

DIRECTIONAL  
ASTROLOGY  
SEPHARIAL



Fernando Pessoa











DIRECTIONAL ASTROLOGY





# DIRECTIONAL ASTROLOGY

TO WHICH IS ADDED A DISCUSSION OF  
PROBLEMATIC POINTS AND A COM-  
PLETE SET OF TABLES NECESSARY  
FOR THE CALCULATION OF  
ARCS OF DIRECTION

BY

SEPHARIAL

AUTHOR OF

"COSMIC SYMBOLISM," "A MANUAL OF ASTROLOGY,"

"A MANUAL OF OCCULTISM," "THE KARALA OF NUMBERS,"

"KABALISTIC ASTROLOGY," ETC.

LONDON

WILLIAM RIDER AND SON, LIMITED

1915

PRINTED IN GREAT BRITAIN BY  
NEILL AND CO., LTD.,  
EDINBURGH.



## PREFACE

A WORD by way of introduction to this work may be necessary, inasmuch as it deals with a technical subject, and the scope and purport of it cannot very readily be apprehended by the casual reader. It is essentially a book for the astrological student. To the astronomer it is particularly informing in that it brings out the more scientific part of the subject and shows the mathematical basis underlying the "lucky hits" to which many of our astrological exponents have undisputed claim.

The general scope of this work embraces all that is essential to the art of "directing" as practised by Claudius Ptolemy and Titus de Placidus, and more recently by Sir John Wharton, Mr John Gadbury, Commander Morrison, R.N., and Mr A. J. Pearce, all of whom pursued the same general principles of astronomical directing, and differed considerably in their application of the celestial arcs to the measure of time. These points are reviewed and critically examined in the following pages.

An attempt having been made to bring the Arabian system of a day for a year into accord with the astronomical system of a degree for a year, some suggestions have here been made as to their rapprochement, the feeling being that, where credit is claimed for one system over another by exponents of either, the probability is that there is truth in both and hence there must be a co-ordinating factor. In the attempt to scientifically extend our horizon to include a prescience of coming events, we have primarily to remember that there are many ways up a mountain, but there is only one top. A study of these various methods may lead to the conclusion that they are all leading in the same direction. It is as if one should say there are three hundred and sixty paces from end to end of the path, and another should say that there are three hundred and sixty-five. Both may be right according to their count and the measure of their tread, but the actual length of the path will remain the same whatever they make of it. This pathway is that which a man has to travel from his cradle to his grave; and there is nothing that concerns a man so vitally as that he should know its trend and gradient, its pitfalls and rocky eminences, in advance of his going, so that experience may be laid by the heels and made to serve instead of to subjugate. And in the direst extreme of human experience we have to remember that "the wise man foreseeeth the evil

and obscureth himself, while the ignorant pass on and are hurt."

I have used a well-known and thoroughly authenticated horoscope for purposes of illustration, and anybody following the rules here given in relation to that horoscope will have no difficulty in following them out in respect to any other horoscope. Particular care has been taken to define the principle underlying each operation, and to give a clean-cut rule of procedure. Unlike most authors, who proceed by befogging the mind of the student with technicalities and afterwards explaining them by means of an appendix, I have devoted the first chapters of my work to technical definitions which are essential to the proper understanding of the subject; and until these are clearly apprehended and understood, the student need go no further.

To save further expense and trouble, my publishers have completed my work by the insertion of a complete set of tables, which include tables of Right Ascension and Declination for every degree of the zodiac, together with the ascensional difference due to the latitudes of London, Birmingham, and Liverpool under the present obliquity of the Ecliptic; also tables of Sines and Tangents, and tables of Proportional Logarithms. These are all that are essential to the present treatise, and in themselves constitute a very valuable addition to the volume. It is, of course, presumed that the



student of "Directional Astrology" will have mastered the preliminary task of setting a horoscope for any given time and place with adequate precision, and hence that he is familiar with the use of an ephemeris. The present work is intended to replace and supersede *Prognostic Astronomy*, which is now out of print.

Beyond this I have nothing to say, save that I trust to have done my work efficiently and to have left no point on which a reader need question me. In such case the work may be regarded as complete, and so I hope it will be found.

SEPHARIAL.

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# Directional Astrology

## CHAPTER I

### ASTRONOMICAL DEFINITIONS

THE following definitions must be fully understood by the student before the more intricate part of the system of directing is undertaken.

*Longitude* is of two kinds : longitude in the Orbit, and longitude in the Ecliptic. The latter is the only one recognised and used in this system. It is defined as distance from the vernal equinox, Aries 0, measured on the plane of the Ecliptic or Sun's path.

*Latitude*.—Celestial latitude is distance north or south of the Ecliptic.

*Declination* is distance north or south of the Equator. The Ecliptic lies in declination  $23^{\circ} 27'$  north and south.

*Right Ascension* is distance from the vernal equinox measured on the plane of the Equator. Right ascension thus answers to geographical longitude in the same way as declination answers to geographical latitude.

*Meridian Distance* is the distance of a celestial



body from the midheaven of a place; that is to say, from its meridian, measured in right ascension.

*Semiarc* of a planet is half the time it remains above or below the horizon of a place, measured in degrees of right ascension. The diurnal semiarc is half the arc in right ascension of a planet above the horizon, and nocturnal semiarc is half the time it is (measured in right ascension) below the horizon. The diurnal semiarc taken from  $180^\circ$  will give the nocturnal semiarc, and the nocturnal semiarc taken from  $180^\circ$  will give the diurnal semiarc.

*Horizontal Arc* is the distance in right ascension from a body to the point of its rising or setting. The semiarc less the meridian distance is always the horizontal arc.

*Oblique Ascension* is the right ascension of a body increased or diminished by its ascensional difference, according as its declination may be south or north. In northern latitudes the right ascension is increased for a body having south declination and decreased for a body having north declination, but the reverse of this is the case in southern latitudes.

*Ascensional Difference* is the time (measured in right ascension) that a body is above or below the horizon more or less than six hours. If, therefore, its semiarc is more than  $90^\circ$  the excess of  $90^\circ$  is its ascensional difference. All bodies that are not exactly on the equinox (Aries 0 or Libra 0) have ascensional difference. For a planet in south declination the ascensional difference is added to

its right ascension to get its oblique ascension, and for bodies having north declination the ascensional difference is subtracted. The reverse of this gives the oblique descension. The O.A. plus or minus  $180^\circ$  gives the obl. descension of the opposite point.

*Pole of Latitude.*—The pole of a place is the same as its latitude. The pole of a planet is measured by a circle of position or small circle parallel to the meridian of a place. The pole of the ascendant is the same as the latitude of the place, and this diminishes as we reach the meridian, where it is 0.

*Direction* is the process by which we bring the body of a planet to the longitude or body of another in a different part of the heavens either by its rising or setting, and this direction of one body to another, or to the place of another, is measured in right ascension; that is to say, by the number of degrees which pass under the meridian of a place in the interval. All directions are taken in the prime vertical, or circle of observation—that in which a person stands upright facing south. Having the proportional distance of a planet between the meridian and horizon, we may bring another body to the same proportional distance along its own arc until it appears to be in the same relative position as the first body. This supposes that the position and influence of a planet is indelibly located in that part of the heavens in which it was found at the moment of birth. All arcs of direction are measured in right ascension.

*Significators*, in this scheme, are the Midheaven, Ascendant, Sun, and Moon. These are the bodies or positions that are directed or moved in the prime vertical in order to form conjunctions, oppositions, and various aspects with other positions and bodies. They are called "significators," from the fact that they are found to signify certain things in the life of an individual; as, the Sun signifies male relationships, the Moon female relationships, the Midheaven honour and position, credit, etc., and the Ascendant the health and general play of events in the individual sphere of life. For further elaboration of this point refer to the *Text-book of Astrology* or *The New Manual of Astrology*.

*Promittors*.—These are the planets Neptune, Uranus, Saturn, Jupiter, Mars, Venus, and Mercury. The Sun and Moon may also be classed as promittors when the Midheaven or Ascendant is directed to them.

*Logarithms*, invented by Baron Napier of Merchiston, first-class mathematician and astrologer, were designed for the purpose of simplifying calculations in spherical trigonometry. In this scheme the arc of  $90^\circ$  of a right sphere is made to equal 10·00000, which is called the radix. Then, having the logarithm of any arc, it may be multiplied into any other arc by simple addition of their logarithms; and, similarly, arcs may be divided by one another by subtracting one logarithm from another. Napier thus emphasises the fact that multiplication is



merely the addition of a number to itself a given number of times, while division is merely subtraction a number of times. Then by means of a proportional circle we can multiply and divide any arc by simple addition and subtraction. The complement of an arc is what it lacks of  $90^\circ$ , and as this is equal to the radix 10, the complement of a logarithm is what it lacks of 10. Thus the logarithm of the sine of  $32^\circ$  is log. sine 9.72421, which is also the log. cosine of  $58^\circ$ , because 58 is the complement of 32, both together making 90. The arithmetical complement of the logarithm is 0.27579, since this, added to the log. sine of  $32^\circ$ , makes 10.00000. Familiarity with the use of logarithms will readily establish their great value in all mathematical calculations connected with the sphere.

I may now ask the reader to take in hand an ephemeris for the current year, 1916, and turn to the 1st January, and the above definitions may then be illustrated.

Let us suppose that a birth took place at noon, Greenwich mean time, on that date in London. The ephemeris being calculated for mean noon at Greenwich, there will be no equation of time necessary. The Sun, Moon, and planets will be in the positions indicated in the ephemeris. The Sun's longitude is seen to be Capricornus  $9^\circ 45' 14''$ . The Sun never has latitude, inasmuch as it defines the Ecliptic, distance above or below which constitutes celestial latitude. All other bodies have



latitude except when they are on that point where their orbits cross the Ecliptic, that is, their nodes. The course of the Sun being across the plane of the Equator at an angle of  $23^{\circ} 27'$  it will attain that declination at the solstices; that is to say, on the 21st June and the 22nd December. On the 1st January it is found to have declination  $23^{\circ} 6'$  south of the Equator, and, therefore, would be immediately overhead at noon at a place which had geographical latitude  $23^{\circ} 6'$  south, and the Sun's diurnal course around the Earth would follow this parallel of latitude. The Sun's right ascension (R.A.) can be found in the tables (see Appendix) from its longitude.

*Rule 1.*—To find the R.A. of any body without latitude.

From the log. cosine of its distance from the nearest equinox subtract the log. cosine of its declination. Remainder is the log. cosine of its R.A. from the same equinox.

