	0 17 47	1 1 29	1 29 17	1 33 37	1 12 37	0 31 31	19
12	0 19 23	1 2 43	1 29 51	1 33 20	1 11 33	0 29 54	18
13	0 20 59	1 3 56	1 30 22	1 33 0	1 10 26	0 28 18	17
14	0 22 35	1 5 8	1 30 50	1 32 38	1 9 17	0 26 40	16
15	0 24 10	1 6 18	1 31 19	1 32 14	1 8 8	0 25 3	15
16	0 25 45	1 7 27	1 31 45	1 31 50	1 6 58	0 23 23	14
17	0 27 19	1 8 36	1 32 12	1 31 23	1 5 46	0 21 45	13
18	0 28 52	1 9 42	1 32 34	1 30 55	1 4 32	0 20 7	12
19	0 30 25	1 10 49	1 32 57	1 30 25	1 3 19	0 18 28	11
20	0 31 57	1 11 54	1 33 17	1 29 54	1 2 1	0 16 48	10
21	0 33 29	1 12 58	1 33 36	1 29 20	1 0 45	0 15 8	9
22	0 35 2	1 14 1	1 33 52	1 28 15	0 59 26	0 13 28	8
23	0 36 32	1 15 1	1 34 6	1 28 9	0 58 7	0 11 48	7
24	0 38 1	1 16 0	1 34 18	1 27 30	0 56 45	0 10 7	6
25	0 39 29	1 16 59	1 34 30	1 26 50	0 55 23	0 8 20	5
26	0 40 59	1 17 57	1 34 40	1 26 27	0 54 1	0 6 44	4
27	0 42 26	1 18 52	1 34 48	1 25 5	0 52 37	0 5 3	3
28	0 43 54	1 19 47	1 34 54	1 24 39	0 51 12	0 3 21	2
29	0 45 19	1 20 40	1 34 58	1 23 52	0 49 45	0 1 40	1
30	0 46 45	1 21 32	1 35 1	1 23 4	0 48 19	0 0 0	0
	11 si. +	10 si. +	9 si. +	8 si. +	7 si. +	6 si. +	

TABLE 7.—Second Equation of the Mean to the true Syzygy. *Argument.* ☽'s equated Anomaly.

De.	0 si. + H.M.S.	1 si. + H.M.S.	2 si. + H.M.S.	3 si. + H.M.S.	4 si. + H.M.S.	si. 5 + H.M.S.	De.
0	0 0 0	5 12 48	8 47 8	9 46 41	8 8 59	4 34 33	30
1	0 10 58	5 21 56	8 51 45	9 45 3	8 3 12	4 26 1	29
2	0 21 56	5 30 57	8 56 10	9 45 12	7 57 23	4 17 25	28
3	0 32 54	5 39 51	9 0 25	9 44 11	7 51 33	4 8 47	27
4	0 43 52	5 48 37	9 4 31	9 42 59	7 45 46	4 0 7	26
5	0 54 50	5 57 17	9 8 25	9 41 36	7 39 46	3 51 23	25
6	1 5 48	6 5 51	9 12 9	9 40 3	7 33 36	3 42 32	24
7	1 16 46	6 14 19	9 15 43	9 38 19	7 27 22	3 33 38	23
8	1 27 44	6 22 41	9 19 5	9 36 24	7 21 2	3 24 42	22
9	1 38 40	6 30 57	9 22 14	9 34 18	7 14 30	3 15 44	21
10	1 49 33	6 39 4	9 25 12	9 32 1	7 7 50	3 6 45	20
11	2 0 23	6 47 0	9 27 51	9 29 33	7 1 2	2 57 43	19
12	2 11 10	6 54 46	9 30 32	9 26 54	6 54 8	2 48 39	18
13	2 21 54	7 2 24	9 32 58	9 24 4	6 47 9	2 39 34	17
14	2 32 34	7 9 52	9 35 12	9 21 3	6 40 6	2 30 28	16
15	2 43 9	7 17 9	9 37 14	9 17 51	6 32 56	2 21 19	15
16	2 53 38	7 24 19	9 39 8	9 14 28	6 25 40	2 12 8	14
17	3 4 3	7 31 18	9 40 51	9 10 54	6 18 18	2 2 53	13
18	3 14 24	7 38 9	9 42 21	9 7 9	6 10 49	1 53 36	12
19	3 21 42	7 44 51	9 43 42	9 3 13	6 3 16	1 44 16	11
20	3 34 58	7 51 24	9 44 53	8 59 6	5 55 35	1 34 54	10
21	3 45 11	7 57 45	9 45 52	8 54 50	5 47 54	1 25 31	9
22	3 55 21	8 3 56	9 46 38	8 50 24	5 40 4	1 16 7	8
23	4 5 26	8 9 57	9 47 13	8 45 48	5 32 9	1 6 41	7
24	4 15 26	8 15 46	9 47 36	8 41 2	5 24 9	0 57 13	6
25	4 25 20	8 21 24	9 47 49	8 36 6	5 16 5	0 47 44	5
26	4 35 6	8 26 53	9 47 54	8 31 0	5 7 56	0 38 13	4
27	4 44 42	8 32 11	9 47 46	8 25 44	4 59 42	0 28 41	3
28	4 54 11	8 37 19	9 47 33	8 20 18	4 51 15	0 19 8	2
29	5 3 33	8 42 18	9 47 14	8 14 33	4 43 2	0 9 34	1
30	5 12 48	8 47 8	9 46 44	8 8 59	4 34 33	0 0 0	0
	11 si. —	10 si. —	9 si. —	8 si. —	7 si. —	6 si. —	

TABLE 42.—Correction, to be used in finding the Right Ascension of a heavenly body. *Arguments.* Longitude and Latitude of the body.

Lon. — 0 signs with N. Lat. or — 6 signs with S. Lat.

°	6° Lat.	5° Lat.	4° Lat.	3° Lat.	2° Lat.	1° Lat.	°
0	2 23 49	1 59 44	1 35 43	1 11 45	47 49	23 54	30
10	2 23 17	1 59 9	1 35 8	1 11 14	47 25	23 40	20
20	2 19 34	1 55 56	1 32 29	1 8 9	45 59	22 56	10
30	2 12 21	1 49 49	1 27 29	1 5 21	43 24	21 37	0

Lon. + 5 signs with N. Lat. or + 11 signs with S. Lat.

Lon. + 0 signs with S. Lat. or + 6 signs with N. Lat.

°	1° Lat.	2° Lat.	3° Lat.	4° Lat.	5° Lat.	6° Lat.	°
0	23 54	47 49	0 11 45	1 35 43	1 59 41	2 23 49	30
10	23 37	47 12	1 10 45	1 34 18	1 57 50	2 21 23	20
20	22 50	45 34	1 8 14	1 30 50	1 53 23	2 15 54	10
30	21 29	42 50	1 4 3	1 25 11	1 46 13	2 7 10	0

Lon. — 5 signs with S. Lat. or — 11 signs with N. Lat.

Lon. — 1 sign with N. Lat. or — 7 signs with S. Lat.

°	6° Lat.	5° Lat.	4° Lat.	3° Lat.	2° Lat.	1° Lat.	°
0	2 12 21	1 49 49	1 27 29	1 5 21	43 24	21 37	30
10	2 1 7	1 40 23	1 19 53	0 59 36	39 33	19 41	20
20	1 45 23	1 27 15	1 9 21	0 51 41	31 15	17 2	10
30	1 21 51	1 10 11	0 55 44	0 41 30	27 29	13 39	0

Lon. + 4 signs with N. Lat. or + 10 signs with S. Lat.

Lon. + 1 sign with S. Lat. or + 7 signs with N. Lat.

°	1° Lat.	2° Lat.	3° Lat.	4° Lat.	5° Lat.	6° Lat.	°
0	21 29	42 50	1 4 3	1 25 11	1 46 13	2 7 10	30
10	19 30	38 51	0 58 3	1 17 7	1 36 3	1 54 54	20
20	16 51	33 31	0 50 3	1 6 25	1 22 39	1 38 46	10
30	13 29	26 48	0 39 53	0 53 0	1 5 54	1 18 41	0

Lon. — 4 signs with S. Lat. or — 10 signs with N. Lat.

Lon. — 2 signs with N. Lat. or — 8 signs with S. Lat.

°	6° Lat.	5° Lat.	4° Lat	3° Lat.	2° Lat.	1° Lat.	°
0	1 21 51	1 10 11	55 44	41 30	27 29	13 39	30
10	0 59 44	0 49 23	39 10	29 9	19 17	9 34	20
20	0 30 55	0 25 32	20 15	15 4	9 58	4 51	10
30	0 0 0	0 0 0	0 0	0 0	0 0	0 0	0

Lon. + 3 signs with N. Lat. or + 9 signs with S. Lat.

Lon. + 2 signs with S. Lat. or + 8 signs with N. Lat.

°	1° Lat.	2° Lat.	3° Lat.	4° Lat.	5° Lat.	6° Lat.	°
0	13 29	26 48	39 58	53 0	1 5 54	1 18 41	30
10	9 26	18 45	27 57	37 3	0 46 20	0 54 56	20
20	4 52	9 40	14 24	19 5	0 23 42	0 28 16	10
30	0 0	0 0	0 0	0 0	0 0 0	0 0 0	0

Lon. — 3 signs with S. Lat. or — 9 signs with N. Lat.

TABLE 14.—Angle of the axis of the Moon's Orbit with the axis of the Ecliptic, in Eclipses. *Arguments.* Her distance from her Ascending Node, in the right or left column; and her Hourly Motion from the Sun at the top of the table.

0, 6	27 ° '	28 ° '	29 ° '	30 ° '	31 ° '	32 ° '	33 ° '	34 ° '	35 ° '	36 ° '	5, 11
0	5 47	5 46	5 45	5 44	5 43	5 42	5 41	5 41	5 40	5 39	30
3	5 46	5 45	5 44	5 43	5 42	5 42	5 41	5 40	5 40	5 39	27
6	5 45	5 44	5 43	5 42	5 41	5 40	5 39	5 39	5 38	5 38	24
9	5 42	5 41	5 40	5 39	5 39	5 38	5 37	5 37	5 36	5 35	21
12	5 39	5 38	5 37	5 36	5 35	5 35	5 34	5 33	5 33	5 32	18
15	5 35	5 34	5 33	5 32	5 31	5 31	5 30	5 29	5 29	5 28	15
18	5 31	5 30	5 30	5 29	5 28	5 27	5 26	5 26	5 25	5 24	12

TABLE 59.—Length of a Degree of Longitude at different Latitudes.

Lat. °	Eng. miles	Lat.	Eng. miles
0	69.50	46	48.23
2	69.46	48	46.50
4	69.33	50	44.67
6	69.12	52	42.79
8	68.82	54	40.85
10	68.44	56	38.86
12	67.98	58	36.83
14	67.44	60	34.75
16	66.81	62	32.63
18	66.10	64	30.47
20	65.31	66	28.27
22	64.88	68	26.04
24	63.49	70	23.77
26	62.47	72	21.48
28	61.36	74	19.16
30	60.19	76	16.81
32	58.49	78	14.45
34	57.62	80	12.07
36	56.23	82	9.67
38	54.77	84	7.26
40	53.24	86	4.85
42	51.65	88	2.43
44	49.99	90	0.00

TAB. 37.—5th Equa. Moon's Lon. Reduction. *Arg.* 5th. Moon's dis. from her A. Node.

°	0, 6— ' "	1, 7— ' "	2, 8— ' "	°
0	0 0	5 53	5 53	30
10	2 19	6 41	4 22	20
20	4 22	6 41	2 19	10
30	5 53	5 53	0 0	0
	5, 11+	4, 10+	3, 9+	

☞ Most of the numbers in the columns of Miles in Table 59, were estimated, instead of being calculated by rule; they, therefore, may not all be strictly accurate. To make such a Table perfectly correct, say by Trigonometry, as Radius is to the length of a degree on the Equator, so is the Co-Sine of the given Latitude reduced by Table 41, page 18, to the length of a degree in that Latitude.

TABLE 10.—The Sun's mean Longitude and Anomaly at the beginning of current years. Also the Sun's mean motion in Longitude and Anomaly, in Julian Years; in Months; in Days; and in Hours, Minutes, and Seconds: with the mean distance the Sun and Moon's Ascending Node move from each other in Hours, Minutes, and Seconds, this being used in calculating eclipses.

At the beginning of current years.

Cur. Yrs.	Longitude. S.	°	′	″	Anomaly. S.	°	′	″
1800	9	9	54	21	6	0	25	21
1810	9	9	29	23	5	29	50	3
1820	9	10	3	32	6	0	13	52
1830	9	9	38	34	5	29	28	34
1834	9	9	40	21	5	29	36	14
1835	9	9	26	2	5	29	21	52
1836	9	10	10	51	6	0	4	38
1837	9	9	56	31	5	29	49	17
1838	9	9	42	11	5	29	33	55
1839	9	9	27	52	5	29	18	33
1840	9	10	12	41	6	0	2	20
1850	9	9	47	41	5	29	27	0
1860	9	10	21	50	5	29	50	49
1870	9	9	54	51	5	29	13	29
1880	9	10	31	0	5	29	39	17
1890	9	10	6	0	5	29	3	58
1900	9	9	41	0	5	28	28	38

Mean motion in Julian Years.