<i>Example :</i>	The Sun is here $80^{\circ} 15'$	
	from Aries 0 . . .	cos. 9.22878
	Its declination is $23^{\circ} 6'$	cos. 9.96370
		_____
	Distance in R.A. from	
	Aries 0 = $79^{\circ} 23'$ . . .	cos. 9.26508

Therefore from  $360^{\circ}$  take  $79^{\circ} 23'$ , and the R.A. of the Sun is thus found to be  $280^{\circ} 37'$ . Note that it is sufficient for our purpose to take the various quantities to the nearest minute of space.

Now take the Moon's place in the ephemeris, which is seen to be Scorpio  $17^{\circ} 54'$ . This is  $47^{\circ} 54'$  from Libra 0. The declination of the Moon is  $22^{\circ} 7'$ . Reference to the tables will show that the declination of Scorpio  $17^{\circ} 54'$  is  $17^{\circ} 10'$  only, and we therefore know that the Moon has latitude and is not on the Ecliptic at this time. The ephemeris shows it to have  $5^{\circ} 9'$  of south latitude. In finding its R.A., therefore, we have to take this latitude into account.

*Rule 2.*—To find the R.A. of a body having latitude.

Add the log. cos. of its distance from the equinox to the log. cos. of its latitude, and from the sum subtract the log. cos. of its declination. The remainder is log. cos. of its R.A. from the same equinox.

<i>Example :</i>	Moon's distance from		
	Libra 0 = $47^{\circ} 54'$	. cos.	9.82635
	Its latitude is $5^{\circ} 9'$	. cos.	9.99824
			_____
	Sum . . .	cos.	9.82459
	Moon's declination,		
	$22^{\circ} 7'$ . . .	. cos.	9.96681
			_____
	Its R.A. from Libra 0 = $43^{\circ} 53'$	cos.	9.85778
	R.A. Libra 0 = $180^{\circ} 0'$		
			_____
	Moon's R.A. = $223^{\circ} 53'$		

*Note.*—If we take the arithmetical complement of the log. cos. of the declination and add it to the log. cos. of both the latitude and the longitudinal distance, we shall have the same result.

The R.A. of the other bodies is taken in the same manner, as they all happen to have some measure of latitude. Only when a body is in its node, and therefore coincident with the Ecliptic, does it have no latitude. In such case its R.A. is the same as that of the degree of the Ecliptic it holds.

We have next to find the meridian distances of the several bodies. To do this we have to find the R.A. of the Midheaven and Nadir, and take the nearest distance in R.A. of each body. Thus at noon on the 1st January 1916 the sidereal time is 18h. 39m. 16 secs. Convert this into degrees and minutes of the circle, thus : multiply the hours by 15 and call them degrees ; divide the minutes of time by 4 and call them degrees and minutes of space ; also divide the seconds of time by 4 and call them minutes and seconds of space.

$$\text{Thus 18h.} = 270^{\circ} 0' 0''$$

$$39\text{m.} = 9^{\circ} 45' 0''$$

$$16\text{s.} = 0^{\circ} 4' 0''$$

$$\text{R.A. of M.C.} = 279^{\circ} 49' 0''$$

$$180^{\circ} 0' 0''$$

$$\text{R.A. of I.C.} = 99^{\circ} 49' 0''$$

The upper meridian is called the Midheaven



(*medium cæli*) and the lower meridian is called the Nadir (*imaum cæli*).

Having the R.A. of the M.C. and I.C., we are able to find the quantity of R.A. which separates the various planets from them, and this is the meridian distance of each of such planets.

Thus the Sun's R.A. was found to be  $280^{\circ} 37'$ , and that of the M.C. (to which it is nearest) is  $279^{\circ} 49'$ . The difference is  $0^{\circ} 48'$ , which is therefore the meridian distance of the Sun.

The Moon is found to be in the South-west quarter of the heavens, and therefore nearer to the upper than the lower meridian. Its meridian distance must therefore be taken from this point. Thus :

R.A. of M.C.	$= 279^{\circ} 49'$
R.A., Moon	$= 223^{\circ} 53'$
	<hr style="width: 20%; margin-left: auto; margin-right: 0;"/>
Meridian distance of Moon	$= 55^{\circ} 56'$

The other bodies are taken in the same way according to which meridian (upper or lower) they are nearest in R.A.

The semi-arcs of the planets and luminaries have next to be found.

*Rule 3.*—To the log. tangent of the latitude of place for which the figure is set, or the horoscope cast, add the log. tangent of the planet's declination. The sum is the log. sine of the ascensional difference of that planet under the latitude of birth.



Uniformly, add this ascensional difference to  $90^\circ$  when the planet's R.A. is less than  $180^\circ$ , and subtract it from  $90^\circ$  if the planet's R.A. is more than  $180^\circ$ . The result is the diurnal semiarc of that planet. By subtracting this from  $180^\circ$  you will have the nocturnal semiarc.

Finally, by taking the meridian distance of the planet from its semiarc (diurnal if above the horizon, and nocturnal if below), you will have the horizontal arc, or distance in R.A. from the horizon.

Next find the proportional logarithm of the semiarc of each body, and take its arithmetical complement. Add to this A.C. the proportional logarithm of the planet's meridian distance. This is the constant log. of the planet for purposes of directing.

Enter all these elements into a single table, which is called the Speculum, an example of which will be found in the following pages. The scheme will now be ready for the practice of directing.

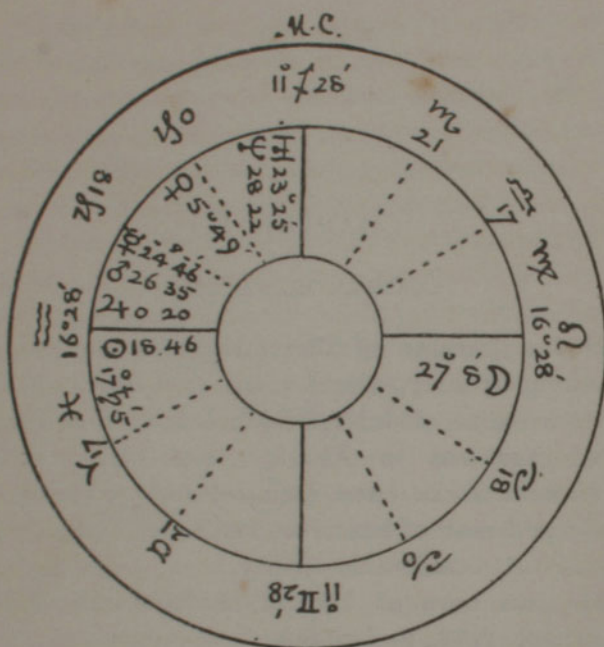
## CHAPTER II

### EXAMPLE HOROSCOPE

FOR the purpose of illustrating the method of directing by proportional semiars, I have selected the horoscope of John Ruskin, whose *Fors Clavigera*, *Mornings in Florence*, and other world-renowned works have stamped him indelibly as artist and man of letters as well as an independent thinker of considerable virility.

He was born at 7.30 in the morning of 8th February 1819, in London.

It is an invariable rule in practice to use that semiarc and meridian distance which are related to one another. Thus the Sun in the speculum is just below the east horizon at the moment of birth, as may be seen by comparing its nocturnal semiarc with its distance from the lower meridian, which are  $110^{\circ} 1'$  and  $108^{\circ} 44'$  respectively. This shows the Sun to be  $1^{\circ} 17'$  below the horizon. But as by the diurnal rotation of the earth on its axis from west to east the Sun will be carried above the east horizon upwards towards the Midheaven, during the course of which it will pass the places



## SPECULUM.

Planets.	Lat.	Declin.	R.A.	Merid. Dist.	Semi-arc.	Hor. Arc.
Sun . . . . .	° —	15 13 S.	321 12	108 44	110 1	1 17
Moon . . . . .	5 1 N.	25 39 N.	120 17	50 21	52 51	2 30
Mercury . . . . .	0 23 S.	21 34 S.	296 47	46 51	60 11	13 20
Venus . . . . .	5 10 N.	18 10 S.	276 6	26 10	65 37	39 27
Mars . . . . .	0 55 S.	21 45 S.	299 6	49 10	59 53	10 43
Jupiter . . . . .	0 21 S.	20 26 S.	302 37	52 41	62 3	9 22
Saturn . . . . .	1 56 S.	6 54 S.	348 54	81 2	98 45	17 43
Uranus . . . . .	0 6 S.	23 24 S.	262 49	12 53	57 1	44 8
Neptune . . . . .	1 13 N.	22 14 S.	267 47	17 51	59 5	41 14

of Mars, Mercury, Venus, Neptune, and Uranus, it will be convenient also to have the semidiurnal arc and the meridian distance from the Midheaven. For whenever we use the nocturnal arc we always use the corresponding meridian distance from the lower meridian, and whenever we use the diurnal arc we also use the corresponding meridian distance from the Midheaven or upper meridian. This point should not be forgotten. It cannot be overlooked if the constant log. of the planet is inserted in the speculum, because this embodies the proportion of the semiarc to the corresponding meridian distance.

Ruskin was agreeably disposed towards the idea of planetary influence in human life, for, although he confessed entire ignorance of the subject himself, he was always willing that others should have the full benefit of his experience and views, and he readily gave his birth data to those who sought it for the purpose of astrological calculations. His assertion that "there is more in it than is generally supposed" was doubtless the opinion he formed of the science from experience; and if it does not carry the weight of scientific criticism, it stamps Ruskin, at all events, as a man of fearless integrity of thought.

In this horoscope we have a remarkable illustration of the principles of astrology. The Sun and Jupiter are rising in the humane sign Aquarius, while most of the planets are rising and above the



horizon. These are indications of success and distinction in the world. The conjunction of Mars and Mercury in opposition to the Moon indicated that asperity and outspokenness which characterised this man of genius and rendered him fearless in the expression of his views. His eccentricities may well be attributed to the meridian position of Uranus and Neptune, while Venus, in closest aspect to Jupiter, and well elevated, disposed to success in the pursuit of art, of which he became a foremost exponent. But, of course, these positions do not make character. They only afford the opportunity for its full expression. Character and environment together constitute destiny, and it is undoubtedly often the case that one or the other of them is a misfit. It is only when we get a strong innate character with appropriate celestial environment that we look for the expression of genius.

We may now proceed to use this horoscope to illustrate the principles of directing.

Take first the Midheaven. This is directed by right ascension, and the planets coming to the meridian will form arcs of direction to it. The aspects to Midheaven should be noted. Thus the semisquare aspect falls in Capricorn  $26^{\circ} 28'$ , and the sextile aspect is Aquarius  $11^{\circ} 28'$ , and planets coming to these points will form aspects in the zodiac to the Midheaven. The square aspect falls in Pisces  $11^{\circ} 28'$ ; and as Saturn is lower in the heavens than that point, it must come up to the

place of this aspect and form the zodiacal square to the Midheaven. And the times in which these aspects are formed by the several planets will be in the proportion of their semiarcs. These directions are in zodiac.

The other kind of direction is in mundo—that is, in the circle of observation or prime vertical. Thus a body that is on the cusp of the twelfth house is in mundane sextile to the Midheaven or upper meridian, and one that is on the cusp of the eleventh house is in mundane sextile to the horizon or Ascendant. A planet that is in the middle of the eleventh house will be half way between the Midheaven and Ascendant, and, therefore, in semisquare aspect in mundo, because the meridian and horizon are always at right angles to one another. If a planet is not thus situated at the moment of birth it will afterwards attain that position, and the number of equatorial degrees which pass under the meridian from birth to the time when the aspect is formed will be the measure of the arc of direction. The original position of a body, either in the zodiac or in mundo, is always that to which direction is made.

*Mundane Directions* are those that are made to the apparent place of a celestial body, or to its aspects, in the circle of observation.

*Zodiacal Directions* are those which are made to the geocentric longitude of a body, or to aspects of that longitude, in the circle of observation or prime vertical.

All directions are formed by the rotation of the Earth upon its axis from west to east, by which the planets appear to rise, culminate, and set, pursuing a course that is from east to west. The lines or arcs traversed by the planets in this apparent motion are parallels of latitude of the same quantity and denomination as geographical parallels of latitude—that is, lines parallel to the Equator. The planets follow the parallel of declination in which they are found at the time of birth.

It is understood that the radical imprint of a planet is localised in that part of the heavens it occupied at the moment of birth; and although the actual planets do thereafter change their declinations and semi-arcs, as well as their meridian distances, the radical imprint of the planet remains ever the same, and is to be regarded as entirely distinct from the planet itself, which, of course, moves along its arc in the heavens.

In the process of directing we are, therefore, only concerned with the radix or root horoscope and the changes which thereafter take place in the heavens, not among the bodies themselves, but in their relations to the radix. All directions of this nature are formed within a few hours of the moment of birth.

Directions (whether in the zodiac or mundo) are of two orders. These are “direct” and “converse.”

Direct directions are such as are formed by one



body being carried by the motion of the Earth towards another body or aspect in the heavens that precedes it. Converse directions, however, are such as are formed in the opposite direction. Thus in the foregoing horoscope of Ruskin, if we bring the Sun to the place of Jupiter, or Mars, or Mercury, or Venus, these would be direct directions, because that is the direct motion of the bodies in the heavens. But if we brought the Sun to the place of Saturn it would appear that we are carrying it backwards to a position that it held previous to the moment of birth. This, however, is not the case. The Sun is joined to the Earth by a direct ray which is called its earth-line, and it is this line which, by the rotation of the Earth on its axis, is carried down (bearing the solar imprint) to the place held by Saturn at the birth. This is a converse direction. But if we bring Saturn up to the place of the Sun it would be a direct direction.

Therefore all directions are formed by the one natural fact of the Earth's rotation on its axis, and aspects that cannot thus be formed are not within the category of primary directions.

We may now pass on to illustrate the method of forming every kind of direction, direct and converse, in zodiac and mundo.



## CHAPTER III

### DIRECTIONS IN MUNDO

THE principle involved in this process is that which enters into the construction of the horoscope, wherein we take one-third of the Sun's tropical semiarc as the extent of the house or division of the prime vertical. This principle enters into the construction of the tables of houses for various latitudes, the Sun's extreme declination remaining a constant quantity.

But in every horoscope we have the various planets with different declinations, and therefore with different semiarcs; and consequently we are dealing with arcs which, although parallel to the Equator and to one another, are not parallel to the circle of observation. Hence an equal division of the prime vertical into twelve parts or houses will not effect an equal division of the various planetary semiarcs, which cut the meridian and horizon at varying angles depending on their declinations. Nevertheless, it has been found in practice that one-third of the semiarc, great or small, is equal to a house-space under the pole of that planet.

Suppose a planet to be exactly rising at the time of birth. Let its semidiurnal arc be  $66^{\circ} 21'$ . This is an arc of right ascension. Therefore when it has traversed one-third of its arc from the horizon to the meridian,  $22^{\circ} 7'$  will have passed under the meridian, and that will be the arc of the planet's direction to the cusp of the twelfth house. Another  $22^{\circ} 7'$  will bring it to the cusp of the eleventh house, and yet another arc of the same value will bring it to the meridian. When on the cusp of the twelfth house it will be in sextile aspect to the Midheaven, and when on the cusp of the eleventh it will be in sextile to the Ascendant, both directions being *in mundo*, as distinguished from similar aspects in the zodiac.

If the Sun or Moon happen to be exactly on the cusp of a house, then the planet coming to the cusp by one-third divisions of its semiarc will simultaneously form aspects in mundo to the Sun or Moon. But if they are not so placed, then we have to find their proportional distances from the nearest cusp or limit of a house, and bring the planet to the same proportional distance in order to form the aspect.

*Rule.*—To find the cuspal distance of a planet. Note the cusp to which it is nearest at the time of birth. The distance of that cusp from the horizon compared with the planet's horizontal arc will give the planet's cuspal distance.

*Example.*—In the specimen figure the Sun is

nearest to the cusp of the first house or ascendant, and therefore its horizontal arc,  $1^{\circ} 17'$ , will be its cuspal distance. The Moon has a semiarc of  $52^{\circ} 51'$ , and its horizontal arc is  $2^{\circ} 30'$ , and as this is nearest to the cusp of the seventh house, that will also be its cuspal distance.

Now, as in all directions, the body to which direction is made is considered to remain stationary while the body directed is moved towards it by its natural motion in the heavens, we here direct the Moon to the sesquiquadrate aspect of the Sun, which it attains in the middle of the fifth house, that point being four and a half houses, or  $135^{\circ}$ , from the ascendant. The Sun, however, is not on the ascendant, and therefore we have to bring the Moon to a proportional distance from the middle of the fifth house. Thus :

As the semiarc of the Sun, $110^{\circ} 1'$ ,	
prop. log. . . . .	0-21381
arith. comp. . . . .	9-78619
Is to its cuspal distance, $1^{\circ} 17'$ ,	2-14693
So is the semiarc of Moon, $52^{\circ} 51'$ ,	0-53223
To its proportional distance, $0^{\circ} 37'$ ,	
prop. log. . . . .	2-46535

Now, as one-third of the Moon's semiarc is  $17^{\circ} 37'$ , that will be its house-space, and one-half will be  $8^{\circ} 48\frac{1}{2}'$ , making for one and a half houses  $26^{\circ} 25\frac{1}{2}'$ , and from this we subtract the above proportional



distance, namely  $0^{\circ} 37'$ , and there remains the arc of direction: Moon,  $135^{\circ}$ , Sun in mundo,  $25^{\circ} 48\frac{1}{2}'$ .

Another example: Bring the Sun in the example horoscope to the mundane conjunction with Jupiter.

In order to effect this the Sun has to cross the horizon, its distance from which has been found to be  $1^{\circ} 17'$ . Thereafter we employ its diurnal arc and bring it to an equivalent distance from the horizon southwards as Jupiter is in the horoscope, by proportion of their semidiurnal arcs.

Jupiter's semiarc is  $62^{\circ} 3'$ , and its meridian distance  $52^{\circ} 41'$ , their difference  $9^{\circ} 22'$ , which is the horizontal arc of Jupiter and therefore its distance from the cusp of the first house. Then we say:—

As the semiarc Jupiter (arith. comp.) is to its cuspal distance, so is the semiarc of the Sun (diurnal =  $69^{\circ} 59'$ ) to its proportional distance from the same cusp southwards. This works out as follows:—

S.A. Jupiter, $62^{\circ} 3'$	. . . . .	log. 0.46253
	Arith. comp.	9.53747
Cusp. distance, $9^{\circ} 22'$	. . . . .	1.28369
S.A. Sun, $69^{\circ} 59'$	. . . . .	0.41028
Sun's prop. distance = $10^{\circ} 34'$		log. 1.23144
Sun to horizon = $1^{\circ} 17'$		
Arc of direction = $11^{\circ} 51'$		
Sun conj. Jupiter <i>m.</i>		



It should be observed that the arc of direction to the horizon must always be added when the planet or body has to cross the horizon in forming the direction. Here the proportion of the Sun's arc to that of Jupiter gives a cuspal distance of  $10^{\circ} 34'$ , and to this has to be added the distance of the Sun from below the horizon, making the arc altogether  $11^{\circ} 51'$ . When crossing the meridian to form a direction, no change of arc is necessary, but the arc to the meridian, which is the meridian distance of the planet, must be added to the arc formed on the other side of it.

It should be observed also that the body to which direction is made, and which is supposed to be stationary, supplies the first and second terms of the proportion, while that body which moves to form the direction supplies the third term and the resulting fourth term. In practice it will be found expedient to arrange all the mundane aspects in the order in which they are formed by each of the planets. The Midheaven and Ascendant remain stationary, and the Sun, Moon, and planets are the promissors that are moved to form directions upon them. Take one of these bodies at a time and make a list of the mundane directions it forms to the Midheaven, Ascendant, Sun, and Moon, calculate them, and arrange them afterwards in the order of their values. Always remember that the diurnal motion of the Earth upon its axis from west to east is the underlying cause of all

directions, and that the planet to which direction is made, remains still, while the other moves towards it. You cannot then go wrong in your application of the method.

Direction to the conjunction in mundo is effected by bringing the body of a planet to the body of another, and not to its zodiacal longitude merely, as is done in the case of the zodiacal conjunction.

Thus in the case of Uranus to conjunction M.C. in mundo, we take its meridian distance as the arc of direction, whereas in the zodiac we take the meridian distance of its longitude, Sagittarius  $23^{\circ} 25'$ , and this will be the arc of direction.

In all cases we bring the *body* of the planet directed to the conjunction or aspect of another body in mundo, to form mundane directions, all such directions being formed in the prime vertical, and expressed in terms of right ascension.

It will be found convenient to have the constant log. of the cuspal distance of each planet in the speculum. Subtract the proportional log. of the semiarc from the proportional log. of the cuspal distance. This will give the constant log., to which we have merely to add the proportional log. of the semiarc of any other planet to find the proportional cuspal distance of that planet.