1	11	29	45	40	11	29	44	38
2	11	29	31	21	11	29	29	17
3	11	29	17	1	11	29	13	55
4	0	0	1	50	11	29	57	42
5	11	29	47	30	11	29	42	20
6	11	29	33	11	11	29	26	59
7	11	29	18	51	11	29	11	37
8	0	0	3	40	11	29	55	24
9	11	29	49	20	11	29	40	2
10	11	29	35	1	11	29	24	40
20	0	0	9	10	11	29	48	29
30	11	29	44	10	11	29	13	9
40	0	0	18	19	11	29	36	58
50	11	29	53	20	11	29	1	38
60	0	0	27	29	11	29	25	26
70	0	0	2	30	11	28	50	7
80	0	0	36	39	11	29	13	55
90	0	0	11	39	11	28	38	36
100	0	0	45	48	11	29	2	24
200	0	1	31	36	11	28	4	48
300	0	2	17	25	11	27	7	12
400	0	3	3	13	11	26	9	36
500	0	3	49	26	11	25	12	0
600	0	4	34	49	11	24	14	24
700	0	5	20	38	11	23	16	48
800	0	6	6	26	11	22	19	12
900	0	6	52	14	11	21	21	36
1000	0	7	38	52	11	20	24	0
2000	0	15	17	45	11	10	48	0
3000	0	22	54	7	11	1	12	0
4000	1	0	32	10	10	21	36	0
5000	1	8	10	12	10	12	0	0
10000	2	16	20	24	8	24	0	0

In Days, the same in Lon. as Anom

D	°	′	″	D	°	′	″
1	0	59	8	17	16	45	22
2	1	58	17	18	17	44	30
3	2	57	25	19	18	43	38
4	3	56	33	20	19	42	45
5	4	55	42	21	20	41	55
6	5	54	50	22	21	41	3
7	6	53	58	23	22	40	12
8	7	53	7	24	23	39	20
9	8	52	15	25	24	38	28
10	9	51	23	26	25	37	37
11	10	50	32	27	26	36	45
12	11	49	40	28	27	35	53
13	12	48	48	29	28	35	2
14	13	47	57	30	29	34	10
15	14	47	5	31	30	33	18
16	15	46	13				

The Sun's mean motion in Longitude and Anomaly, and the mean distance the Sun and Moon's Ascending Node move from each other, in Hours, Minutes, and Seconds.

Time.	Motion In Lon. & Anom.			Sun from Moon's As. Node		
H.	°	′	″	°	′	
M.	′	″	‴		″	″
S.	″	‴	⁗	″	‴	⁗
1	0	2	28	0	2	36
2	0	4	56	0	5	12
3	0	7	24	0	7	47
4	0	9	51	0	10	23
5	0	12	19	0	12	59
6	0	14	47	0	15	35
7	0	17	15	0	18	11
8	0	19	43	0	20	46
9	0	22	11	0	23	22
10	0	24	38	0	25	58
11	0	27	6	0	28	34
12	0	29	34	0	31	9
13	0	32	2	0	33	45
14	0	34	30	0	36	21
15	0	36	58	0	38	57
16	0	39	26	0	41	33
17	0	41	53	0	44	8
18	0	44	21	0	46	44
19	0	46	49	0	49	20
20	0	49	17	0	51	56
21	0	51	45	0	54	32
22	0	54	13	0	57	7
23	0	56	40	0	59	43
24	0	59	8	1	2	19
25	1	1	36	1	4	55
26	1	4	4	1	7	31
27	1	6	32	1	10	6
28	1	9	0	1	12	42
29	1	11	28	1	15	18
30	1	13	55	1	17	54
31	1	16	23	1	20	29
32	1	18	51	1	23	5
33	1	21	19	1	25	41
34	1	23	47	1	28	17
35	1	26	15	1	30	53
36	1	28	42	1	33	28
37	1	31	10	1	36	4
38	1	33	38	1	38	40
39	1	36	6	1	41	16
40	1	38	34	1	43	52
41	1	41	2	1	46	27
42	1	43	30	1	49	3
43	1	45	57	1	51	39
44	1	48	25	1	54	15
45	1	50	53	1	56	51
46	1	53	21	1	59	26
47	1	55	49	2	2	2
48	1	58	17	2	4	38
49	2	0	44	2	7	14
50	2	3	12	2	9	50
51	2	5	40	2	12	25
52	2	8	8	2	15	1
53	2	10	36	2	17	37
54	2	13	4	2	20	13
55	2	15	32	2	22	48
56	2	17	59	2	25	24
57	2	20	27	2	28	0
58	2	22	55	2	30	36
59	2	25	23	2	33	12
60	2	27	51	2	35	47

The Sun's mean motion in Longitude and Anomaly, from the beginning of the year, to the beginning of each month.

Month.		Longitude. S.	°	′	″	Anomaly. S.	°	′	″
Jan.	Com.	0	0	0	0	0	0	0	0
	Leap.	11	29	0	52	11	29	0	52
Feb.	Com.	1	0	33	18	1	0	33	13
	Leap.	0	29	34	10	0	29	34	5
March		1	28	9	11	1	28	9	1
April		2	28	42	30	2	28	42	15
May		3	28	16	40	3	28	16	20
June		4	28	49	58	4	28	49	32
July		5	28	24	8	5	28	23	37
August		6	28	57	26	6	28	56	50
September		7	29	30	44	7	29	30	3
October		8	29	4	54	8	29	4	8
November		9	29	38	12	9	29	37	20
December		10	29	12	22	10	29	11	25

TAB. 41.

Given Latitude.	Reduction of Lat.
°	′
6	2
12	5
18	7
24	9
30	10
36	11
42	11
48	11
54	11
60	10
66	9
72	7
78	5
84	2

TABLE 17.—Reduction of the Ecliptic to the Equator, or the difference between the Ecliptic Longitude and Right Ascension. *Argument.* Sun's Longitude, or the Longitude of the points of the Ecliptic. This Table changed into time, is that part of the equation of time that depends on the obliquity of the ecliptic to the equator. The other part of the equation is the equation of the sun's centre, or the difference between his mean and true place changed into time.

°	0 — 6 — °	′	″	1 — 7 — °	′	″	2 — 8 — °	′	″	°
0	0	0	0	2	5	42	2	11	15	30
3	0	14	52	2	13	7	2	3	5	27
6	0	29	36	2	19	9	1	53	29	24
9	0	44	2	2	23	44	1	42	31	21
12	0	58	3	2	26	47	1	30	20	18
15	1	11	30	2	28	16	1	17	3	15
18	1	24	14	2	28	7	1	2	49	12
21	1	36	9	2	26	20	0	47	48	9
24	1	47	7	2	22	55	0	32	12	6
27	1	57	0	2	17	52	0	16	12	3
30	2	5	42	2	11	15	0	0	0	0
	5 + 11 +			4 + 10 +			3 + 9 +			

TABLE 30.—The Moon's mean Longitude and Anomaly, and the mean Longitude of the Moon's Ascending Node, at the beginning of *Current Years.*

Yrs.	Longitude. S.	°	′	″	Anomaly. S.	°	′	″	Lon. ☊ S.	°	′	″
1800	11	5	43	12	9	20	19	29	1	3	15	39
1810	7	5	55	12	4	3	40	30	6	19	52	5
1820	3	19	17	47	11	0	5	23	0	6	25	20
1830	11	19	29	47	5	13	26	24	5	23	1	46
1834	5	10	12	42	5	21	23	34	3	5	39	42
1835	9	19	36	2	8	20	6	53	2	16	20	1
1836	2	12	9	42	0	1	54	6	1	26	57	4
1837	6	21	32	47	3	0	27	25	1	7	37	41
1838	11	0	55	52	5	29	20	44	0	18	18	36
1839	3	10	18	58	8	28	4	3	11	28	57	54
1840	8	2	52	22	0	9	51	17	11	9	35	0
1850	4	3	4	22	6	23	12	16	4	26	11	26
1860	0	16	26	59	1	19	37	11	10	12	44	41
1870	8	16	38	59	8	2	58	10	3	29	21	7
1880	5	0	1	42	2	29	23	3	9	15	54	22
1890	1	0	13	42	9	12	44	2	3	2	30	48
1900	9	0	25	42	3	26	6	1	8	19	7	14

TABLE 24.—Dip, or Depression of the Sea, or of the level surface of the earth, at different distances in Sea miles from the Observer, and at different heights of the eye above the horizon.

Distance.	Height of the eye in feet. 5	10	15	20	25	30	35	40
	′	′	′	′	′	′	′	′
¼	11	22	34	45	56	68	79	90
½	6	11	17	22	28	34	39	45
¾	4	8	12	15	19	23	27	30
1	4	6	9	12	15	17	20	23
1¼	3	5	7	9	12	14	16	19
1½	3	4	6	8	10	11	14	15
2	2	3	5	6	8	10	11	12
2½	2	3	5	6	7	8	9	10
3	2	3	4	5	6	7	8	8
3½	2	3	4	5	6	6	7	7
4	2	3	4	4	5	6	7	7
5	2	3	4	4	5	5	6	6
6	2	3	4	4	5	5	6	6

TABLE 35.—3d Equa. Moon's Lon. Equa. Moon's Centre. *Arg.* 3d. Moon's cor. anomaly.

°	0— ° ′ ″	1— ° ′ ″	2— ° ′ ″	3— ° ′ ″	4— ° ′ ″	5— ° ′ ″	°
0	0 0 0	2 58 30	5 16 21	6 17 38	5 38 46	3 20 56	30
5	0 30 52	3 25 [illegible]	5 32 [illegible]	6 18 28	5 [illegible] 10	2 50 21	25
10	1 1 33	3 50 [illegible]	5 46 48	6 16 24	5 2 48	2 18 13	20
15	1 31 51	4 14 5	5 58 27	6 11 21	4 40 50	1 44 48	15
20	2 1 34	4 37 [illegible]	6 7 [illegible]	6 3 27	4 16 24	1 10 25	10
25	2 30 31	4 57 [illegible]	6 13 59	5 52 34	3 49 42	0 35 22	5
30	2 58 30	5 16 21	6 17 38	5 38 46	3 20 56	0 0 0	0
	11+	10+	9+	8+	7+	6+	

TABLE 21.—Time to be added to the Moon's Southing to find the time of High Water at any place in the table: rise of the water in feet; and the Latitude and Longitude of the place from Greenwich Observatory.