It has been customary to regard the semiarc of a planet as equal to the quadrant, and therefore one-third as equal to a house or  $30^{\circ}$ . This is true in regard to a prime vertical whose pole is the

same as the declination of the planet, but it is not true in regard to any other pole or geographical latitude. That is why we take the proportion of the semiarc in finding the cuspal distances of planets. The test is this: If we take the oblique ascension of a planet, that is, exactly one-third of its semiarc from the horizon, it should have the same oblique ascension as the cusp of the twelfth house, but by adding 60 to the right ascension of the Mid-heaven to get the oblique ascension of that house, we shall find that if the planet has any other declination than  $23^{\circ} 27'$  there is a difference between the two results. It cannot, therefore, be truly said that a planet is in mundane sextile aspect to the Mid-heaven when it is one-third of its semiarc above the horizon, inasmuch as its position in the prime vertical does not then coincide with the cusp of the twelfth house; but it may be said to correspond with that cusp on the general proposition that all circles are equal to one another and therefore that all quadrants are equal, and in practice it is found that one-third of a semiarc corresponds with one-third of the prime vertical, and this was allowed by Placidus, who was the first exponent of this system of mundane directions.



## CHAPTER IV

### DIRECTIONS IN THE ZODIAC

THESE are calculated on the same principle as mundane directions, that is to say, by proportion of the semiarc; but instead of taking the actual body of the planet, or its position in the prime vertical, we take the longitude only and direct to that, and also to its aspects in the zodiac.

Thus in the horoscope of Ruskin the planet Neptune holds the longitude Sagittarius  $28^{\circ} 22'$ , and therefore its zodiacal sextiles will fall in Aquarius  $28^{\circ} 22'$  and Libra  $28^{\circ} 22'$ , its squares in Pisces  $28^{\circ} 22'$  and Virgo  $28^{\circ} 22'$ , and so on.

The longitude of the planet, or its aspect if we are directing to it, remains stationary, and the actual body of the planet or luminary which is directed to it is moved along its own semiarc until it reaches the longitude or aspect to which direction is made.

Therefore we take the meridian distance and semiarc of the ecliptic degree held by a planet and use these as the first and second terms of a proportion, in which the semiarc of the body directed forms the third term.



*Example.*—Direct the Sun to a conjunction with Jupiter in the zodiac.

Jupiter's longitude is Aquarius  $0^{\circ} 20'$ , and from the tables we find this longitude to have R.A.  $302^{\circ} 31'$ , from which take the R.A. of Midheaven,  $249^{\circ} 56'$ , and we get its meridian distance,  $52^{\circ} 35'$ .

The same tables give the ascensional difference under London as  $30^{\circ} 51'$ , which, taken from  $90^{\circ}$  as the declination is south, gives the diurnal semiarc =  $59^{\circ} 9'$ .

Prop. log. meridian dist.	.	$52^{\circ} 35'$	=	$\cdot 53442$
„ semiarc	.	$59^{\circ} 9'$	=	$\cdot 48332$
<hr/>				
Constant log. Aquarius	.	$0^{\circ} 20'$	=	$\cdot 05110$
Prop. log. Sun's semiarc	.	$69^{\circ} 59'$	=	$\cdot 41028$
<hr/>				
„ Sun's prop. dist.	.	$62^{\circ} 13'$	=	$\cdot 46138$
Take from Sun's merid. dist.	.	$71^{\circ} 16'$		
<hr/>				
Arc of direction	.	$9^{\circ} 3'$		

The constant logarithm of a longitude, once obtained, should be reserved, as it will serve for all zodiacal directions made to the same point of the ecliptic by simply adding the log. semiarc of the body directed to it. We then have the proportional meridian distance, which, compared with its original distance, gives the arc of direction.

Uniformly, find the R.A. of the longitude to which direction is made; from this derive the meridian distance. Find its declination, and from

this derive the semiarc. Subtract the proportional logarithm of the semiarc from that of the meridian distance, and derive the constant log. of the given longitude. To this constant log. add the log. semiarc of the body directed to it, and thus obtain the proportional distance of that body from the meridian at the point of direction. The difference between this and its radical meridian distance is the arc of direction.

*Examples:—*

1. Direct the Sun to aspects of the Midheaven in the zodiac. The aspects to which the Sun applies are the sextile in Aquarius  $11^{\circ} 28'$ , the semisquare in Capricorn  $26^{\circ} 28'$ , and the conjunction in Sagittarius  $11^{\circ} 28'$ .

Aquarius  $11^{\circ} 28'$  has R.A.  $313^{\circ} 55'$

The Midheaven has R.A.  $249^{\circ} 56'$

Merid. dist. of aspect =  $63^{\circ} 59'$  prop. log. .44921

Asc. diff.  $23^{\circ} 9'$

$90^{\circ} 0'$

Semiarc  $66^{\circ} 51'$

prop. log. .43017

Constant log. of aspect in Aquarius  $11^{\circ} 28' = .01904$

Add prop. log. Sun's semiarc diurnal .41028

Sun's prop. dist. from M.C.  $66^{\circ} 59'$  .42932

Radical dist. of Sun from M.C.  $71^{\circ} 16'$

Arc of direction, Sun sextile M.C. =  $4^{\circ} 17'$

2. The next aspect of the Sun to the Midheaven in zodiac falls in Capricorn  $26^{\circ} 28'$ , which is the semisquare aspect of  $45^{\circ}$ .

The R.A. of this longitude is  $298^{\circ} 29'$ , and its meridian distance is therefore  $298^{\circ} 29' - 249^{\circ} 56' = 48^{\circ} 33'$ . Its ascensional difference is  $28^{\circ} 40'$ , which gives its diurnal semiarc  $= 61^{\circ} 20'$ .

Proportional log.  $48^{\circ} 33'$  — prop. log.  $61^{\circ} 20'$  = constant log. of aspect, .10150

To this we add the

prop. log. of Sun

as before, namely, .41028

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.51178 =  $55^{\circ} 23'$  Sun's propor.  
meridian distance;

which take from

$71^{\circ} 16'$  Sun's radical  
distance,

remains

---

$15^{\circ} 53'$  the arc of direction Sun  
semisq. Midheaven.

3. The next aspect of the Sun to Midheaven in zodiac is the conjunction. For this the calculation is simply the difference of their right ascensions.

That of the Sun is  $321^{\circ} 12'$

That of the M.C.  $249^{\circ} 56'$

---

Difference  $71^{\circ} 16'$  = arc of direction.



These examples will doubtless serve for all cases that may arise in the course of directing a planet to the longitude and aspects of another in the zodiac.

We may now consider *converse* directions in the zodiac. These are calculated in exactly the same manner as the direct directions; but instead of moving the directed body forward in the heavens, that is, from the Nadir to the Ascendant, from the Ascendant to the Midheaven, from the Midheaven to the Occident, and so on, we move it conversely against the natural diurnal motion of the celestial bodies in the heavens. Thus, in the example horoscope the Moon is in Cancer  $27^{\circ} 8'$ . Therefore, to bring Saturn to the square aspect of the Moon in the zodiac, we have to bring it to Aries  $27^{\circ} 8'$  by converse motion. We therefore find the meridian distance and semiarc of that point in the ecliptic, the meridian distance being taken from the lower meridian, to which it is nearest, and the semiarc being the nocturnal arc. Find the constant log. due to this point of the zodiac, and add to it the log. of the nocturnal semiarc of Saturn. From this we derive the proportional distance of Saturn from the lower meridian, and the difference between this and its radical distance is the arc of direction.

Similarly, we bring the Sun down the eastern heavens to form the converse zodiacal conjunction with Saturn. Here we take the meridian distance of Pisces  $17^{\circ} 5'$ , and also its semiarc. Find the con-



stant log. due to these and add to it the log. of the nocturnal semiarc of the Sun. The sum will be the prop. log. of the Sun's meridian distance at the conjunction, and the difference between this and the radical distance of the Sun from the same meridian will be the arc of direction.

The bodies of Jupiter, Mars, Mercury, Venus, Neptune, and Uranus are brought to the zodiacal conjunction with the ascendant conversely by the measure of their horizontal arcs, which are derived by subtracting the meridian distance from the semiarc.

Thus Jupiter comes to the conjunction with the ascendant in zodiac conversely in an arc of  $9^{\circ} 21'$ , Mars in an arc of  $10^{\circ} 43'$ , Mercury in an arc of  $13^{\circ} 20'$ , Venus in an arc of  $39^{\circ} 27'$ , Neptune in an arc of  $41^{\circ} 14'$ ,<sup>1</sup> and Uranus in an arc of  $44^{\circ} 8'$ . Similarly, the Moon is brought to an opposition of the ascendant in zodiac by an arc of  $2^{\circ} 30'$ , which is the difference between its semiarc and meridian distance. This arc is much smaller than appears from its longitudinal position, and is due to the fact that the Moon has  $5^{\circ}$  of north latitude. A body with much north latitude sets much later and rises much sooner than does the degree of the ecliptic it holds. This is the radical difference between the mundane and zodiacal positions of a celestial body.

<sup>1</sup> An ephemeris of the approximate longitude and latitude of the planet Neptune from 1800 to 1900 A.D. is published by Messrs Foulsham & Co. Price 1s.

The Midheaven is directed to the conjunction with these planets in the zodiac by an arc equal to the difference of the R.A. of the Midheaven and that of the longitude of the planet.

Thus Venus comes to the Midheaven with the R.A. of Capricorn  $5^{\circ} 49'$ , which is  $276^{\circ} 25'$ , and the difference between this and the R.A. of the Midheaven  $249^{\circ} 56' = 26^{\circ} 29'$  arc of direction of Midheaven conjunction Venus in zodiac.

Uranus comes to the Midheaven in the zodiac by an arc of  $12^{\circ} 53'$ , Neptune by an arc of  $18^{\circ} 17'$ , Venus by an arc of  $26^{\circ} 29'$  (as above), Mercury by an arc of  $46^{\circ} 44'$ , Mars by an arc of  $48^{\circ} 41'$ , Jupiter by an arc of  $52^{\circ} 36'$ , and the Sun by an arc of  $71^{\circ} 16'$ . These arcs, it will be observed, differ from the meridian distances of the several bodies as given in the speculum by an increment which is due to the latitudes of the various bodies. The meridian distances in the speculum will be the same as the measure of their directions to conjunction with the Midheaven in mundo.

We may now pass to another series of directions.

## CHAPTER V

### ZODIACAL AND MUNDANE PARALLELS

IN astrology the parallel of declination is deemed of the same significance and value as the conjunction, but its effects are more lasting, and if formed near the tropics, Cancer 0 or Capricorn 0, they will last for years together and characterise a whole period of the life.

A *zodiacal* parallel is formed by directing a body to the place held by a zodiacal degree which has the same declination as that held by a planet to which direction is made.

*Example.*—The Sun at birth has  $15^{\circ} 13'$  of declination. On the principle that all parallels of declination, being at the same distance from the Equator, act magnetically in unison, any body coming to an ecliptic degree which holds the same declination as the Sun, namely,  $15^{\circ} 13'$ , whether north or south of the Equator, will act as if in conjunction with the Sun. Reference to the tables will show that there are four points which have this same declination, namely, Aquarius  $18^{\circ} 46'$ , Taurus  $11^{\circ} 15'$ , and Scorpio  $11^{\circ} 15'$ . Therefore, if we



direct any body to any of these four longitudes in the zodiac by the rules given for directions in the zodiac, we shall bring them to parallels of the Sun in zodiac. The process is exactly the same as if we were directing to an aspect in the zodiac.

A *mundane* parallel is formed by the direction of a body to the same distance on one side of the meridian or horizon as that radically held by another body on the other side of the same meridian or horizon. These can be readily computed by reference to their horizontal arcs.

*Example.*—Bring Saturn to the mundane parallel of the Sun. The Sun's radical distance from the horizon northwards is determined by the difference of its meridian distance and semiarc, namely,  $110^{\circ} 1' - 108^{\circ} 44' = 1^{\circ} 17'$ , and we therefore have to bring Saturn to the same distance above the horizon. The semiarc of Saturn is  $98^{\circ} 45'$ , and its meridian distance  $81^{\circ} 2'$ ; its horizontal arc therefore is  $17^{\circ} 43'$ . Then say: As the semiarc Sun is to its horizontal distance, so is the semiarc Saturn to its proportional distance, which, being added to the first or radical distance of Saturn from the horizon, will give the arc of direction.

Some writers on this subject have repudiated the parallel in mundo formed upon the horizon, but without adequate reason being adduced in support of their objection. Yet the same writers have not denied the efficacy of parallels formed on the *same* side of the meridian, one south and the other



north, as in the 4th and 9th houses, or the 11th and 2nd, 10th and 3rd, etc., forgetting that bodies so placed are at equivalent distances from the horizon!

The rule for parallels is the same as for aspects. As the semiarc of the stationary body is to its meridian distance, so is the semiarc of the moving body to its proportional distance, which, taken from its primary distance, or added if it passes into another quadrant in forming the aspect, will give the arc of direction.

Thus we may bring Saturn to a parallel with the Moon in mundo. The Moon here is  $2^{\circ} 30'$  from the west horizon, and below it. If we bring Saturn along its own arc until it reaches a proportionate distance below the east horizon, we shall have a mundane parallel formed on the same side of the horizon, but on opposite sides of the meridian. We could work this problem by reference to the meridian distances of the two bodies from the Nadir, and the result would be the same.

It should be observed that the Sun and Moon are regarded as significators in the formation of mundane parallels by the other bodies, and the meridian and horizon therefore become sectors, upon which the parallels are formed.

Another form of the parallel in mundo is what is known as the *rapt parallel*. This is formed by the motion of the Earth on its axis, whereby the various bodies are carried from east to west at

their several relative distances from one another until they come to the same distance on either side of the meridian or horizon. In this case *both* bodies move in the prime vertical at a rate proportionate to their relative semiarcs.

*Rule.*—As half the sum of their semiarcs is to half the sum of their meridian or horizontal distances, so is the semiarc of the body applying to the angle, to its distance from that angle at the formation of the parallel. This distance taken from its radical distance from the same meridian or horizon will give the arc of direction.

What we are actually doing is to bring the meridian or horizon to the mid-distance between the Sun and a planet, or between the Moon and a planet. And these mid-distances are of the greatest significance, whether in the zodiac or in mundo. Here we are considering them only in mundo.

*Example.*—Bring the Moon and Saturn to a rapt parallel. This is formed on the lower meridian.

Semiarc, Moon (nocturnal)		52° 51'	
,, Saturn	,,	98° 45'	
		2)151° 36'	
		75° 48'	
Half sum of semiarcs	.	75° 48' prop. log. 37560	
		Arith. comp. 9.62439	

	Arith. comp.	9.62439
Merid. dist. of Moon	. 50° 21'	
"    "    Saturn	. 81° 2'	
	<hr style="width: 50%; margin-left: auto; margin-right: 0;"/>	
	2)131° 23'	
	<hr style="width: 50%; margin-left: auto; margin-right: 0;"/>	
	65° 41' prop. log.	43782
Semiarc, Moon . . . . .	. 52° 51'	,, 53223
	<hr style="width: 50%; margin-left: auto; margin-right: 0;"/>	
Proportional dist., Moon . . . . .	. 45° 48'	,, .59444
Radical distance	. 50° 21'	
	<hr style="width: 50%; margin-left: auto; margin-right: 0;"/>	
Moon rapt. par., Saturn	= 4° 33' arc of direction.	

*Note.*—In all cases where the Midheaven (meridian) and Ascendant (horizon) are employed as sectors, the Sun and Moon are employed as signifiers. They form aspects by their own apparent motions in the prime vertical, and the planets form aspects to the radical of the Sun and Moon by the same motion. This is the underlying principle of all parallels in mundo, and all rapt parallels. Remember that in mundane directions you are always dealing with the bodies themselves and not their longitudes.

## CHAPTER VI

### ORDER OF DIRECTING

THE student will do well to employ some definite method of noting the various directions, and of collating and tabulating his results, otherwise he is sure to overlook some that are important when considered in association with others that attend them, whether they be of the same or a contrary nature. Thus, if in a train or sequence of evil directions there should occur a good aspect of Jupiter to the Sun or Moon, the health and fortunes will be greatly sustained thereby, so that what would otherwise appear a fatal set of arcs, in the presence of this benefic arc of direction would lose that extreme significance, and, although sickness might supervene, the good direction would indicate a favourable crisis.

The following method is therefore suggested as inclusive of all legitimate directions.

#### 1. *Mundane Directions*

(a) Direct all the bodies to aspects and conjunctions with the Ascendant from east to west and from west to east.



(b) Direct each of the bodies to all the aspects and the conjunction with the Midheaven, both ways.

(c) Direct the Sun to other bodies and their aspects in mundo, both ways.

(d) Direct the Moon to other bodies and their aspects in mundo, both ways.

(e) Direct each of the planets separately to mundane aspects and conjunctions with the Sun.

(f) Do the same in regard to the Moon.

(g) Direct the Sun to mundane parallels with the Moon and planets.

(h) Direct the Moon to mundane parallels with the Sun and planets.

(i) Direct the Sun to rapt parallels with the Moon and planets.

(j) Direct the Moon to rapt parallels with the Sun and planets.

## 2. *Zodiacal Directions*

Follow the same order as for mundane directions, omitting classes (g), (h), (i), and (j) (mundane and rapt parallels), which are not formed in the zodiac.

Note that in zodiacal directions a body is always moved to a longitude to form a conjunction or aspect, never the reverse of this. Also that the meridian and horizon are fixed circles which do not move in regard to any particular locality. The Midheaven and Ascendant are those points where

the ecliptic cuts through the meridian and horizon respectively.

All this long process of directing may appear to be very tedious. It certainly requires patience and method. But once done it lasts for a lifetime, which is a point to be considered. In possession of such a chart one may direct one's course with wisdom and success, avoiding those dangerous shoals, sandbanks, and breakers which occur in the course of every life—or, if it be beyond the power of a man so to do, he can at all events divest evils of much of their power over him by adjusting himself to them, making provision against times of evil fortune and doubling his efforts when times of prosperity are shown. Thus may a man order his going and bring his life to a peaceful end. Sudden death cannot overtake the man who has knowledge of the time of that event years in advance; and the keen edge of many afflictions, to which an all-wise Providence may dispose us for the greater ends of life, are dulled by a philosophic anticipation, so that, cutting less deeply, they leave the vital soul of man unhurt. Therefore, rather than pray that what is foreordained by the laws of life to the inscrutable ends thereof may be averted, let us rather pray with the Psalmist: "Teach me the number of my days, that I may apply my heart to wisdom."

## CHAPTER VII

### EFFECTS OF DIRECTIONS

IN order to complete this section of the work, which deals with that system of direction by semiarcs currently practised and approved, it will be necessary here to indicate the general effects of directions, so that the nature and import of events may be known as certainly as the time at which they are likely to transpire. I am here speaking of "effects" of directions as if these latter had a direct dynamic result upon the character and actions of an individual. I am disposed to classify astrologers in three main groups—fatalists, casuists, and idealists—according to the various views they take of the nature and purport of astrology. The Fatalists believe, or profess to believe, that there is a planetary configuration and an event which attends it. They admit no possible intervention, amelioration, or extenuation. *Che sarà sarà*, and that is the end of the matter. They argue a certain necessity of connection between character and environment as we find it and planetary positions at the moment of birth. As regards "directions," all of which



are formed within a few hours of the birth, they speak of them as "seeds sown" in the plastic soil of the human soul which spring up and bear fruit at the appointed time, as measured by the arc of direction. They are born when they are born by necessity of universal law, and they die when they die because fatal arcs of direction are then in force.

They speak of laws of Nature as if they were dynamic forces against which mankind cannot possibly contend. They forget that laws are only mental concepts induced upon our minds by an apprehension of the correlated successiveness of events, and that what we know about natural laws is an infinitesimal part of the possibly knowable. They speak of the bodies of this microscopic solar system of ours as if they were the be-all and end-all of existence. They forget that the continuity of matter is a fact only on the material plane, and that there are forces of an immaterial nature which transcend both matter and what we call the laws of material existence. The moral law is an illustration of this. It is spiritual in its origin and spiritual in its effects. If astrology teaches fatalism, its use is at an end and it becomes a suicidal science, since there is no object in knowing that which must inevitably take place. It would reduce man to an automaton and divest him of all moral responsibility.

The Casuists are those astrologers who accommo-



date their facts and figures to popular concepts by a discreet use of a *mélange* of spurious philosophy. They forever quote the effete adage: "The wise man rules his stars, the fool obeys them"; and that other which says: "The stars incline but do not compel." They put a premium upon the wisdom of experience and the will-power of a purposeful character, and promptly consign a man to destruction by telling him that his horoscope indicates he has neither one nor the other. They do not suggest to him that astrology, properly conceived and applied, is in itself the very concrete of experience, nor that the will-to-be and the will-to-do are functions of the human soul which rise superior to all circumstance, outlasting life itself.

The Idealists are those among astrologers who regard the intelligible universe as the expression of a Supreme Intelligence, who regard the planetary combinations merely as symbols, knowing that the causes of all effects are within man himself, the cogniser of all experience. They regard the "signs of the times" as the driver of a locomotive regards the signals, not as "causes" of disaster, but as warnings against it, an open book to those who can read the signals, but of no value to those who cannot. They look upon the science of astrology as a wireless operator looks upon his code-book, merely as a means of interpreting the signals—a science evolved by man for the service of man.