Names Places.	H.	M.	Ft.	Latitude.			Longitude.		
Abbeville, France . .	10	30	15	50	7	N.	1	49	E.
Aberdeen, Scotland .	0	45	16	57	9	N.	2	8	W.
Air, Scotland	10	30	15	51	25	N.	4	26	W.
Albany, N. Y.	3	30	1	42	39	N.	73	45	W.
Amboy, N. J.	8	15	5	40	33	N.	74	20	W.
Babelmandel Str. . .	0	0		12	50	N.	43	45	E.
Balasore, Hindostan .	10	0		20	21	N.	86	45	E.
Ballamore, Md. . . .	1	36	3	39	17	N.	76	38	W.
Bayonne, France . .	3	30	15	43	29	N.	1	29	W.
Belfast, Ireland . . .	10	0	16	54	43	N.	5	52	W.
Bergen, Norway . . .	1	30		60	23	N	5	12	E.
Blue Hill Bay, Me. .	11	0	12	44	2	N.	68	47	W.
Boston, Mass.	11	30	11	42	21	N	71	4	W.
Bourdeaux, France .	7	14	15	44	50	N.	0	35	W.
Brunswick, N. J. . .	9	5	5	39	39	N.	74	18	W.
Calais, France	11	45	16	50	57	N.	1	50	E.
Calcutta, Bengal . . .	3	5		22	35	N.	88	28	E.
Campo Bello, N. B. .	11	0	25	44	54	N.	66	55	W.
Cape Charles	7	46	6	37	33	N.	76	19	W.
Cape Cod, Mass. . . .	11	30	6	42	0	N.	70	6	W.
Cape Henry	7	51	6	36	57	N.	76	19	W.
Cape of Good Hope .	3	0	3	34	29	S.	18	23	E.
Castine, Me.	11	10	12	43	40	N.	69	50	W.
Charleston, S. C. . .	7	15	5	32	47	N.	80	1	W.
Dort, Holland	3	0	12	51	47	N.	4	35	E.
Dover, England . . .	11	45	16	51	8	N.	1	19	E.
Dublin, Ireland . . .	9	0	14	53	22	N.	6	17	W.
Eastport, Me.	11	35	25	44	51	N.	66	56	W.
Edinburgh, Scotland	4	30	13	55	57	N.	3	12	W.
Fairfield, Ct.	10	58	6	41	16	N.	72	57	W.
Fair Isl., Orkney Is. .	10	0		59	30	N.	1	46	W.
Fayal Town, Azores Is.	2	20		38	32	N.	23	41	W.
Florida Keys	8	52	5	25	15	N.	80	20	W.
Glasgow, Scotland . .	3	0	18	55	52	N.	4	15	W.
Gondar, Abyssinia . .	1	30		12	34	N.	37	28	E.
Greenwich, England	2	40		51	29	N.	0	0	
Hague, Holland . . .	8	15	12	52	4	N.	4	17	E.
Halifax, N. S.	7	30	9	44	39	N.	63	37	W.
Hartford, Ct.	9	25	1	41	46	N.	72	50	W.
Helena, St.	2	15	3	15	55	S.	5	49	W.
Holy Head, Wales . .	9	45	20	53	23	N.	4	45	W.
Ipswich, Mass. . . .	11	15	10	42	43	N.	70	50	W.
Isle of Shoals, N. H. .	11	15	12	42	59	N.	70	51	W.
Jamestown, Va. . . .	9	56	4	37	9	N.	76	55	W.
Kingston, N. Y. . . .	2	30	2	41	56	N.	73	56	W.
Kennebunk, Me. . . .	11	15	10	43	25	N.	70	32	W.
Lima, Peru	6	30	2	12	2	S.	76	50	W.
Lisbon, Portugal . . .	3	28	9	38	42	N.	9	9	W.
Louisbourg Island . .	7	15	8	45	54	N.	59	59	W.
Macao, China	5	50	5	22	13	N.	113	35	W.
Martha's Vineyard .	7	37	7	41	5	N.	70	35	W.
Nantucket	12	11	11	41	16	N.	70	8	W.
Newburyport, Mass.	11	15	11	42	49	N.	70	52	W.
New Haven, Ct. . . .	10	17	8	41	18	N.	72	58	W.
New London, Ct. . .	8	58	8	41	22	N.	72	9	W.
New York	8	56	6	40	43	N.	74	2	W.
Nootka Sound	12	20	6	49	36	N.	126	43	W.
Ohitatoo Island . . .	2	30	3	9	55	S.	139	6	W.
Oporto, Portugal . .	3	15	10	41	10	N.	8	27	W.
Owyhee Island	3	45	3	18	54	N.	155	48	W.
Panama, Mexico . . .	3	10	6	8	58	N.	80	15	W.
Pensacola, Florida . .	8	12	7	30	28	N.	87	12	W.
Philadelphia, Pa. . .	2	0		39	57	N.	75	11	W.
Portland, Me.	10	45	13	43	39	N.	70	21	W.
Port Royal, Isl. . . .	8	15		18	0	N.	76	45	W.
Portsmouth, N. H. .	11	15	10	43	5	N.	70	45	W.
Providence, R. I. .	8	25	5	41	49	N.	71	26	W.
Quebec, Canada . . .	8	12		46	47	N.	70	57	W.
Rochelle, France . .	3	45	18	46	9	N.	1	10	W.
Rotterdam, U. Pro. .	3	45	7	51	56	N.	4	28	E.
Sag Harbour, L. I. .	9	52	7	41	2	N.	73	5	W.
Salem, Mass.	11	30	11	42	31	N.	70	54	W.
Savannah, Geo. . . .	7	45	4	32	2	N.	81	3	W.
Senegal Fort, Af. . .	10	30	9	15	53	N.	16	31	W.
St. Andrews, N. B. .	11	30	25	44	59	N.	66	56	W.
St. John's, N. F. L. .	6	0	7	47	32	N.	52	26	W.
St. John's, N. B. . . .	12	0	25	44	58	N.	66	16	W.
St. Salvador, Isl. . . .	3	20	8	24	30	N.	74	30	W.
Tavira, Portugal . .	1	30	9	37	8	N.	7	40	E.
Tricomali, Ceylon . .	6	0	3	8	33	N.	81	21	E.
Venice, Italy	10	30	3	45	27	N.	12	4	E.
Weymouth, England	7	20	18	52	40	N.	2	34	W.
Williamsburg, Va. .	11	10	4	37	14	N.	76	49	W.

TABLE 31.—Annual Equation or Correction of the Moon's Mean Anomaly. *Argument.* The Sun's Mean Anomaly.

	0+ ′ ″	1+ ′ ″	2+ ′ ″	3+ ′ ″	4+ ′ ″	5+ ′ ″	
0	0 0	10 37	18 33	21 42	19 1	11 5	30
10	3 40	13 41	20 13	21 27	16 53	7 36	20
20	7 15	16 21	21 16	20 34	14 13	3 52	10
30	10 37	18 33	21 42	19 1	11 5	0 0	0
	11—	10—	9—	8—	7—	6—	

TABLE 47.—The Lunar Cycle or Golden Number for Old and New Style, for 3800 years after Christ.

Centuries.		Old years, or years less than a Hundred. 00 19 38 57 76 95	01 20 39 58 77 96	02 21 40 59 78 97	03 22 41 60 79 98	04 23 42 61 80 99	05 24 43 62 81	06 25 44 63 82	07 26 45 64 83	08 27 46 65 84	09 28 47 66 85	10 29 48 67 86	11 30 49 68 87	12 31 50 69 88	13 32 51 70 89	14 33 52 71 90	15 34 53 72 91	16 35 54 73 92	17 36 55 74 93	18 37 56 75 94
0	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	20	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5
2	21	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10
3	22	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
4	23	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1
5	24	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6
6	25	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11
7	26	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
8	27	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2
9	28	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7
10	29	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12
11	30	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
12	31	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3
13	32	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8
14	33	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13
15	34	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
16	35	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1	2	3	4
17	36	10	11	12	13	14	15	16	17	18	19	1	2	3	4	5	6	7	8	9
18	37	15	16	17	18	19	1	2	3	4	5	6	7	8	9	10	11	12	13	14

TABLE 19.—Longitude on the earth changed into time, or time into longitude.

° ′ ″	H. M. S.	M. S. T.	° ′ ″	H. M. S.	M. S. T.
1	0	4	37	2	28
2	0	8	38	2	32
3	0	12	39	2	36
4	0	16	40	2	40
5	0	20	41	2	44
6	0	24	42	2	48
7	0	28	43	2	52
8	0	32	44	2	56
9	0	36	45	3	0
10	0	40	46	3	4
11	0	44	47	3	8
12	0	48	48	3	12
13	0	52	49	3	16
14	0	56	50	3	20
15	1	0	51	3	24
16	1	4	52	3	28
17	1	8	53	3	32
18	1	12	54	3	36
19	1	16	55	3	40
20	1	20	56	3	44
21	1	24	57	3	48
22	1	28	58	3	52
23	1	32	59	3	56
24	1	36	60	4	0
25	1	40	70	4	40
26	1	44	80	5	20
27	1	48	90	6	0
28	1	52	100	6	40
29	1	56	110	7	20
30	2	0	120	8	0
31	2	4	130	8	40
32	2	8	140	9	20
33	2	12	150	10	0
34	2	16	160	10	40
35	2	20	170	11	20
36	2	24	180	12	0

TABLE 22.—Stars' Right Ascension and Declination

Names.	rt.as.		Decl.	
Algenib . .	0	4	16	16n
Schedar . .	0	31	55	26n
Pole Star .	1	0	88	21n
Mirach . .	1	0	34	43n
Almaach . .	1	51	41	31n
Menkar . .	2	53	3	55n
Algol . . .	2	57	40	16n
7 Stars . . .	3	38	23	35n
Aldebaran	4	26	16	10n
Capella . .	5	4	45	49n
Rigel . . .	5	6	8	24s
Bellatrix .	5	16	2	34s
Yard L. .	5	26	1	19s
Betelguez .	5	46	7	22n
Sirius . . .	6	38	16	29s
Castor . . .	7	21	32	15n
Procyon .	7	30	5	39n
Pollux . .	7	35	28	26n
Acubens . .	8	49	12	43s
Alphard . .	9	19	7	56s
Regulus . .	10	0	12	48n
Dubhe . .	10	53	62	40n
Denebola .	11	40	15	41n
Algorab . .	12	2	16	37n
Alioth . . .	12	47	56	52n
Spica . . .	13	16	10	16s
Benetnach	13	41	50	10n
Arcturus .	14	8	20	4n
Seginus . .	14	27	39	3n
Kochab . .	14	51	74	51n
Zubeneig .	15	8	8	45s
Alphacca .	15	28	27	18n
Antares . .	16	19	26	3s
Rasalgethi	17	7	14	35n
Lesath . .	17	20	36	57n
Rasalhagus	17	27	12	41n
Rastaben .	17	53	51	31n
Lyræ . . .	18	31	38	38n
Albirea . .	19	20	17	33n
Altair . . .	19	42	8	26n
Deneb . . .	20	36	44	41n
Alderamin	21	15	61	52n
Fomalhaut	22	48	30	38s
Scheat . .	22	56	27	8n
Markab . .	22	56	14	18n

TABLE 8.—Third Equation of the Mean to the true Syzygy. *Argument.* The remainder found by subtracting the Moon's equated anomaly from the Sun's mean anomaly.

Degs.	0 si. — 6 si. + M.	S.	1 si. — 7 si. + M.	S.	2 si. — 8 si. + M.	S.	Degs.
0	0	0	2	22	4	12	30
5	0	25	2	42	4	27	25
10	0	50	3	2	4	38	20
15	1	15	3	22	4	48	15
20	1	40	3	42	4	54	10
25	2	0	3	57	4	57	5
30	2	22	4	12	4	58	0
Deg.	5 si. — 11 si. +		4 si. — 10 si. +		3 si. — 9 si. +		Deg.

TABLE 4.—The number of Days from the beginning of March to the beginning of each of the other months.

March	0
April	31
May	61
June	92
July	122
August	153
September . . .	184
October	214
November . . .	245
December . . .	275
January	306
February	337

TABLE 18.—Equation of Time; or the difference between the Sun and Clock, for every sign and degree of the Sun's Longitude, and for the days of the year. M, at the head of the table, stands for March; A for April; M for May; J for June; J for July, &c. d stands for days; m for minutes; and s for seconds. + shows that the equation is to be added to the time by the clock to find the time by the Sun; and — subtracted. The signs of the Sun's Longitude are at the head of the table, and the degrees in the left column. The Table begins with the 20th day of March, when the Sun's Longitude is 0.

De.	M	0 —		A	1 +		M	2 +		J	3 —		J	4 —		A	5 —		S	6 +		O	7 +		N	8 +		D	9 +		J	10 —		F	11 —	
	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.	d.	m.	s.
0	20	7	36	19	1	9	20	3	51	20	1	13	22	5	57	23	2	20	23	7	38	23	15	31	22	13	33	21	1	11	20	11	28	18	14	19
1	21	7	17	20	1	23	21	3	47	21	1	26	23	5	59	24	2	4	24	7	58	24	15	39	23	13	17	22	0	42	21	11	45	19	14	13
2	22	6	58	21	1	36	22	3	41	22	1	40	24	6	0	25	1	48	25	8	19	25	15	46	24	13	0	23	+	12	22	12	1	20	14	6
3	23	6	59	22	1	48	23	3	37	23	1	55	25	6	1	26	1	31	26	8	40	26	15	52	25	12	42	24	—	17	23	12	17	21	13	59
4	24	6	20	24	2	0	24	3	32	24	2	7	26	6	1	27	1	14	27	9	1	27	15	57	26	12	23	25	0	46	24	12	32	22	13	51
5	25	6	1	25	2	11	25	3	26	25	2	20	27	6	0	28	0	56	28	9	21	28	16	2	27	12	4	26	1	16	25	12	46	23	13	43
6	26	5	42	26	2	22	26	3	19	27	2	33	28	5	59	29	0	33	29	9	41	29	16	6	28	11	44	27	1	45	26	12	59	24	13	34
7	27	5	24	27	2	32	27	3	12	28	2	45	29	5	57	30	0	20	30	10	1	30	16	9	29	11	23	28	2	14	27	13	12	25	13	24
8	28	5	5	28	2	42	28	3	4	29	2	58	30	5	54	31	—	1	O	10	20	31	16	11	30	11	1	29	2	43	28	13	24	26	13	14
9	29	4	47	29	2	51	29	2	56	30	3	11	A	5	51	S	+	18	2	10	39	N	16	13	D	10	39	30	3	11	29	13	35	27	13	3
10	30	4	28	30	3	0	30	2	47	J	3	23	2	5	47	2	0	37	3	10	57	2	16	13	2	10	16	31	3	39	30	13	45	28	12	51
11	31	4	9	M	3	8	J	2	38	2	3	35	3	5	42	3	0	57	4	11	15	3	16	13	3	9	53	J	4	7	31	13	54	M	12	39
12	A	3	50	2	3	16	2	2	29	3	3	46	4	5	37	4	1	17	5	11	33	4	16	12	4	9	29	2	4	35	F	14	2	2	12	27
13	2	3	32	3	3	23	3	2	19	4	3	58	5	5	31	5	1	38	6	11	51	5	16	10	5	9	5	3	5	2	1	14	9	3	12	14
14	3	3	13	4	3	30	4	2	8	5	4	9	6	5	24	6	1	59	7	12	8	6	16	7	6	8	40	4	5	29	2	14	16	4	12	0
15	4	2	55	5	3	36	5	1	57	6	4	19	7	5	17	7	2	19	8	12	25	7	16	4	7	8	14	5	5	56	3	14	22	5	11	46
16	5	2	37	6	3	41	6	1	46	7	4	29	8	5	9	8	2	40	9	12	41	8	16	0	8	7	48	6	6	22	4	14	27	6	11	31
17	6	2	19	7	3	46	7	1	35	8	4	39	9	5	1	9	3	1	10	12	57	9	15	55	9	7	22	7	6	48	5	14	31	7	11	16
18	7	2	1	8	3	50	8	1	23	9	4	48	10	4	52	10	3	22	11	13	12	10	15	49	10	6	55	8	7	13	6	14	35	8	11	1
19	8	1	43	9	3	53	9	1	11	10	4	57	11	4	43	11	3	44	12	13	27	11	15	42	11	6	28	9	7	37	7	14	38	9	10	46
20	9	1	26	10	3	56	10	0	59	11	5	5	12	4	33	12	4	5	13	13	42	12	15	35	12	6	0	10	8	1	8	14	40	10	10	30
21	10	1	9	11	3	58	11	0	46	12	5	13	13	4	22	13	4	26	14	13	56	13	15	26	13	5	32	11	8	21	9	14	41	11	10	14
22	11	0	52	12	4	0	12	0	34	13	5	20	14	4	11	14	4	47	15	14	9	14	15	17	14	5	4	12	8	47	10	14	42	12	9	58
23	12	0	36	13	4	1	13	0	21	14	5	27	15	3	50	15	5	9	16	14	21	15	15	7	14	4	36	13	9	9	11	14	41	13	9	41
24	13	0	20	14	4	1	14	+	8	15	5	33	16	3	46	16	5	30	17	14	33	16	14	56	15	4	8	14	9	31	12	14	40	14	9	24
25	14	—	4	15	4	1	15	—	5	16	5	39	18	3	33	17	5	32	18	14	44	17	14	44	16	3	39	15	9	53	13	14	39	15	9	6
26	15	+	11	16	4	0	16	0	19	17	5	44	19	3	19	18	6	13	19	14	53	18	14	31	17	3	10	16	10	14	14	14	37	16	8	48
27	16	0	26	17	3	59	17	0	31	18	5	48	20	3	4	19	6	35	20	15	5	19	14	17	18	2	41	17	10	34	15	14	34	17	8	30
28	17	0	40	18	3	57	18	0	46	19	5	52	21	2	50	20	6	56	21	15	14	20	14	3	19	2	11	18	10	53	16	14	30	18	8	12
29	18	0	53	19	3	54	19	0	59	20	5	55	22	2	35	21	7	17	22	15	23	21	13	48	20	1	41	19	11	11	17	14	25	19	7	54
30	19	1	9	20	3	51	20	1	13	21	5	57	23	2	20	22	7	28	23	15	31	22	13	33	21	1	11	20	11	28	18	14	19	20	7	36