My own view of the matter is that there is some-

thing to say for the materialist side of the question, and a great deal more for the idealistic. There is not the shadow of doubt in my own mind as to the material fact of the interaction of the planetary bodies, nor as to the fact that this interaction is registered by an intervening body of the system only at certain angles. The Platonic dictum that "God geometrises" is nowhere better illustrated than in the law governing the interaction of bodies belonging to the same system. The physical effects of the syzygies, and especially of ecliptic conjunctions of the luminaries, are immediately appreciable. The law of the tides is a concrete example of the fact of interplanetary action. We cannot deny the dynamic effects of planetary action on the material plane, and we have every reason for including in this category the human organism, compounded as it is of cosmic elements and in direct physical relations with a material environment. But that does not warrant us in extending our views to include the action of physical bodies upon the immaterial part of us, the only part of us that is essential and distinctively human. The only thing that can directly affect the soul of man is the soul of another human being. There is continuity of action upon all planes of existence because there is a continuity of matter upon all planes, but we have no grounds for extending the range of action from one plane to another plane, except it be by mediation or agency. Else we

could say that a good soul must be possessed of a sound body, a beautiful soul of a comely body, and that our moral principles are derived from what we eat and drink—instead of which, what we eat and drink depends on our moral principles. There is sound philosophy in the words of Tennyson when he says that "Soul to soul strikes through a finer element of its own." It is capable of acting mediately through the physical body or immediately through its own essential being. These views will doubtless alter our viewpoint in regard to much that hitherto has been regarded as fundamental to a belief in astrology. The effort to accommodate the facts of astrology to the materialistic science of a generation ago has tended to this issue. Without in any way disposing of astrology as a physical science, it is high time that we learned to interpret the facts of that science in the light of the higher spiritual teaching to which we have access. Otherwise we shall debase the science and enslave our own souls. In such case it were better that our astrology had never been written. As a physical science, astrology has an immense future before it in this utilitarian age upon which we have embarked; but as a fatalistic creed it is not worth an hour's study.

These remarks will enable the reader to understand why, in the following statement of the "Effects of Directions," I have pursued the common practice of attributing certain results or



sets of conditions as accompanying the formation of "directions" or planetary combinations in the horoscope subsequent to the birth. They should not be regarded as inevitable "effects" of such directions, but rather as things signalled, as if we should hoist the red light to indicate "danger ahead," the green light for "caution," and the white light for "road clear." These signals do not cause disasters, but our ignorance of them, our inability to see them, or our wilful disregard of them may very well result in a catastrophe. Human science has harnessed many of the subtle and intangible forces of Nature and deployed them to the service of man. It may do the same with cosmic forces that are as universal as etheric action

#### *The Midheaven*

This point of the horoscope stands for dignity, influence, authority, and position, the worldly honour and credit of the subject, and for all that is associated with his social and communal status. Good directions, such as the sextile and trine of all planets, and the conjunction and parallel of Jupiter, Venus (and Mercury when well aspected at birth), are indications of an enhanced position, higher honours, social distinctions, increase of prestige, etc.

Evil directions, such as the semisquare, square, and opposition of all planets (including the Sun and Moon in this category), and the conjunctions



and parallels of Uranus, Neptune, Saturn, and Mars, indicate assaults upon the good name and credit of the subject, hurt to the business affairs, loss of position, rivalries, and unprofitable associations.

#### *The Ascendant*

This point of the horoscope indicates things personal to the subject, as health, general welfare, comfort, environment, changes, and the common relationships of life, that which affects him through collective influence, the public state of affairs, etc.

Good aspects (as above enumerated) tend to benefit the subject by a variety of means differing as the nature of the planet which is in aspect by direction.

Evil aspects signal bad health, obstacles, hindrances, incommodities, troubles and annoyances of various kinds, according to the nature and position of the planet directed.

#### *The Sun,*

when in a hyleglial place (as defined by Ptolemy), has significance of the vital constitution and life of the subject. Generally it stands for the father and male representatives of a family, and for the honour, credit, and position of the subject himself. It is thus associated more particularly with the Midheaven.

*The Moon*

denotes the health, changes of fortune, the mother and female representatives of the family, the functional powers of the body, and, in its association with the Ascendant, public bodies, the populace, and public concerns generally.

If in a hylegliacal position, it indicates the vital organs and life of the subject.

*Note.*—Ptolemy defines certain parts of the horoscope as being vested with a vital prerogative, wherein the Sun has precedence by day and the Moon by night. It is a moot point whether other bodies, being in such positions (in the absence of the luminaries), may not be vested with the same prerogative, and again, whether the Sun or Moon, not radically in such a position, may become invested with such significance by coming to a hylegliacal place by direction after birth. Failing either the Sun or Moon, Ptolemy invests the Ascendant with the properties of hyleg or life-giver. But, whatever may be concluded in this debatable matter, it is certain that the Ascendant is most generally affected by evil directions at the time of a physical crisis, the afflicting planet generally indicating the nature of its cause.

The above points in the horoscope, the Mid-heaven, Ascendant, Sun, and Moon, are the signifiers, because they signify such persons and things in the life of the subject as are capable

of being affected by the conflict of human circumstance.

All directions are made either (*a*) by the natural motion of the significators to the places and aspects of the planets, or (*b*) by the natural motions of the planets to the places and aspects of the significators.

The triangle (trine) and parts of it are good aspects, and indicate some advantage according to the position and nature of the planet directed. The cross (square) and parts of the square are evil aspects, and indicate similar disadvantages.



## CHAPTER VIII

### PLANETARY INDICATORS AND THE MEASURE OF TIME

THE following definitions of planetary indications are necessarily only partial and incomplete, but they will serve doubtless to convey a more or less definite idea of the nature of events which may be expected to attend directions formed by them with the various significators.

It should be observed that the house which a planet directed to holds in the horoscope of birth, or that which a planet which is directed arrives at when the aspect is complete, has chief significance in regard to the department of life in which the events will transpire, the nature of those events depending primarily on (a) the nature of the aspect and (b) the nature of the planet involved.

In this light, therefore, it may be said that *Neptune* in good aspect indicates events of a beneficial nature connected with the use of the faculties or some special faculty, and frequently in connection with a form of art; benefits from unexpected sources coming mysteriously to the subject; unseen

and intangible influences at work for the benefit of the subject ; brilliant flashes and inspirations of the mind ; spiritual aid ; intuitive activity.

In evil aspect by direction it denotes chaotic and mysterious events adverse to the interests ; scandal, secret enmity ; undermining of the credit by misrepresentation and fraud ; treachery, ambush ; an involved state of affairs ; nervous leakage and depletion of energy ; wasting of tissue ; physical ennui and decline of the vital powers from inscrutable causes ; apprehension, fear, and dread of consequence ; danger of espionage ; loss by fraudulent concerns and false investments ; mental unrest and loss of faculty.

*Uranus* in good aspect denotes civic and governmental honours, preference, advancement ; unexpected benefits arising out of public concerns and affairs ; ingenuity, inventiveness ; originality ; success in mechanical and engineering business ; strokes of good fortune coming from unexpected sources ; new associations and alliances.

In evil aspect this planet denotes the breaking down of existing relationships, lesions and fractures, partings and separations, loss of a sudden and unlooked-for nature ; hurt by strikes and public demonstrations ; nervous lesion, paralysis ; breaks and dislocations.

*Saturn* in good aspect indicates favours from aged persons and benefits from old associations, long investments, time contracts, and a general

state of stability and steadiness in the fortunes, congenial retirement and sequestration.

In evil aspect Saturn depletes the vital powers, causes physical hurts by falls and contusions, morbid diseases, colds and chills, inhibition of bodily functions; loss of money and property; mental and nervous depression; privations, obstructions, hindrances, and general misfortunes. Saturn is anciently known as the Greater Infortune.

*Jupiter* in good aspect denotes increase of fortune, opening up of new and lucrative opportunities, expansion of interests, advancement, progress, honours, confidence, good judgment, a general feeling of expansion and well-being, both physical and mental.

In evil aspect Jupiter denotes losses, errors of judgment, vanity or excessive confidence, disfavour of legal men and clericals, physical disabilities arising from congestion and surfeit, excess or over-indulgence, "too much of a good thing," too much *confiance en soi*, and consequent loss of esteem with others. It indicates a period of low finance, due to lavish expenditure, severe losses, or heavy investments. Jupiter is anciently known as the Greater Benefic, but it is certain that its evil aspects denote anything but a beneficial state of affairs.

*Mars* in good aspect denotes activity, new enterprises, great output of energy with commensurate good results, travelling, the executive powers are stimulated, and much profitable work is done.



Benefits accrue from military men, business connected with iron, steel, and fire. The muscular system is strengthened and there is a disposition to increased activity. Honours due to deeds of daring and chivalry. Women frequently marry under this aspect.

In evil aspect Mars denotes hurts by burns, scalds, fire, and steel, with loss of blood, abrasions and cuts, and also fevers and inflammatory conditions of the body or that part of it indicated by the position of Mars by direction. Loss by fire or theft, sometimes attended by violence. Sudden alarms and disasters of various sorts. Mars was anciently known as the Lesser Infortune.

The *Sun* in good aspect indicates increase of prestige, honours and emoluments, new friends and associations of a creditable character, general advancement and good fortune.

In evil aspect the Sun denotes losses, disfavour of superiors, troubles through male members of the family, the chief, overseer, or manager of a business; loss by governing bodies; ill-health due to fevers. Reverses of various sorts according to the house in which the direction is completed.

*Venus* in good aspect signifies social and domestic success, pleasures and enjoyments, gifts and presents, decorations; the young court or marry, and the mature have children born or daughters engaged or given in marriage, and such events happen as cause pleasure and satisfaction. The

affectional nature is stimulated and the health is good.

In evil aspect Venus denotes sorrows, disappointments, bereavements, grief, and losses, domestic and social troubles, and hurts associated with young women or children. Venus was anciently known as the Lesser Benefic, and the less one has of it when in evil aspect the better for all concerned.

*Mercury* acts in terms of the planet to which at birth it is in closest aspect ; but if not within orbs of an aspect with any planet, then in terms of the ruler of the sign it occupies. In good aspect it usually signifies activity, much occupation of a profitable nature, connected with writings, science, and business of a general nature. Travelling, profitable journeys, good news, gain in connection with the avocation or trade. An active time generally.

In evil aspect Mercury produces annoyances and disturbances, evil news, worry and anxiety, many short journeys to and fro to no purpose or profit, sleeplessness, irregular feeding, unrest.

The *Moon* in good aspect denotes pleasant and profitable changes, a change for the better in the general state of affairs, gain by public associations and concerns, favours from women of mature age, popularity.

In evil aspect it denotes loss by any of the above means, and a state of unrest both physical and mental which leads to neglect of duties and conse-

quent loss. Hurts from women. Some public affronts may be suffered. Changes are unfortunate, and best avoided.

### *The Measure of Time*

In the foregoing system of primary directions by proportion of the semiarses, the measure of time is  $1^{\circ}=1$  year, and every  $5'=1$  month.

Considerable discussion has been devoted to the question of time measurement in directions. Those who advocate the Arabian system of a day for a year have sought to bring primary directions into line with that system by equating arcs of direction made on the foregoing principle of semiarses, by adding the arc to the Sun's right ascension at birth, and then finding the day after birth at which the Sun attains this new right ascension. The count is made at the rate of one day for a year of life, and two hours for every month.

Others, again, have sought to apply a plus increment at the ratio of 365 to 360, seeing that the Sun moves through 360 degrees in 365 days, which is the same as taking the Sun's mean motion  $59' 8''$  as the value for  $1 \text{ day}=1$  year.

But it is obvious that none of these methods has any direct application to the system we are now concerned with, inasmuch as all the directions formed by the diurnal rotation of the Earth on its axis are formed within a few hours of birth so far as they apply to a life of ordinary length, and



they are measured in degrees of right ascension—that is to say, by the passage of the Equator under the local meridian in the prime vertical,—and therefore degrees of right ascension are the only uniform basis of measurement. It certainly does not seem consistent to measure arcs by one method and equate them in terms of another.

It should be observed, however, that primary directions in right ascension do not always coincide exactly with the events they are held to signify. Sometimes they are too short, and sometimes too long, but never more than a few minutes either way. Commander Morrison, R.N., was of opinion that the event signified was delayed or accelerated by reason of current transits in the horoscope at the time, and he further states that the chief effects may be expected to transpire when the lunar or secondary directions come into accord with them. This gives rather a wide margin of operation to the primary direction, and has led many to the conclusion that the secondary direction is, after all, the important one and deserving of primary consideration. A very little experience will show that it is not so, for, unless there are concurrent primaries in operation, lunar or secondary directions frequently pass with little or no result.

Primary directions and transits appear to answer to all the more important events in life.

At the same time we have to consider the *duration* of effects, and in regard to this it has been observed

that the process of formation of an arc of direction should be considered. For the longer a direction may be in forming, the longer will those events endure which it signifies. Here we have Fitzroy's old maxim again in evidence: "Long foretold, long last: short notice, soon past."

Thus an aspect to the Ascendant formed during the rising of a sign of short ascension such as Aquarius, Pisces, Aries, Taurus in northern latitudes, and the opposite signs to these in southern latitudes, will be speedily formed and over. On the other hand, a similar direction formed to the Ascendant when in a sign of long ascension will be formed more slowly, and will dissolve more slowly. In such case we might expect the signified event to begin to happen earlier and to end later than in the former case.

One finds in experience, however, that men frequently trace years of toil and suffering to a sudden disaster overtaking them in a moment. In my theory of transits, this could not happen in earlier years, but might easily occur at maturity when the accumulated results of a man's labour were heaped around him. (See Transits.)

The following illustrations will, however, sufficiently prove that there is adequate coincidence between arcs of direction and the events they are held to signify, to warrant the measure of time  $1^{\circ} = 1$  year as scientifically valid.

## CHAPTER IX

### ILLUSTRATION

IN the example horoscope given in these pages we have a singularly interesting subject. The chief events of the life are well defined and closely indicated by the attendant arcs of direction. Hundreds of horoscopes, whether pertaining to individuals in high walks of life or of modest position in the world, could be adduced to show that this coincidence of direction and event is not fortuitous, but regular and consistent, and as dependable as any astronomical formulary. The student will find pleasure and instruction in working out the following arcs of direction in the present instance.

John Ruskin leapt into fame and became a "lion" in the world of art in the autumn of 1843 under the direction of

Sun sextile Midheaven mundo  $24^{\circ} 37'$

He was married on the 19th April 1848, and, while on his honeymoon, took a chill while sketching in Salisbury Cathedral and was seriously ill. This happened under the adverse directions—



Moon oppos. Venus mundo conv.  $29^{\circ} 16'$

Moon square Venus mundo dir.  $29^{\circ} 16'$

The nearness of these adverse arcs to the event of marriage proved unfortunate for such a domestic change. The danger of his choice of a wrong time and a wrong partner for marriage was radically indicated by the Moon's opposition to Mars and Mercury, and nothing but constant bickering could have been expected from such indications.

The first serious break in Ruskin's health was in May 1840, for which we have the direction—

Moon oppos. Saturn zod.  $21^{\circ} 46'$

He received honours from the University of Cambridge in May 1867 under the appropriate directions of

Ascendant trine Venus mundo  $48^{\circ} 2'$

Ascendant sextile Moon zod.  $48^{\circ} 22'$

He was elected Slade Professor of Fine Art on the 10th August 1869, and commenced his course of lectures under the following directions :

Ascendant trine Jupiter zod.  $50^{\circ} 35'$

Midheaven par. Jupiter zod.  $50^{\circ} 57'$

Ascendant par. Jupiter zod.  $51^{\circ} 14'$

Moon rapt par. Jupiter .  $51^{\circ} 22'$

In the following year his health gave way, and his mother died in December of that year, 1871. The arc for that year measured from  $51^{\circ} 53'$  to  $52^{\circ} 53'$ , and within these limits we have the significant directions—

Ascendant square Saturn zod. con.	51° 59'
Moon square Mars mundo . . . . .	52° 0'
Sun par. Uranus zod. con. . . . .	52° 0'
Ascendant square Jupiter mundo . . . . .	52° 41'

followed by Moon par. Mars zod. 53° 3', close upon the death of his mother.

His health completely broke down again in 1888, under the directions—

Sun opposition Uranus zod. . . . .	68° 49'
Sun opposition Uranus mundo . . . . .	69° 14'
Moon rapt par. Saturn . . . . .	69° 30'

Here the Sun is hylegliacal, and, being so heavily afflicted from angles of the horoscope, and the Moon also afflicted by Saturn, only disastrous illness and misfortune could have been signified.

Nevertheless, he survived this affliction, and further added to his reputation as a man of letters and exponent of fine art during some ten years, until eventually, with declining vitality laying him open to attack, he was afflicted by influenza and succumbed on 20th January 1900, the arc for that date being 80° 57'. The following significant train of directions was then in force :

Sun par. Uranus zod. . . . .	80° 10'
Ascendant square Saturn mundo . . . . .	81° 2'
Ascendant sesquiq. Sun zod. . . . .	81° 11'
Ascendant par. Uranus zod. . . . .	81° 27'
Moon square Mars zod. con. . . . .	81° 30'

In view of these directions, it cannot be said that we are not duly signalled by the celestial bodies, not only of the approach of evil times, when more than usual care and attention are due to health and fortunes, but also of those periods of good fortune when the sun smiles upon all our efforts and stimulates us to greater endeavours. The fault is altogether ours if we do not regard these portents. The beneficent Creator, having established these celestial bodies "for signs and for seasons," is ever faithful. He puts up the signals on every occasion. It is for us to apprehend and read them.

In King Edward VII.'s horoscope we have the attachment which led to his marriage indicated by

Venus conjunction Moon mundo .  $19^{\circ} 25'$

Moon conjunction Venus con. .  $20^{\circ} 7'$

The attempt on his life by the maniac Sipido, when as King he was travelling in Germany, measures to an arc of  $58^{\circ} 25'$ , and the appropriate direction was—

Sun opposition Neptune zod.  $58^{\circ} 21'$

The death of the Empress Frederick (Princess Royal) in August 1901 was indicated by the direction—

Midheaven conjunction Saturn  $59^{\circ} 43'$

The death of his royal mother, Queen Victoria,



requires an arc of  $59^{\circ} 14'$ , and we find the appropriate directions—

Midheaven square Moon zod.	. $58^{\circ} 58'$
Ascendant opposition Moon .	. $59^{\circ} 19'$
Saturn semisq. Ascendant .	. $59^{\circ} 22'$
Midheaven conjunction Saturn zod.	$59^{\circ} 42'$

These illustrations will doubtless serve for all practical purposes, and they can be worked out at leisure by those who wish to exercise themselves in this art.

Other methods than that here illustrated must claim our attention, inasmuch as they have consistently been advocated by various authors. There are, moreover, several points which may be considered as debateable, and these also have to be considered before our work is rendered complete. We must therefore pass on.

## CHAPTER X

### PTOLEMY AND PLACIDUS

It is generally conceded that the system of directing which has so far occupied our attention first originated as a measure of time in the mind of Claudius Ptolemy, the famous geographer, mathematician and astronomer of Alexandria, who flourished in the second century of our era, and wrote a standard work on the subject of astrology called in the Greek *Tetrabiblos*, and in the Latin *Quadripartite*, being four books on the Influence of the Stars. He also wrote the *Syntaxis* and the *Almagest*, which, together with his work on astrology, have been translated into every language in Europe and into many Oriental languages also.

From the writings of Sir Isaac Newton we have evidence that there were many sources of information open to Ptolemy in the pursuit of astrological knowledge, and there is no reason to suppose that he did not avail himself of them fully, for none has ever suggested that astrology as a science was first promulgated by him. But it may certainly be

affirmed that Ptolemy gave to the Western world the first scientific exposition of the subject. There are two Latin editions of the work and one in Greek. The best translation that we have is the paraphrase of Proclus from the Greek text rendered into English with extensive commentary by J. M. Ashmand, and recently published as a supplement to *Coming Events*. Ashmand has followed the Elzevir text, dated 1635.

The name of Claudius Ptolemy will be revived wherever astronomy and astrology are studied. It is enough for the purpose of this sketch to note that he was born at Pelusium in Egypt, and became a brilliant disciple of the Alexandrian School. It appears that he was born about the year 80 A.D., flourished during the reigns of Adrian and Antoninus Pius, and died in the seventy-eighth year of his age.

Of Placidus de Titus, who first rendered a studied version of Ptolemy's work on astrology, we have very little information. It appears that he was known as Didacus Placidus, and was a native of Bologna, became a monk, and was appointed mathematician to the Archduke Leopold William of Austria. He wrote in the early part of the seventeenth century a work entitled the *Primum Mobile*, in which he gives a thorough digest of the teaching of Ptolemy. The best English translation is by Cooper. Placidus showed that Ptolemy recognised two sets of directions arising out of



two sets of planetary positions, one in the zodiac and the other in the world, *i.e.* in the prime vertical. To Placidus remains the credit of having elaborated that part of directional astrology which has regard to directions in mundo.