TABLE 26.—The Sun's Semidiurnal, or Seminocturnal arc. *Arguments.* The Sun's Declination in degrees, at the head of the table, and the Latitude of the place in the left column. N. B. If the Declination and Latitude are of the same name, that is, both north, or both south, it is the Semi-*diurnal* arc; otherwise, the Semi-*nocturnal* arc. The Semidiurnal arc is the time of the Sun's sitting; the Seminocturnal arc is the time of his rising.

	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	23° 28'
°	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '	h '
0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0
5	6 0	6 0	6 1	6 1	6 1	6 2	6 2	6 2	6 3	6 3	6 4	6 4	6 4	6 5	6 5	6 5	6 6	6 6	6 7	6 7	6 7	6 8	6 8	6 9	6 9
10	6 0	6 1	6 1	6 2	6 3	6 4	6 2	6 5	6 6	6 6	6 7	6 8	6 9	6 9	6 10	6 11	6 12	6 12	6 13	6 14	6 15	6 16	6 16	6 17	6 18
12	6 0	6 1	6 2	6 3	6 3	6 4	6 5	6 6	6 7	6 8	6 9	6 9	6 10	6 11	6 12	6 13	6 14	6 15	6 16	6 17	6 18	6 19	6 20	6 21	6 21
15	6 0	6 1	6 2	6 3	6 4	6 5	6 6	6 8	6 9	6 10	6 11	6 12	6 13	6 14	6 15	6 16	6 18	6 19	6 20	6 21	6 22	6 24	6 25	6 26	6 27
18	6 0	6 1	6 2	6 4	6 5	6 6	6 8	6 9	6 10	6 12	6 13	6 14	6 16	6 17	6 19	6 20	6 21	6 22	6 24	6 26	6 27	6 29	6 30	6 32	6 32
20	6 0	6 1	6 3	6 4	6 6	6 7	6 9	6 10	6 12	6 13	6 15	6 16	6 18	6 19	6 21	6 22	6 24	6 24	6 27	6 29	6 30	6 32	6 33	6 35	6 36
23	6 0	6 2	6 3	6 5	6 7	6 9	6 10	6 12	6 14	6 15	6 17	6 19	6 21	6 23	6 24	6 26	6 28	6 30	6 32	6 34	6 36	6 37	6 39	6 41	6 42
25	6 0	6 2	6 4	6 6	6 7	6 9	6 11	6 13	6 15	6 17	6 19	6 21	6 23	6 25	6 27	6 29	6 31	6 33	6 35	6 37	6 39	6 41	6 42	6 46	6 47
28	6 0	6 2	6 4	6 6	6 9	6 11	6 13	6 15	6 17	6 19	6 22	6 24	6 26	6 28	6 30	6 33	6 35	6 37	6 40	6 42	6 45	6 47	6 50	6 52	6 53
30	6 0	6 2	6 5	6 7	6 9	6 12	6 14	6 16	6 19	6 21	6 23	6 26	6 28	6 31	6 33	6 35	6 38	6 41	6 43	6 46	6 48	6 51	6 54	6 57	6 58
31	6 0	6 2	6 5	6 7	6 10	6 12	6 15	6 17	6 19	6 22	6 24	6 27	6 29	6 32	6 34	6 37	6 40	6 42	6 45	6 48	6 50	6 53	6 56	6 59	7 1
32	6 0	6 2	6 5	6 8	6 10	6 13	6 15	6 18	6 20	6 23	6 25	6 28	6 31	6 33	6 36	6 39	6 41	6 44	6 47	6 50	6 53	6 56	6 58	7 1	7 3
33	6 0	6 3	6 5	6 8	6 10	6 13	6 16	6 18	6 21	6 24	6 26	6 29	6 32	6 34	6 37	6 40	6 43	6 46	6 49	6 52	6 55	6 58	7 1	7 4	7 5
34	6 0	6 3	6 5	6 8	6 11	6 14	6 16	6 19	6 22	6 25	6 27	6 30	6 33	6 36	6 39	6 42	6 45	6 48	6 51	6 54	6 57	7 0	7 3	7 6	7 8
35	6 0	6 3	6 6	6 8	6 11	6 14	6 17	6 20	6 23	6 25	6 28	6 31	6 34	6 37	6 40	6 43	6 46	6 49	6 53	6 56	6 59	7 2	7 6	7 9	7 11
36	6 0	6 3	6 6	6 9	6 12	6 15	6 18	6 20	6 23	6 26	6 29	6 32	6 36	6 39	6 42	6 45	6 48	6 51	6 55	6 58	7 1	7 5	7 8	7 12	7 14
37	6 0	6 3	6 6	6 9	6 12	6 15	6 18	6 21	6 24	6 27	6 31	6 34	6 37	6 40	6 43	6 47	6 50	6 53	6 57	7 0	7 4	7 7	7 11	7 15	7 16
38	6 0	6 3	6 6	6 9	6 13	6 16	6 19	6 22	6 25	6 28	6 32	6 35	6 38	6 42	6 45	6 48	6 52	6 55	6 59	7 2	7 6	7 10	7 14	7 17	7 19
39	6 0	6 3	6 6	6 10	6 13	6 16	6 20	6 23	6 26	6 29	6 33	6 36	6 40	6 43	6 47	6 50	6 54	6 57	7 1	7 5	7 9	7 12	7 16	7 20	7 22
40	6 0	6 3	6 7	6 10	6 13	6 17	6 21	6 24	6 27	6 31	6 34	6 38	6 41	6 45	6 48	6 52	6 56	7 0	7 3	7 7	7 11	7 15	7 19	7 23	7 25
41	6 0	6 3	6 7	6 10	6 14	6 17	6 21	6 25	6 28	6 32	6 35	6 39	6 43	6 46	6 50	6 54	6 58	7 2	7 6	7 10	7 14	7 18	7 22	7 27	7 29
42	6 0	6 4	6 7	6 11	6 14	6 18	6 22	6 25	6 29	6 33	6 37	6 40	6 44	6 48	6 52	6 56	7 0	7 4	7 8	7 12	7 17	7 21	7 25	7 30	7 32
43	6 0	6 4	6 7	6 11	6 15	6 19	6 22	6 26	6 30	6 34	6 38	6 42	6 46	6 50	6 54	6 58	7 2	7 7	7 11	7 15	7 19	7 24	7 28	7 33	7 35
44	6 0	6 4	6 8	6 12	6 15	6 19	6 23	6 27	6 31	6 35	6 39	6 43	6 47	6 52	6 56	7 0	7 4	7 9	7 13	7 18	7 22	7 27	7 31	7 36	7 39
45	6 0	6 4	6 8	6 12	6 16	6 20	6 24	6 28	6 32	6 36	6 41	6 45	6 49	6 53	6 58	7 2	7 7	7 11	7 16	7 21	7 25	7 30	7 35	7 40	7 43
46	6 0	6 4	6 8	6 12	6 17	6 21	6 25	6 29	6 33	6 38	6 42	6 46	6 51	6 55	7 0	7 4	7 9	7 14	7 19	7 23	7 29	7 34	7 39	7 44	7 47
47	6 0	6 4	6 9	6 13	6 17	6 22	6 26	6 30	6 35	6 39	6 43	6 48	6 53	6 57	7 2	7 7	7 12	7 16	7 22	7 27	7 32	7 37	7 43	7 48	7 51
48	6 0	6 4	6 9	6 13	6 18	6 22	6 27	6 31	6 36	6 41	6 45	6 50	6 55	6 59	7 4	7 9	7 14	7 19	7 25	7 30	7 35	7 41	7 47	7 53	7 56
49	6 0	6 5	6 9	6 14	6 18	6 23	6 28	6 32	6 37	6 42	6 47	6 52	6 57	7 2	7 7	7 12	7 17	7 22	7 28	7 33	7 39	7 45	7 51	7 57	8 0
50	6 0	6 5	6 10	6 14	6 19	6 24	6 29	6 34	6 39	6 44	6 49	6 54	6 59	7 4	7 9	7 14	7 20	7 25	7 31	7 37	7 43	7 49	7 55	8 2	8 5
51	6 0	6 5	6 10	6 15	6 20	6 25	6 30	6 35	6 40	6 45	6 50	6 56	7 1	7 6	7 12	7 17	7 23	7 29	7 35	7 41	7 47	7 53	8 0	8 7	8 10
52	6 0	6 5	6 10	6 15	6 21	6 26	6 31	6 36	6 41	6 47	6 52	6 58	7 3	7 9	7 14	7 20	7 26	7 32	7 38	7 45	7 51	7 58	8 5	8 12	8 15
53	6 0	6 5	6 11	6 16	6 21	6 27	6 32	6 38	6 43	6 49	6 54	7 0	7 6	7 11	7 17	7 23	7 29	7 36	7 42	7 49	7 56	8 3	8 10	8 17	8 21
54	6 0	6 6	6 11	6 17	6 22	6 28	6 33	6 39	6 45	6 50	6 56	7 2	7 8	7 14	7 20	7 27	7 33	7 40	7 46	7 53	8 0	8 8	8 15	8 23	8 27
55	6 0	6 6	6 11	6 17	6 23	6 29	6 35	6 40	6 46	6 52	6 58	7 4	7 10	7 17	7 23	7 30	7 37	7 44	7 51	7 58	8 5	8 13	8 21	8 29	8 33
58	6 0	6 6	6 13	6 19	6 26	6 32	6 39	6 45	6 52	6 59	7 6	7 13	7 20	7 27	7 34	7 42	7 49	7 57	8 5	8 14	8 22	8 32	8 41	8 51	8 56
60	6 0	6 7	6 14	6 21	6 28	6 35	6 42	6 49	6 56	7 4	7 11	7 19	7 26	7 34	7 42	7 51	7 59	8 8	8 17	8 26	8 36	8 47	8 58	9 0	9 15

TABLE 53.—To reduce true to orbit syzy. *Argument.* Moon from her Ascending Node.

— 0 signs. 6 —		
°	' "	°
0	0 0	30
5	2 24	25
10	4 47	20
15	7 10	15
20	9 30	10
+ 5 sig. 11 +		

TABLE 25.—Augmentation of the Altitude of a Heavenly body at different apparent altitudes; caused by the earth's atmosphere.

Alt. ° '	Refr. ' "	Alt. °	Refr. ' "
0 0	33 0	7	7 20
0 5	32 10	8	6 29
0 10	31 22	9	5 48
0 15	30 35	10	5 15
0 20	29 50	11	4 47
0 25	29 6	12	4 23
0 30	28 23	13	4 3
0 35	27 41	14	3 45
0 40	27 0	15	3 30
0 50	25 42	16	3 17
1 0	24 29	17	3 4
1 15	22 47	18	2 51
1 30	21 15	19	2 44
1 45	19 51	20	2 35
2 0	18 35	25	2 2
2 15	17 26	30	1 38
2 30	16 24	35	1 21
2 45	15 27	40	1 8
3 0	14 36	45	0 57
3 15	13 49	50	0 43
3 30	13 6	55	0 40
3 45	12 27	60	0 33
4 0	11 51	65	0 26
4 15	11 18	70	0 21
4 30	10 48	75	0 15
5 0	9 54	80	0 10
5 30	9 8	85	0 5
6 0	8 28	90	0 0

TABLE 29.—The Moon's mean motion in Longitude and Anomaly; and the mean motion of the Moon's Node, in Julian Years; in Months; in Days; and in Hours, Minutes, and Seconds.

Yrs.	In Lon.				Anomaly.				Node.			
	s.	°	'	"	s.	°	'	"	s.	°	'	"
1	4	9	23	5	2	28	43	19	0	19	19	43
2	8	18	46	10	5	27	26	38	1	8	39	27
3	0	28	9	15	8	26	9	57	1	27	59	10
4	5	20	42	55	0	7	57	10	2	17	22	4
5	10	0	6	0	3	6	40	30	3	6	41	47
6	2	9	29	4	6	5	23	49	3	26	1	31
7	6	18	52	10	9	4	7	8	4	15	21	12
8	11	11	25	50	0	15	54	21	5	4	44	8
9	3	20	48	55	3	14	37	40	5	24	3	51
10	8	0	12	0	6	13	20	59	6	13	23	34
20	4	13	34	34	1	9	45	52	0	26	50	19
40	8	27	9	8	2	19	31	44	1	23	40	38
60	1	10	43	43	3	29	17	36	2	20	30	58
80	5	24	18	16	5	9	3	28	3	17	21	17
100	10	7	52	50	6	18	49	20	4	14	11	36
200	8	15	45	40	1	7	38	40	8	28	23	12
300	6	23	38	30	7	26	28	0	1	12	34	48
400	5	1	31	20	2	14	57	20	5	26	46	24
500	3	9	24	10	9	4	6	40	10	10	58	0
1000	6	18	48	20	6	8	13	20	8	21	56	0
2000	1	7	36	40	0	16	26	40	5	13	52	0
3000	7	26	25	0	6	24	40	0	2	5	48	0
6000	3	22	59	0	1	19	20	0	4	11	36	0

Months.	In Lon.				Anomaly.				Node.			
Jan. Com.	0	0	0	0	0	0	0	0	0	0	0	0
Jan. Leap.	11	16	49	25	11	16	56	6	11	29	56	49
Feb. Com.	1	18	28	6	1	15	0	53	0	1	38	30
Feb. Leap.	1	5	17	31	1	1	56	59	0	1	35	19
March.	1	27	24	27	1	20	50	4	0	3	7	28
April.	3	15	52	33	3	5	50	57	0	4	45	57
May.	4	21	10	3	4	7	47	56	0	6	21	17
June.	6	9	38	9	5	22	48	49	0	7	59	46
July.	7	14	55	40	6	24	45	48	0	9	35	6
August.	9	3	23	46	8	9	46	41	0	11	13	35
September.	10	21	51	52	9	24	47	34	0	12	52	5
October.	11	27	9	23	10	26	44	34	0	14	27	24
November.	1	15	37	29	0	11	45	26	0	16	5	54
December.	2	20	54	59	1	13	42	25	0	17	41	13

D's.	In Longitude.				In Anomaly.				Node.		
	s.	°	'	'	s.	°	'	"	°	'	"
1	0	13	10	35	0	13	3	54	0	3	11
2	0	26	21	10	0	26	7	48	0	6	21
3	1	9	31	45	1	9	11	42	0	9	32
4	1	22	42	20	1	22	15	36	0	12	43
5	2	5	52	55	2	5	19	30	0	15	53
6	2	19	3	30	2	18	23	24	0	19	4
7	3	2	14	5	3	1	27	18	0	22	14
8	3	15	24	40	3	14	31	12	0	25	25
9	3	28	35	15	3	27	35	6	0	28	36
10	4	11	45	50	4	10	39	0	0	31	46
11	4	24	56	25	4	23	42	53	0	34	57
12	5	8	7	0	5	6	46	47	0	38	8
13	5	21	17	35	5	19	50	41	0	41	18
14	6	4	28	10	6	2	54	35	0	44	29
15	6	17	38	45	6	15	58	29	0	47	40
16	7	0	49	20	6	29	2	23	0	50	50
17	7	13	59	55	7	12	6	17	0	54	1
18	7	27	10	30	7	25	10	11	0	57	11
19	8	10	21	5	8	8	14	5	1	0	22
20	8	23	31	41	8	21	17	59	1	3	33
21	9	6	42	16	9	4	41	53	1	6	43
22	9	19	52	51	9	17	25	47	1	9	54
23	10	3	3	26	10	0	29	41	1	13	5
24	10	16	14	1	10	13	33	35	1	16	15
25	10	29	24	36	10	26	37	29	1	19	26
26	11	12	35	11	11	9	41	23	1	22	37
27	11	25	45	46	11	22	45	17	1	25	47
28	0	8	56	21	0	5	49	11	1	28	58
29	0	22	6	56	0	18	53	5	1	32	8
30	1	5	17	31	1	1	56	59	1	35	19
31	1	18	28	6	1	15	0	53	1	38	30

Motion in Hours, Minutes, and Seconds.

H M S	Long.			Anom.			Node.	
	° ' "	' " ‴	" ‴ ⁗	° ' "	' " ‴	" ‴ ⁗	' " ‴	" ‴ ⁗
1	0	32	56	0	32	39	0	8
2	1	5	53	1	5	20	0	16
3	1	38	49	1	37	59	0	24
4	2	11	46	2	10	39	0	32
5	2	44	42	2	43	18	0	40
6	3	17	39	3	15	59	0	48
7	3	50	35	3	48	38	0	56
8	4	23	32	4	21	18	1	4
9	4	56	28	4	53	58	1	12
10	5	29	25	5	26	38	1	19
11	6	2	21	5	59	17	1	27
12	6	35	18	6	31	57	1	35
13	7	8	14	7	4	37	1	43
14	7	41	10	7	37	16	1	51
15	8	14	7	8	9	56	1	59
16	8	47	3	8	42	36	2	7
17	9	20	0	9	15	16	2	15
18	9	52	56	9	47	55	2	23
19	10	25	53	10	20	35	2	31
20	10	58	49	10	53	15	2	39
21	11	31	46	11	25	55	2	47
22	12	4	42	11	58	34	2	55
23	12	37	39	12	31	14	3	3
24	13	10	35	13	3	54	3	11
25	13	43	32	13	36	34	3	19
26	14	16	28	14	9	13	3	26
27	14	49	24	14	41	53	3	34
28	15	22	21	15	14	33	3	42
29	15	55	17	15	47	13	3	50
30	16	28	14	16	19	52	3	58
31	17	1	10	16	52	32	4	6
32	17	34	7	17	25	13	4	14
33	18	7	3	17	58	0	4	22
34	18	40	0	18	30	31	4	30
35	19	12	55	19	3	12	4	37
36	19	45	53	19	35	50	4	45
37	20	18	48	20	8	30	4	53
38	20	51	47	20	41	10	5	1
39	21	24	41	21	13	49	5	8
40	21	57	37	21	46	30	5	16
41	22	30	36	22	19	12	5	24
42	23	3	30	22	51	48	5	32
43	23	36	30	23	24	30	5	39
44	24	9	24	23	57	6	5	47
45	24	42	19	24	29	48	5	55
46	25	15	18	25	2	30	6	3
47	25	48	12	25	35	6	6	11
48	26	21	12	26	7	48	6	19
49	26	54	6	26	40	30	6	27
50	27	27	0	27	13	6	6	35
51	28	0	0	27	45	48	6	43
52	28	32	55	28	18	30	6	51
53	29	5	54	28	51	6	6	59
54	29	38	48	29	23	48	7	6
55	30	11	48	29	56	24	7	14
56	30	44	42	30	29	6	7	22
57	31	17	36	31	1	48	7	30
58	31	50	36	31	34	24	7	38
59	32	23	30	32	7	6	7	46
60	32	56	39	32	39	48	7	58

TABLE 32.—Annual Equation of the Moon's Node. *Argument.* Sun's mean Anomaly.

	0 +	1 +	2 +	3 +	4 +	5 +	
°	' "	' "	' "	' "	' "	' "	°
0	0 0	4 30	7 52	9 12	8 4	4 42	30
10	1 34	5 48	8 34	9 6	7 9	3 13	20
20	3 4	6 56	9 1	8 43	6 1	1 38	10
30	4 30	7 52	9 12	8 4	4 42	0 0	0
	11 —	10 —	9 —	8 —	7 —	6 —	

TABLE 33.—1st Equation Moon's Longitude. *Argument.* Sun's mean Anomaly.

	0 +	1 +	2 +	3 +	4 +	5 +	
°	' "	' "	' "	' "	' "	' "	°
0	0 0	5 27	9 31	11 9	9 47	5 42	30
10	1 53	7 1	10 23	11 1	8 41	3 54	20
20	3 43	8 23	10 55	10 34	7 19	1 59	10
30	5 27	9 31	11 9	9 47	5 42	0 0	0
	11 —	10 —	9 —	8 —	7 —	6 —	

VARIATION.

TABLE 36.—4th Equation of the Moon's Longitude. *Argument.* The remainder found by subtracting the Sun's true Longitude from the Moon's equated Longitude.

	0 +	1 +	2 +	3 —	4 —	5 —	
°	' "	' "	' "	' "	' "	' "	°
0	0 0	30 9	29 6	2 2	32 28	31 55	30
10	12 0	34 1	20 56	14 6	35 32	23 40	20
20	22 30	33 39	10 8	24 40	36 22	12 36	10
28	28 54	30 19	0 + 27	31 10	33 8	2 31	2
29	29 32	29 44	0 — 47	31 50	32 32	1 17	1
30	30 9	29 6	2 2	32 28	31 55	0 0	0
	11 —	10 —	9 —	8 +	7 +	6 +	

TABLE 27.—Change of the Moon's Right Ascension from the Sun's in from 0 h. to 12 hours. *Arguments.* The Moon's Horizontal Parallax or daily retardation in passing the meridian at the head of the table; and the time in the left column.

	53	54	55	56	57	58	59	60	61	62
H	38	41	44	47	50	53	56	59	62	65
0	0	0	0	0	0	0	0	0	0	0
1	2	2	2	2	2	2	2	2	3	3
2	3	3	4	4	4	4	5	5	5	5
3	5	5	5	6	6	7	7	7	8	8
4	6	7	7	7	8	8	9	10	10	11
5	8	9	9	10	10	11	12	12	13	14
6	9	10	11	12	12	13	14	15	15	16
7	11	12	13	14	15	15	16	17	18	19
8	13	14	15	16	17	18	19	20	21	22
9	14	15	16	18	19	20	21	22	23	25
10	16	17	18	20	21	22	23	25	26	27
11	17	18	20	22	23	24	26	27	28	30
12	19	20	22	23	25	26	28	29	31	32

TABLE 50.—Moon's mean angular dis. from Sun at beginning of current years.

Yrs.	s.	°	'	"
1761	2	20	47	19
1781	2	4	12	47
1800	1	25	49	25
1810	9	26	26	28
1820	6	9	15	6
1830	2	9	52	6
1840	10	22	40	33
1850	6	23	17	33
1860	3	6	6	0
1870	11	6	43	0
1880	7	19	31	27
1890	3	20	8	27
1900	11	20	45	27

TABLE 9.—Fourth Equation of the mean to the true Syzygy. *Argument.* Sun's mean distance from the Moon's Ascending Node.

Degs.	0 6 } +		1 7 } +		2 8 } +		Degs.
	M.	S.	M.	S.	M.	S.	
0	0	0	1	22	1	22	30
5	0	16	1	27	1	14	25
10	0	32	1	32	1	3	20
15	0	47	1	34	0	49	15
20	1	0	1	33	0	31	10
25	1	12	1	28	0	16	5
30	1	22	1	22	0	0	0
Deg.	5 11 } —		4 10 } —		3 9 } —		Deg.

☞ It will be perceived that the Tables are not inserted in the order in which they are wanted for use, or in numerical order as they are explained; but with a view to economise for room, such Tables are inserted on a page as will best fill up the page. Thus, Table 12 follows Table 3, and Table 14 follows Table 42, &c.

TABLE 55.—Logarithms of the natural Numbers from 1 to 1000; by which, with the explanation of the Table, the Logarithm for any number may readily be found.

	0	1	2	3	4	5	6	7	8	9	
1	00000	04139	07918	11394	14613	17609	20412	23045	25527	27875	1
2	30103	32222	34242	36173	38021	39794	41497	43136	44716	46240	2
3	47712	49136	50515	51851	53148	54407	55630	56820	57978	59106	3
4	60206	61278	62325	63347	64345	65321	66276	67210	68124	69020	4
5	69897	70757	71600	72428	73239	74036	74819	75587	76343	77085	5
6	77815	78533	79239	79934	80618	81291	81954	82607	83251	83885	6
7	84510	85126	85733	86332	86923	87506	88081	88649	89209	89763	7
8	90309	90849	91381	91908	92428	92942	93450	93952	94448	94939	8
9	95424	95904	96379	96848	97313	97772	98227	98677	99123	99564	9
10	00000	00432	00860	01284	01703	02119	02531	02938	03342	03743	10
11	04139	04532	04922	05308	05690	06070	06446	06819	07188	07555	11
12	07918	08279	08636	08991	09342	09691	10037	10380	10721	11059	12
13	11394	11727	12057	12385	12710	13033	13354	13672	13988	14301	13
14	14613	14922	15229	15534	15836	16137	16435	16732	17026	17319	14
15	17609	17898	18184	18469	18752	19033	19312	19590	19866	20140	15
16	20412	20683	20952	21219	21484	21748	22011	22272	22531	22789	16
17	23045	23300	23553	23805	24055	24304	24551	24797	25042	25285	17
18	25527	25768	26007	26245	26482	26717	26951	27184	27416	27646	18
19	27875	28103	28330	28556	28780	29003	29226	29447	29667	29885	19
20	30103	30320	30535	30750	30963	31175	31387	31597	31806	32015	20
21	32222	32428	32634	32838	33041	33244	33445	33646	33846	34044	21
22	34242	34439	34635	34830	35025	35218	35411	35603	35793	35984	22
23	36173	36361	36549	36736	36922	37107	37291	37475	37658	37840	23
24	38021	38202	38382	38561	38739	38917	39094	39270	39445	39620	24
25	39794	39967	40140	40312	40483	40654	40824	40993	41162	41330	25
26	41497	41664	41830	41996	42160	42325	42488	42651	42813	42975	26
27	43136	43297	43457	43616	43775	43933	44091	44248	44404	44560	27
28	44716	44871	45025	45179	45332	45484	45637	45788	45939	46090	28
29	46240	46389	46538	46687	46835	46982	47129	47276	47422	47567	29
30	47712	47857	48001	48144	48287	48430	48572	48714	48855	48996	30
31	49136	49276	49415	49554	49693	49831	49969	50106	50243	50379	31
32	50515	50651	50786	50920	51055	51188	51322	51455	51587	51720	32
33	51851	51983	52114	52244	52375	52504	52634	52763	52892	53020	33
34	53148	53275	53403	53529	53656	53782	53908	54033	54158	54283	34
35	54407	54531	54654	54777	54900	55023	55145	55267	55388	55509	35
36	55630	55751	55871	55991	56110	56229	56348	56467	56585	56703	36
37	56820	56937	57054	57171	57287	57403	57519	57634	57749	57864	37
38	57978	58092	58206	58320	58433	58546	58659	58771	58883	58995	38
39	59106	59218	59329	59439	59550	59660	59770	59879	59988	60097	39
40	60206	60314	60423	60531	60638	60746	60853	60959	61066	61172	40
41	61278	61384	61490	61595	61700	61805	61909	62014	62118	62221	41
42	62325	62428	62531	62634	62737	62839	62941	63043	63144	63246	42
43	63347	63448	63548	63649	63749	63849	63949	64048	64147	64246	43
44	64345	64444	64542	64640	64738	64836	64933	65031	65128	65225	44
45	65321	65418	65514	65610	65706	65801	65896	65992	66087	66181	45
46	66276	66370	66464	66558	66652	66745	66839	66932	67025	67117	46
47	67210	67302	67394	67486	67578	67669	67761	67852	67943	68034	47
48	68124	68215	68305	68395	68485	68574	68664	68753	68842	68931	48
49	69020	69108	69197	69285	69373	69461	69548	69636	69723	69810	49
50	69897	69984	70070	70157	70243	70329	70415	70501	70586	70672	50
51	70757	70842	70927	71012	71096	71181	71265	71349	71433	71517	51
52	71600	71684	71767	71850	71933	72016	72099	72181	72263	72346	52
53	72428	72509	72591	72673	72754	72835	72916	72997	73078	73159	53
54	73239	73320	73400	73480	73560	73640	73719	73799	73878	73957	54
55	74036	74115	74194	74273	74351	74429	74507	74586	74663	74741	55
56	74819	74896	74974	75051	75128	75205	75282	75358	75435	75511	56
57	75587	75664	75740	75815	75891	75967	76042	76118	76193	76268	57
58	76343	76418	76492	76567	76641	76716	76790	76864	76938	77012	58
59	77085	77159	77232	77305	77379	77452	77525	77597	77670	77743	59
60	77815	77887	77960	78032	78104	78176	78247	78319	78390	78462	60
61	78533	78604	78675	78746	78817	78888	78958	79029	79099	79169	61
62	79239	79309	79379	79449	79518	79588	79657	79727	79796	79865	62
63	79934	80003	80072	80140	80209	80277	80346	80414	80482	80550	63
64	80618	80686	80754	80821	80889	80956	81023	81090	81158	81224	64
65	81291	81358	81425	81491	81558	81624	81690	81757	81823	81889	65
66	81954	82020	82086	82151	82217	82282	82347	82413	82478	82543	66
67	82607	82672	82737	82802	82866	82930	82995	83059	83123	83187	67
68	83251	83315	83378	83442	83506	83569	83632	83696	83759	83822	68
69	83885	83948	84011	84073	84136	84198	84261	84323	84386	84448	69
70	84510	84572	84634	84696	84757	84819	84880	84942	85003	85065	70
71	85126	85187	85248	85309	85370	85431	85491	85552	85612	85673	71
72	85733	85794	85854	85914	85974	86034	86094	86153	86213	86273	72
73	86332	86392	86451	86510	86570	86629	86688	86747	86806	86864	73
74	86923	86982	87040	87099	87157	87216	87274	87332	87390	87448	74
75	87506	87564	87622	87679	87737	87795	87852	87910	87967	88024	75
76	88081	88138	88195	88252	88309	88366	88423	88480	88536	88593	76
77	88649	88705	88762	88818	88874	88930	88986	89042	89098	89154	77
78	89209	89265	89321	89376	89432	89487	89542	89597	89653	89708	78
79	89763	89818	89873	89927	89982	90037	90091	90146	90200	90255	79
80	90309	90363	90417	90472	90526	90580	90634	90687	90741	90795	80
81	90849	90902	90956	91009	91062	91116	91169	91222	91275	91328	81
82	91381	91434	91487	91540	91593	91645	91698	91751	91803	91855	82
83	91908	91960	92012	92065	92117	92169	92221	92273	92324	92376	83
84	92428	92480	92531	92583	92634	92686	92737	92788	92840	92891	84
85	92942	92993	93044	93095	93146	93197	93247	93298	93349	93399	85
86	93450	93500	93551	93601	93651	93702	93752	93802	93852	93902	86
87	93952	94002	94052	94101	94151	94201	94250	94300	94349	94399	87
88	94448	94498	94547	94596	94645	94694	94743	94792	94841	94890	88
89	94939	94988	95036	95085	95134	95182	95231	95279	95328	95376	89
90	95424	95472	95521	95569	95617	95665	95713	95761	95809	95856	90
91	95904	95952	95999	96047	96095	96142	96190	96237	96284	96332	91
92	96379	96426	96473	96520	96567	96614	96661	96708	96755	96802	92
93	96848	96895	96942	96988	97035	97081	97128	97174	97220	97267	93
94	97313	97359	97405	97451	97497	97543	97589	97635	97681	97727	94
95	97772	97818	97864	97909	97955	98000	98046	98091	98137	98182	95
96	98227	98272	98318	98363	98408	98453	98498	98543	98588	98632	96
97	98677	98722	98767	98811	98856	98900	98945	98989	99034	99078	97
98	99123	99167	99211	99255	99300	99344	99388	99432	99476	99520	98
99	99564	99607	99651	99695	99739	99782	99826	99870	99913	99957	99
100	00000	00043	00087	00130	00173	00217	00260	00303	00346	00389	00

TABLE 39.—For the Moon's Latitude. *Arg.* 2d of Latitude. Double dis. of Moon in her orb. from Sun.—1st *Arg.* of Latitude.

	0+ 6–	1+ 7–	2+ 8–	
°	′ ″	′ ″	′ ″	°
0	0 0	4 24	7 38	30
10	1 32	5 40	8 16	20
20	3 1	6 45	8 40	10
30	4 24	7 38	8 48	0
	5+11–	4+10–	3+ 9–	

TABLE 13.—The Sun's Declination corresponding to every sign and degree of his Longitude. or the Declination of every degree of the ecliptic. The Declination is North if the signs at the top or bottom of the table are less than 6, bu' South if they are more.

	0 or 6			1 or 7			2 or 8			
°	°	′	″	°	′	″	°	′	″	°
0	0	0	0	11	29	5	20	10	25	30
1	0	23	53	11	50	6	20	22	57	29
2	0	47	47	12	10	56	20	35	7	28
3	1	11	39	12	31	34	20	46	55	27
4	1	35	30	12	51	59	20	58	20	26
5	1	59	20	13	12	12	21	9	21	25
6	2	23	8	13	32	12	21	19	59	24
7	2	46	54	13	51	58	21	30	13	23
8	3	10	37	14	11	30	21	40	3	22
9	3	34	17	14	30	48	21	49	29	21
10	3	57	54	14	49	52	21	58	30	20
11	4	21	27	15	8	40	22	7	6	19
12	4	44	57	15	27	13	22	15	17	18
13	5	8	22	15	45	30	22	23	3	17
14	5	31	42	16	3	31	22	30	24	16
15	5	54	57	16	21	16	22	37	18	15
16	6	18	6	16	38	44	22	43	47	14
17	6	41	9	16	55	55	22	49	50	13
18	7	4	6	17	12	48	22	55	27	12
19	7	26	57	17	29	23	23	0	38	11
20	7	49	41	17	45	40	23	5	22	10
21	8	12	17	18	1	38	23	9	39	9
22	8	34	45	18	17	18	23	13	29	8
23	8	57	5	18	32	38	23	16	53	7
24	9	19	17	18	47	38	23	19	50	6
25	9	41	19	19	2	18	23	22	20	5
26	10	3	12	19	16	37	23	24	22	4
27	10	24	56	19	30	35	23	25	57	3
28	10	46	30	19	44	13	23	27	5	2
29	11	7	53	19	57	30	23	27	46	1
30	11	29	5	20	10	25	23	28	0	0
	5 or 11			4 or 10			3 or 9			

TABLE 11.—Equation of the Sun's Centre, or the difference between his mean and true place. *Argument.* Sun's Mean Anomaly

Deg.	0 sig. —			1 sig. —			2 sig. —			3 sig. —			4 sig. —			5 sig. —			Deg.
	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	°	′	″	
0	0	0	0	0	56	47	1	39	6	1	55	37	1	41	12	0	58	53	30
5	0	9	52	1	5	12	1	43	52	1	55	24	1	35	52	0	49	49	25
10	0	19	40	1	13	9	1	47	53	1	54	17	1	29	47	0	40	21	20
15	0	29	20	1	20	34	1	51	5	1	52	18	1	23	0	0	30	33	15
20	0	38	47	1	27	24	1	53	37	1	49	26	1	15	33	0	20	30	10
25	0	47	57	1	33	35	1	54	58	1	45	44	1	7	29	0	10	18	5
30	0	56	47	1	39	6	1	55	27	1	41	12	0	58	53	0	0	0	0
	11 sig. +			10 sig. +			9 sig. +			8 sig. +			7 sig. +			6 sig. +			

TABLE 57.—Logistical or Proportional Logarithms.

″	0′	1′	2′	3′	4′	5′	6′	7′	8′	9′	10′	11′	12′	13′	14′	15′	16′	17′	18′	19′	20′	21′	22′	23′	24′	25′	26′	27′	″
0	00000	17782	14771	13010	11761	10792	10000	9331	8751	8239	7782	7368	6990	6642	6320	6021	5740	5477	5229	4994	4771	4559	4357	4164	3979	3802	3632	3468	0
5	28573	17434	14594	12891	11671	10720	9940	9279	8706	8199	7745	7335	6960	6614	6294	5997	5718	5456	5209	4975	4753	4542	4341	4149	3961	3784	3618	3455	5
10	25563	17112	14424	12775	11584	10649	9881	9228	8661	8159	7710	7302	6930	6587	6269	5973	5695	5435	5189	4956	4735	4525	4325	4133	3949	3773	3604	3441	10
15	23802	16812	14260	12663	11498	10580	9823	9178	8617	8120	7674	7270	6900	6559	6243	5949	5673	5414	5169	4937	4717	4508	4308	4117	3934	3759	3590	3428	15
20	22553	16532	14102	12553	11413	10512	9765	9129	8573	8081	7639	7238	6871	6532	6218	5925	5651	5393	5149	4918	4699	4491	4292	4102	3920	3745	3576	3415	20
25	21584	16269	13949	12446	11331	10444	9708	9079	8530	8043	7604	7206	6841	6505	6193	5902	5629	5372	5129	4900	4682	4474	4276	4086	3905	3730	3563	3401	25
30	20792	16021	13802	12341	11249	10378	9652	9031	8487	8004	7570	7175	6812	6478	6168	5878	5607	5351	5110	4881	4664	4457	4260	4071	3890	3716	3549	3388	30
35	20122	15786	13660	12239	11170	10313	9597	8983	8445	7966	7535	7143	6784	6451	6143	5855	5585	5331	5090	4863	4646	4440	4244	4055	3875	3702	3535	3375	35
40	19542	15563	13522	12139	11091	10248	9542	8935	8403	7929	7501	7112	6755	6425	6118	5832	5563	5310	5071	4844	4629	4424	4228	4040	3860	3688	3522	3362	40
45	19031	15351	13388	12041	11015	10185	9488	8889	8361	7891	7467	7081	6726	6398	6094	5809	5541	5290	5052	4826	4611	4407	4212	4025	3846	3674	3508	3349	45
50	18573	15149	13259	11946	10939	10122	9435	8842	8320	7855	7434	7050	6698	6372	6069	5786	5520	5269	5032	4808	4594	4390	4196	4010	3831	3660	3495	3336	50
55	18159	14956	13133	11852	10865	10061	9383	8796	8280	7818	7401	7020	6670	6346	6045	5763	5498	5249	5013	4789	4577	4374	4180	3995	3817	3646	3481	3323	55

″	28′	29′	30′	31′	32′	33′	34′	35′	36′	37′	38′	39′	40′	41′	42′	43′	44′	45′	46′	47′	48′	49′	50′	51′	52′	53′	54′	55′	56′	57′	58′	59′	″
0	3310	3158	3010	2868	2730	2596	2467	2341	2219	2100	1984	1871	1761	1654	1549	1447	1347	1249	1154	1061	969	880	792	706	622	539	458	378	300	223	147	73	0
5	3297	3145	2998	2856	2719	2585	2456	2331	2208	2090	1974	1862	1752	1645	1540	1438	1339	1241	1146	1053	962	872	785	699	615	532	451	371	293	216	141	67	5
10	3284	3133	2986	2845	2707	2575	2446	2320	2198	2080	1965	1852	1743	1636	1532	1430	1331	1233	1138	1045	954	865	777	692	608	525	444	365	287	210	135	61	10
15	3271	3120	2974	2833	2696	2564	2435	2310	2188	2070	1955	1843	1734	1627	1523	1422	1322	1225	1130	1038	947	857	770	685	601	518	438	358	280	204	129	55	15
20	3259	3108	2962	2821	2685	2553	2424	2300	2178	2061	1946	1834	1725	1619	1515	1413	1314	1217	1123	1030	939	850	763	678	594	512	431	352	274	197	122	49	20
25	3246	3096	2950	2810	2674	2542	2414	2289	2169	2051	1936	1825	1716	1610	1506	1405	1306	1209	1115	1022	932	843	756	670	587	505	424	345	267	191	116	42	25
30	3233	3083	2939	2798	2663	2531	2403	2279	2159	2041	1927	1816	1707	1601	1498	1397	1298	1201	1107	1015	924	835	749	663	580	498	418	339	261	185	110	36	30
35	3220	3071	2927	2787	2652	2520	2393	2269	2149	2032	1918	1806	1698	1592	1489	1388	1290	1193	1099	1007	917	828	741	656	573	491	411	332	255	179	104	30	35
40	3208	3059	2915	2776	2640	2510	2382	2259	2139	2022	1908	1797	1689	1584	1481	1380	1282	1186	1091	999	909	821	734	649	566	484	404	326	248	172	98	24	40
45	3195	3047	2903	2764	2629	2499	2372	2249	2129	2012	1899	1788	1680	1575	1472	1372	1274	1178	1084	992	902	814	727	642	559	478	398	319	242	166	91	18	45
50	3183	3035	2891	2753	2618	2488	2362	2239	2119	2003	1889	1779	1671	1566	1464	1363	1266	1170	1076	984	894	806	720	635	552	471	391	313	236	160	85	12	50
55	3170	3022	2880	2741	2607	2477	2351	2229	2109	1993	1880	1770	1663	1558	1455	1355	1257	1162	1068	977	887	799	713	628	546	464	384	306	229	154	79	6	55

TABLE 58.—Visible Eclipses in the United States till 1900.

1836	☽	May	1	3 25m	p	1865	☉	Oct.	19	10 58m	8
1836	☉	May	15	8 40m	8	1866	☽	Mar.	30	11 50 e	t
1837	☽	Oct.	13	6 48 e	t	1866	☉	Oct.	8	11 54m	1
1838	☽	April	9	9 19 e	p	1867	☽	Mar.	20	4 5m	p
1838	☉	Sept.	18	4 50 e	11	1867	☽	Sept.	13	7 50 e	p
1840	☽	Aug.	13	2 28m	p	1869	☽	Jan.	27	8 41 e	p
1841	☽	Feb.	5	9 7 e	t	1869	☉	Aug.	7	6 11 e	10
1841	☽	Aug.	2	5 8m	t	1871	☽	Jan.	6	4 30 e	p
1843	☽	Dec.	6	7 28 e	p	1872	☽	Nov.	15	0 50m	p
1844	☽	Nov.	24	7 9 e	t	1873	☽	May	12	6 43m	t
1844	☉	Dec.	9	sunset	2	1874	☽	Oct.	25	2 57m	p
1845	☉	May	6	sunrise	4	1875	☉	Sept.	29	6 30m	11
1845	☽	Nov.	13	8 20 e	p	1876	☽	Mar.	10	1 25m	p
1846	☉	April	25	0 32 e	7	1876	☉	Mar.	25	4 57 e	4
1848	☽	Sept.	13	1 41m	t	1877	☽	Aug.	23	6 22 e	t
1849	☽	Mar.	8	8 8 e	p	1878	☽	Feb.	17	6 18m	p
1851	☽	July	13	2 23m	p	1878	☉	July	29	5 44 e	7
1851	☉	July	28	8 33m	4	1878	☽	Aug.	12	7 23 e	p
1852	☽	Jan.	7	1 23m	t	1880	☉	Dec.	31	8 16m	5
1852	☽	Dec.	26	8 5m	p	1881	☽	Jan.	12	2 16m	t
1853	☽	Jan.	21	1 23m	p	1883	☽	Oct.	16	2 28m	p
1854	☉	May	26	5 44 e	11	1884	☽	April	10	7 7m	t
1854	☽	Nov.	4	4 44 e	p	1884	☽	Oct.	4	5 34 e	t
1855	☽	May	1	11 26 e	t	1885	☉	Mar.	16	1 45 e	6
1855	☽	Oct.	25	3 2m	t	1885	☽	Sept.	24	3 16m	p
1856	☽	April	20	4 30m	p	1887	☽	Feb.	8	5 24m	p
1856	☽	Oct.	13	6 32 e	p	1888	☽	Jan.	28	6 26 e	t
1858	☽	Feb.	27	5 15m	p	1888	☽	July	23	0 55m	t
1858	☉	Mar.	15	6 38m	6	1889	☽	Jan.	17	0 38m	p
1859	☽	Feb.	27	5 56m	t	1891	☽	Nov.	15	7 56 e	p
1859	☉	July	29	5 58 e	3	1892	☽	May	11	6 20 e	p
1860	☽	Feb.	6	9 37 e	p	1892	☉	Oct.	20	2 6 e	8
1860	☉	July	18	8 17m	6	1894	☽	Sept.	14	11 44 e	p
1861	☽	Dec.	17	3 30m	p	1895	☽	Mar.	10	10 48 e	t
1861	☉	Dec.	31	8 12m	4	1895	☽	Sept.	4	1 9m	t
1862	☽	Jan.	12	1 38m	t	1896	☽	Aug.	23	2 15m	p
1862	☽	Dec.	6	3 3m	t	1897	☉	July	29	10 10m	4
1863	☽	June	1	6 50 e	t	1898	☽	Jan.	7	7 36 e	p
1863	☽	Nov.	25	4 41m	p	1898	☽	Dec.	27	6 57 e	t
1865	☽	April	10	11 50 e	p	1899	☽	Dec.	16	8 54 e	p
1865	☽	Oct.	4	6 10 e	p	1900	☉	May	28	9 26m	11

NOTE.—The times of these eclipses are not presumed to be strictly accurate, (having been hastily calculated;) some may differ 5 or 10 minutes from the truth.

TABLE 15.—The Moon's *Latitude* in Eclipses. *Arg.* Her *Distance* from her Ascend. Node; and the *Angle* of the axis of her orbit with the axis of the ecliptic.

0,or 6 s.	° ′ 5 23	° ′ 5 27	° ′ 5 31	° ′ 5 35	° ′ 5 39	° ′ 5 43	° ′ 5 47	5,or 11 s.
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	
0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	30
1				5 9	5 12	5 15	5 18	29
2				10 17	10 24	10 31	10 38	28
3			15 17	15 26	15 36	15 46	15 57	27
4			20 21	20 34	20 48	21 2	21 16	26
5			25 26	25 43	26 1	26 19	26 37	25
6			30 36	30 55	31 15	31 35	31 55	24
7			35 42	36 6	36 30	36 54	37 18	23
8		40 26	40 53	41 20	41 48	42 16	42 44	22
9		45 32	46 8	46 34	47 6	47 38		21
10		50 40	51 15	51 51	52 27	53 3		20
11		55 48	56 28	57 8	57 48	58 28		19
12		60 58	61 42	62 26	63 10	63 54		18
13		66 12	66 59	67 47	68 35			17
14	70 35	71 26	72 18	73 10	74 2			16
15	75 50	76 46	77 42	78 38	79 34			15
16	81 7	82 7	83 7	84 7	84 8			14
17	86 29	87 33	88 37	89 42				13
18	91 52	93 0	94 8	95 16				12
19	97 17	98 29	99 41					11

TABLE 28.—Time answering to a change of 33′ in the altitude of a celestial body at the horizon. *Arguments.* Declination of the body at the head of the table, and the Latitude of the place in the left column.

L	0°	3°	6°	9°	12°	15°	18°	21°	24°	27°	30°
°	m. s.	m. s.	m. s.	m. s	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.
0	2 12	2 12	2 12	2 13	2 15	2 16	2 17	2 20	2 24	2 27	2 32
10	2 14	2 14	2 14	2 15	2 17	2 18	2 21	2 24	2 27	2 34	2 35
20	2 20	2 20	2 20	2 21	2 24	2 26	2 28	2 31	2 37	2 40	2 46
30	2 32	2 32	2 34	2 35	2 36	2 39	2 43	2 47	2 52	2 58	3 6
36	2 43	2 43	2 45	2 46	2 49	2 51	2 56	3 2	3 8	3 16	3 27
40	2 52	2 52	2 53	2 56	2 59	3 2	3 8	3 15	3 23	3 54	3 47
44	3 3	3 4	3 5	3 8	3 11	3 16	3 23	3 32	3 42	3 56	4 15
48	3 17	3 18	3 20	3 24	3 26	3 33	3 42	3 54	4 9	4 28	4 57
52	3 35	3 36	3 38	3 42	3 48	3 58	4 9	4 26	4 47	5 17	6 7
56	3 55	3 57	4 0	4 6	4 14	4 26	4 31	5 16	5 39	6 44	8 46
60	4 24	4 26	4 31	4 38	4 50	5 8	5 33	6 22	7 33		

TABLE 49.—Showing, by Problem 43, what Day of the Week any Day of the Month is, for ever.

Jan., Oct. . .	A	B	C	D	E	F	G
Feb., Ma.,No.	D	E	F	G	A	B	C
April, July . .	G	A	B	C	D	E	F
May	B	C	D	E	F	G	A
June	E	F	G	A	B	C	D
August	C	D	E	F	G	A	B
Sept., Dec. .	F	G	A	B	C	D	E
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31				

☞ Should any error be detected or suspected in any calculation made from the Tables, examine carefully whether the quantities in them increase or decrease regularly as they should do, as an error may possibly have crept into some of the Tables.

TABLE 44.—Astronomical time at Greenwich of all the mean New Moons for 76 years, or four Lunar Cycles; Old Style. With this Table and two easy equations, by Problem 42, the time of mean New Moon in any month of any year for ten thousand years after the Creation may readily be found, for either O. or N. S.

No.	Yrs A.C	Jan. D.H.	Feb. D.H.	Mar. D.H.	Apr. D.H.	May D.H.	June D.H.	July D.H.	Aug. D.H.	Sep. D.H.	Oct. D.H.	Nov. D.H.	Dec. D.H.
1	1724	14 5	12 17	13 6	11 19	11 8	9 20	9 9	7 22	6 10	5 23	4 12	4 1
2	1725	2 14	1 2	2 15	1 4	0 16	28 18	28 7	26 20	25 8	24 21	23 10	22 23
3	1726	21 11	19 23	21 12	20 1	19 13	18 2	17 15	16 4	14 17	14 5	12 18	12 7
4	1727	10 20	9 9	10 21	9 10	8 23	7 12	7 0	5 13	4 1	3 14	2 3	1 16
5	1728	29 18	28 7	28 19	27 8	26 20	25 9	24 22	23 11	21 23	21 12	20 1	19 14
6	1729	18 2	16 15	18 4	16 16	16 5	14 18	14 7	11 19	11 8	10 21	9 10	8 23
7	1730	7 11	6 0	7 13	6 1	5 14	4 3	3 15	2 4	30 6	29 19	28 8	27 21
8	1731	26 9	24 22	26 10	24 23	24 11	23 0	22 13	21 2	19 14	19 3	17 16	17 5
9	1732	5 17	14 6	14 19	13 8	12 20	11 9	10 22	9 11	7 23	7 12	6 1	5 14
10	1733	4 2	2 15	4 4	2 16	2 5	0 18	29 20	28 8	26 21	26 10	24 23	24 11
11	1734	23 0	21 13	23 1	2 14	21 2	19 15	19 4	17 17	16 5	15 18	14 7	13 20
12	1735	12 9	10 21	12 10	10 23	10 11	9 0	8 13	7 2	5 14	5 3	4 16	3 5
13	1736	1 17		0 19	28 21	28 9	26 22	26 11	25 0	23 12	23 1	21 14	21 3
14	1737	19 15	18 4	19 16	18 5	17 17	16 6	15 19	14 8	12 20	12 9	10 22	10 11
15	1738	8 23	7 12	9 1	7 13	7 2	6 3	5 4	3 17	2 5	1 18	29 20	29 8
16	1739	27 21	26 10	22 13	26 12	26 0	24 13	24 2	22 15	21 10	20 16	19 5	18 18
17	1740	17 6	15 19	16 8	14 21	14 9	12 22	12 11	11 0	9 12	9 1	7 14	7 3
18	1741	5 15	4 4	5 16	4 5	3 17	2 6	1 19	29 20	28 9	27 22	26 11	25 23
19	1742	24 12	23 1	24 14	23 3	22 15	21 4	20 17	19 6	17 18	17 7	15 20	15 9
20	1743	13 21	12 10	13 23	12 12	12 0	10 13	10 2	8 15	7 3	6 16	5 5	4 18
21	1744	3 6	1 19	2 8		29 22	28 11	28 0	26 12	25 1	24 14	23 3	22 15
22	1745	21 4	19 17	21 5	19 18	19 6	17 19	17 8	15 20	14 9	13 22	12 11	12 0
23	1746	10 12	9 1	10 14	9 3	8 15	7 4	6 17	5 6	3 18	3 7	1 20	1 9
24	1747	29 10	27 23	29 11	28 0	27 12	26 1	25 14	24 3	22 15	22 4	20 17	20 6
25	1748	18 18	17 7	17 20	16 9	15 21	14 10	13 23	12 12	11 0	10 13	9 2	8 15
26	1749	7 3	5 16	7 5	5 18	5 6	3 19	3 8	1 21	29 22	29 11	8 0	27 12
27	1750	26 1	24 14	26 3	24 16	24 4	22 17	22 6	20 19	19 7	18 20	17 9	16 22
28	1751	15 10	13 23	15 11	14 0	13 12	12 1	11 14	10 3	8 15	8 4	6 17	6 6
29	1752	4 18	3 7	3 20	2 9	1 21	29 23	29 12	28 0	26 13	26 2	24 15	24 3
30	1753	22 16	21 5	22 18	21 7	20 19	19 8	18 21	17 10	15 22	15 11	14 0	13 13
31	1754	12 1	10 14	12 3	10 16	19 4	8 17	8 6	6 19	5 7	4 20	3 9	2 22
32	1755	1 10		1 11	29 12	29 1	27 14	27 3	24 15	24 4	23 17	22 6	21 18
33	1756	20 7	18 20	19 9	17 21	17 10	15 23	15 12	14 1	12 13	12 2	10 15	10 4
34	1757	8 16	7 5	8 18	7 7	6 19	5 8	4 21	3 10	1 22	1 11	29 13	29 1
35	1758	27 14	26 3	27 15	26 4	25 16	24 5	23 18	22 7	20 19	20 8	18 21	18 10
36	1759	16 22	15 11	17 0	15 13	15 1	13 14	13 3	11 14	10 4	9 17	8 6	7 19
37	1760	6 7	4 20	5 9	3 22	3 10	1 23	1 12	29 13	28 2	27 15	26 4	25 16
38	1761	24 5	22 18	24 7	22 20	22 9	20 22	20 10	18 23	17 11	17 0	15 13	15 2
39	1762	13 14	12 3	13 15	12 4	11 16	10 5	9 18	8 7	5 19	6 8	4 21	4 10
40	1763	2 23	1 12	3 0	1 13	1 1	29 3	23 16	27 4	25 17	25 6	23 19	23 7
41	1764	21 20	20 9	20 22	19 11	18 23	17 12	17 1	15 14	14 2	13 15	12 4	11 17
42	1765	10 5	8 18	10 6	8 19	8 17	6 20	6 9	4 22	3 10	2 23	1 12	1 1
43	1766	29 2	27 15	29 4	27 17	27 5	25 18	25 7	23 20	32 8	21 21	20 10	19 23
44	1767	18 11	17 0	18 13	17 2	16 14	15 3	14 16	13 5	11 18	11 6	9 19	9 8
45	1768	7 20	6 9	6 22	5 11	4 23	3 12	3 1	1 14	29 15	29 4	27 17	27 5
46	1769	25 18	24 7	25 19	24 8	23 20	22 9	21 19	20 11	18 13	18 12	17 1	16 14
47	1770	15 2	13 15	15 4	13 17	13 5	11 16	11 7	9 20	8 8	7 21	6 10	5 23
48	1771	3 23	3 0	4 13	3 2	2 14	1 3	0 16	28 17	27 6	26 19	25 8	24 21
49	1772	23 9	21 22	22 10	20 23	20 11	19 0	18 13	17 2	15 14	15 3	13 16	13 5
50	1773	11 17	10 6	11 19	10 8	9 20	8 9	7 21	6 10	4 23	4 12	3 1	2 14
51	1774	1 2		1 4	29 5	28 18	27 7	26 20	25 8	23 21	23 10	21 23	21 11
52	1775	20 0	18 13	20 2	18 17	18 3	16 16	16 5	14 18	13 6	12 19	11 8	10 21
53	1776	9 9	7 22	8 10	6 23	6 12	5 0	4 13	3 2	1 14	1 3	29 5	8 17
54	1777	27 6	25 19	27 8	25 21	25 9	23 22	23 11	22 0	20 12	20 1	18 14	18 3
55	1778	16 15	15 4	16 17	15 6	14 18	13 7	12 20	11 9	9 21	9 10	7 23	7 12
56	1779	6 0	4 13	6 2	4 15	4 3	2 16	2 5	0 18	28 19	28 8	26 21	26 9
57	1780	24 22	23 11	23 23	22 12	22 0	20 13	20 2	18 15	17 3	16 16	15 5	14 18
58	1781	13 6	11 19	13 8	11 21	11 9	9 22	9 11	8 0	6 12	6 1	4 14	4 3
59	1782	2 15	1 4	2 17	1 6	0 18	28 20	28 9	26 21	25 10	24 23	23 12	23 0
60	1783	21 13	20 2	21 14	20 3	19 15	18 4	17 17	16 6	14 18	14 7	12 20	12 9
61	1784	10 21	9 10	9 23	8 12	8 0	6 13	6 2	4 15	3 3	2 16	1 5	0 18
62	1785	28 19	27 8	28 21	27 10	26 22	25 11	25 0	23 13	22 1	21 14	20 3	19 15
63	1786	18 4	16 17	18 5	16 18	16 6	14 19	14 8	12 21	11 9	10 22	9 11	9 0
64	1787	7 12	6 1	7 14	6 3	5 15	4 4	3 17	2 6	0 18	29 20	28 9	27 21
65	1788	26 10	24 23	25 12	24 1	23 13	22 2	21 15	20 4	18 16	18 5	16 18	16 7
66	1789	14 19	13 8	14 21	13 10	12 22	11 11	11 0	9 13	8 1	7 14	6 3	5 16
67	1790	3 16	2 17	4 5	2 18	2 6	0 19	29 21	28 9	26 22	26 11	25 0	24 12
68	1791	23 1	21 14	23 3	21 16	21 4	19 17	19 6	17 19	16 7	15 20	14 9	13 22
69	1792	12 10	10 23	11 12	10 1	9 13	8 2	7 15	6 4	5 4	4 5	2 18	2 7
70	1793	0 19		0 21	28 22	28 11	27 0	26 13	25 1	23 14	23 3	21 16	21 4
71	1794	19 17	18 6	19 18	18 7	17 19	16 8	15 21	14 10	12 22	12 11	11 0	10 13
72	1795	9 1	7 14	9 3	7 16	7 4	5 17	5 6	3 19	2 7	1 20	29 22	29 10
73	1796	27 23	26 12	27 0	25 13	25 1	23 14	23 3	21 16	20 4	19 17	18 6	17 19
74	1797	16 7	14 20	16 9	14 22	14 10	12 23	12 12	11 1	9 13	9 2	7 15	7 4
75	1798	5 16	4 5	5 18	4 7	3 19	2 8	1 21	29 22	28 11	28 0	26 13	26 1
76	1799	24 14	23 3	24 16	23 5	22 17	21 6	20 18	7 16	17 20	17 9	15 22	15 11

TABLE 43.—Equation for finding the Declination of a celestial body. *Arguments.* Latitude of the body at the head of one of the divisions of the table, and Ecliptic declination in the left hand column.

Latitude and Declination of the same name.

	1°	2°	3°	4°	5°	6°
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
0	4 58	9 56	14 55	19 54	24 54	29 54
5	4 46	9 33	14 21	19 11	24 2	28 54
10	4 8	8 17	12 28	16 42	20 58	25 16
15	3 13	6 7	9 13	12 21	15 32	18 45
18	2 9	4 19	6 31	8 45	11 2	13 19
20	1 26	2 54	4 23	5 54	7 26	8 59
22	0 39	1 18	1 58	2 39	3 20	4 3
23	0 13	0 26	0 39	0 53	1 7	1 21
23 28′	0	0 0	0 0	0 0	0 0	0 0

Latitude and Declination of different names.

	1°	2°	3°	4°	5°	6°
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
0	4 58	9 56	14 55	19 54	24 54	29 54
5	4 45	9 29	14 13	18 56	23 40	28 23
10	4 6	8 11	12 15	16 18	20 20	24 20
15	3 1	6 0	8 58	11 54	14 49	17 43
18	2 8	4 12	6 18	8 21	10 24	12 25
20	1 25	2 50	4 13	5 36	6 53	8 19
22	0 38	1 16	1 54	2 31	3 7	3 43
23	0 13	0 25	0 38	0 50	1 2	1 14
23 28′	0	0 0	0 0	0 0	0 0	0 0

TABLE 23.—Dip or Depression of the Horizon.

ft.	′ ″	ft.	′ ″
1	0 59	26	5 1
2	1 24	27	5 7
3	1 42	28	5 13
4	1 58	29	5 18
5	2 12	30	5 24
6	2 25	40	6 14
7	2 36	50	6 58
8	2 47	60	7 37
9	2 57	70	8 14
10	3 7	80	8 48
11	3 16	90	9 20
12	3 25	100	9 51
13	3 33	200	13 55
14	3 41	300	17 4
15	3 49	400	19 42
16	3 56	500	22 1
17	4 4	600	24 8
18	4 11	700	26 3
19	4 17	800	27 51
20	4 24	900	29 35
21	4 31	1000	31 9
22	4 37	2000	44 3
23	4 43	3000	53 56
24	4 49	4000	62 18
25	4 55	5000	69 38

TABLE 45.—Diff. between the O. S. and N. S.

Yrs. B. C.	Days.	Yrs. A. C.	Days.
5900	46	1300	8
5800	45	1400	9
5700	44	1500	10
5500	43	1700	11
5400	42	1800	12
5300	41	1900	13
5100	40	2100	14
5000	39	2200	15
4900	38	2300	16
4700	37	2500	17
4600	36	2600	18
4500	35	2700	19
4300	34	2900	20
4200	33	3000	21
4100	32	3100	22
3900	31	3300	23
3800	30	3400	24
3700	29	3500	25
3500	28	3700	26
3400	27	3800	27
3300	26	3900	28
3100	25	4100	29
3000	24	4200	30
2900	23	4300	31
2700	22	4500	32
2600	21	4600	33
2500	20	4700	34
2300	19	4900	35
2200	18	5000	36
2100	17	5100	37
1900	16	5200	38
1800	15	5400	39
1700	14	5500	40
1500	13	5700	41
1400	12	5800	42
1300	11	5900	43
1100	10	6100	44
1000	9	6200	45
900	8	6300	46
700	7	6500	47
600	6	6600	48
500	5	6700	49
300	4	6900	50
200	3	7000	51
100	2	7100	52
0	2	7300	53
A. C.		7400	54
100	1	7500	55
200	0	7700	56
300	1	7800	57
500	2	7900	58
600	3	8100	59
700	4	8200	60
900	5	8300	61
1000	6	8500	62
1100	7		

TABLE 40.—Moon's Hourly motion in Lat. *Arg.* Moon's dis. from her ascending Node. Tending North if the sign is + but South if −.

	0+ 6−	1+ 7−	2+ 8−	
°	′ ″	′ ′	′ ″	°
0	2 58	2 34	1 29	30
10	2 55	2 16	1 1	20
20	2 47	1 54	0 31	10
30	2 34	1 29	0 0	0
	5− 11+	4− 10+	3− 9+	

TABLE 38.—For the Moon's Latitude. *Arg.* 1st of Latitude. Moon's distance from her ascending Node.

	0+ 6−	1+7 −	2+ 8−	
°	° ′ ″	° ′ ″	° ′ ″	°
0	0 0 0	2 34 18	4 27 23	30
5	0 26 53	2 57 1	4 39 50	25
10	0 53 35	3 18 23	4 50 9	20
15	1 19 51	3 38 16	4 58 16	15
20	1 45 32	3 56 28	5 4 7	10
25	2 10 25	4 12 53	5 7 38	5
30	2 34 18	4 27 23	5 8 49	0
	5+ 11−−	4+ 10−	3+9 −	

TABLE 48.—Number of Direction for finding Easter Sunday, New Style.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	26	19	5	26	12	33	19	12	26	19	5	26	12	5	26	12	33	19	12
B	27	13	6	27	13	34	20	13	27	20	6	27	13	6	20	13	34	20	6
C	28	14	7	21	14	35	21	7	28	21	7	28	14	7	21	14	28	21	7
D	29	15	8	22	15	29	22	8	29	15	8	22	15	1	22	15	29	22	8
E	30	16	2	23	16	30	23	9	30	16	9	23	16	2	23	9	30	23	9
F	24	17	3	24	10	31	24	10	31	17	10	24	17	3	24	10	31	17	10
G	25	18	4	25	11	32	18	11	32	18	4	25	18	4	25	11	32	18	11