Ptolemy makes it clear in his chapter on the "Number of the Modes of Prorogation" (bk. iii., ch. xiv.) that "when the vital prerogative is vested in the Ascendant, the anareta or killing planet may be brought to it by oblique ascension; and if it be vested in the Midheaven or a body there situate, then direction is to be made by right ascension. If on the occidental horizon, the degrees of oblique descension are to be reckoned. But if not in either of these three places, but in some intermediate station, it should be observed that 'other times' will bring the succeeding place to the preceding one, and not the times of ascension or descension nor of meridian transit as already declared.

"For, if it be desired to calculate agreeably to nature, every process of calculation that can be adopted must be directed to the attainment of one object—that is to say, to ascertain in how many equatorial times the place of the succeeding body or degree will arrive at the position preoccupied at the birth by the preceding body or degree, and, as equatorial times transit equally both the horizon and the meridian, the places in question must be considered in regard to *their proportionate*

*distances from both these, each equatorial degree being taken to signify one year."*

Here Ptolemy makes it clear that he directs a body in the heavens to one that precedes it, or a body to a degree that precedes it, which direction is formed by the diurnal rotation of the Earth on its axis from west to east. He also makes it clear that he uses the proportionate distances of bodies from both the horizon and meridian as the basis of the calculation, and the arc of direction is the intervening degrees (equatorial) between them, at the rate of one equatorial degree for a year of life.

It is evident, therefore, that he takes a proportion of the semiarcs, or, as he calls them, "the horary times," of the planets involved. These arcs he describes as parallel to one another and to the Equator, but cutting the circle of the horizon at various degrees of obliquity.

Obviously, therefore, we have to take proportion of their semiarcs and meridian distances, exactly as we have been instructed in the foregoing exposition; and as these semiarcs are regulated by the latitude of the place of birth and the corresponding ascensional differences of the planets, the positions of the bodies will have respect to the prime vertical and will be their apparent places in the plane of that circle. But it is important to note that Ptolemy says nothing concerning converse directions, whether in mundo or in the zodiac.

That he recognises the mundane position of a body as distinguished from the apparent place of its "degree" of longitude is obvious from his mentioning both in the same sentence; and we distinguish ourselves between the mundane and zodiacal conjunctions only by reference to the body of the planet in the first instance and its longitude in the other case.

To Claudius Ptolemy, therefore, may rightly be accorded the honour of having set astrologers upon the right track with regard to the correct measure of time by reference to the equatorial degrees separating one body from another, or one body from the longitude or aspect of another, as seen from the place of birth.

There is little doubt, from the illustrations of his method that Ptolemy gives, that he uses the "ascensional" times in all cases due to the latitude of the place of birth; and this method serves very well not only for directions to the Ascendant and Descendant, but also for intermediate positions when the planets are in the same or different quarters and on the same side of the meridian, for then their arcs may be measured with great facility and approximate accuracy from the Tables of Houses alone.

#### *Illustration*

1. Bring the Sun to the place of Mars in the horoscope of Ruskin.



	h.	m.
The sidereal time on the Midheaven		
when Mars' place rises is . . .	15	49
That when the Sun rises is . . .	16	44
	<hr/>	
Difference in R.A. on the Mid-		
heaven in S.T. . . . .	0	55

Divided by 4, this gives  $13^{\circ} 45'$  as the arc of direction.

The same arc of direction when exactly calculated by the semiarc method is  $13^{\circ} 49'$ .

2. Bring the Sun to the conjunction with Venus in zodiac.

	h.	m.
The S.T. at sunrise (as above) is . . .	16	44
That when Venus' place rises is . . .	14	35
	<hr/>	
Difference . . . . .	2	9

This gives an arc of  $32^{\circ} 15'$ .

3. Bring Saturn to the place of Sun in zodiac.

The declination of Saturn is  $6^{\circ} 54'$  S., and this answers to the longitude of Pisces,  $12^{\circ} 37'$ .

	h.	m.
S.T. on Midheaven when this point		
rises . . . . .	17	30
S.T. on Midheaven when Sun rises . . .	16	44
	<hr/>	
Difference . . . . .	0	46

This gives an arc of  $11^{\circ} 30'$ .

4. Bring the Moon to the opposition of Venus in zodiac.

The declination of the Moon is  $25^{\circ} 39'$ , which exceeds that of any degree of the zodiac owing to the Moon's extreme latitude north added to the declination of its longitude. But reference to the Tables of Ascensional Difference and Right Ascension will show that its oblique descension answers to the twelfth degree of the sign Leo, which is the same as the oblique ascension of Aquarius  $12^{\circ}$ . Then the arc between the place and Venus in zodiac and Aquarius  $12^{\circ}$  will be the arc of direction. Thus :

	h.	m.
S.T. on Midheaven when Venus long.		
rises . . . . .	14	35
S.T. on Midheaven when the 12th of		
Aquarius rises . . . . .	16	30
Difference . . . . .	1	55

This gives an arc of  $28^{\circ} 45'$ .

5. Bring the Sun to the opposition of Uranus in zodiac.

Take the opposite degree of the zodiac to that held by Uranus, and bring the Sun to it by oblique arc.

	h.	m.
S.T. when Gemini $23^{\circ} 25'$ rises . . . . .	21	21
S.T. when Sun rises . . . . .	16	44
Difference . . . . .	4	37

This gives an arc of  $69^{\circ} 15'$ .

6. Bring Sun to par. Uranus in zodiac direct.

The declination of Uranus is  $23^{\circ} 24'$ , which answers to that of Cancer  $4^{\circ}$ . Find the arc between this and the Sun.

	h.	m.
S.T. on Midheaven when Cancer $4^{\circ}$		
rises . . . . .	22	6
S.T. on Midheaven when Sun rises		
in Aquarius $18^{\circ} 45'$ . . . . .	16	44
Difference . . . . .	5	22

This gives an arc of  $80^{\circ} 30'$ .

These examples will serve to show that without recourse to the elaborations of a speculum or the use of proportional logarithms in the computation of proportional arcs, Ptolemy could, by the mere use of a table of ascensions under any latitude, find the time of an indicated event within an arc of  $30'$  and even less, which, having regard to the approximations which are frequently adduced as "arcs for the event" when both are accurately known, show that they would serve for all practical purposes. I most frequently calculate arcs of direction in this manner, bringing out the results to the nearest quarter of a degree, which measures to three months of time. Ptolemy had constructed such tables, as appears from his *Almagest*, and this is obviously the method he used. In other words, he recognised no other directions than those that could be calculated by the difference of the oblique ascensions of the planets and of their longitudes,



taking the oblique ascension of their opposite degrees when the arc was formed by descension of a body.

A table of oblique ascensions such as that published by Worsdale enables the calculation to be made with even closer exactness. It has only to be remembered that when we are directing the body of a planet to the body or longitude of another, the longitude corresponding to its declination must be dealt with, and not the longitude of the body itself, as the above examples will sufficiently indicate.

## CHAPTER XI

### DIRECTIONS UNDER POLES

THIS method has been much advocated, and especially by Mr R. C. Smith, the first of the almanac writers under the pen-name of "Raphael." It consists in directing a significator under its own pole instead of under the pole of the place for which the horoscope is cast.

#### *To find the Pole of a Planet*

Take its R.A., declination, and semiarc.

Then say :

As the semiarc is to  $90^\circ$ ,

So is its meridian distance

To the difference of its circle of position and  
the meridian.

And this difference, compared with its meridian distance, will give its ascensional difference under its own pole.

Then having this and also its declination, from the sine of its ascensional difference under

its own pole take the tangent of its declination, and the remainder will be the tangent of its pole.

*Example.*—In the horoscope of Ruskin find the pole of the Sun.

The R.A. of Sun is  $321^{\circ} 12'$ , the meridian distance (below)  $108^{\circ} 44'$ , the semiarc  $110^{\circ} 1'$ , and the declination  $15^{\circ} 13'$ .

Semiarc $110^{\circ} 1'$	. . .	prop. log.	0.21381
			9.78619
		Arith. comp.	. 9.78619
Quadrant of $90^{\circ}$	. . . . .		0.30103
Meridian distance	. $108^{\circ} 44'$		0.21891
			0.30613
Difference	. $88^{\circ} 57'$		0.30613
Asc. diff. under pole	$19^{\circ} 47'$	log. sine	9.52951
Sun's declin.	. $15^{\circ} 13'$	log. tang.	9.43458
			10.09493
Pole of Sun	. . . = $51^{\circ} 13'$	log. tang.	10.09493

It is thus seen that the pole is measured along the tangent by its distance from the meridian or nadir, according as the body may be above or below the Earth at the time. At the meridian the pole would be 0, and at the horizon it would be the same as the latitude. Here "pole" is the same as polar elevation. The difference  $88^{\circ} 57'$  indicates the place of the circle of position from the



plane of the meridian circle. Circles of position are small circles which are parallel to the great circle of the meridian and at right angles to the great circle of the horizon. They are like lateral circles of latitude in relation to which the meridian stands as equator and the Ascendant and Descendant as poles. Hence, if a planet be on the cusp of a house, it will have the same pole as that house.

Having calculated the poles of all the planets, and of the Sun and Moon, direction of one to another of them is thus made.

*Rule.*—Take the oblique ascension (or descension, as the case may be) of the promittor or body directed to under the pole of significator, and the difference of this from the oblique ascension (or descension) of the significator under the same pole is the arc of direction.

To find the oblique ascension of a body under the pole of another directed to it, to the log. tang. of its declination add the log. tang. of pole of the body directed, and the sum will be the log. sine of its ascensional difference under that pole. From this its oblique ascension can be found by referring it to its R.A. according to the rule (see “Definitions,” Chapter I.).

*Example.*—Direct the Sun in the example horoscope to the place of Venus in the zodiac.

The declination of Capricorn  $5^{\circ} 49'$  is  $23^{\circ} 20'$ . The Sun's pole is  $51^{\circ} 13'$ . Then—

Pole of Sun, $51^{\circ} 13'$ . . .	log. tang.	10.09493
Dec. Venus long. . . . .	log. tang.	9.63484
<hr/>		
Asc. diff. of aspect $32^{\circ} 28'$	log. sine	9.72977
R.A. of aspect . $276^{\circ} 20'$		
<hr/>		
O.A. of aspect . $308^{\circ} 48'$	under pole of Sun.	
O.A. of Sun . $340^{\circ} 59'$	under its own pole.	
<hr/>		
Diff. . $32^{\circ} 11'$	=arc of direction.	

Applying this method to the hint I have already given as to the use of tables of oblique ascension, or tables of houses for various latitudes, we can calculate this arc perfectly well with a table of the houses for latitude  $51^{\circ} 13'$ , which is the pole of the Sun. And we can calculate all the solar arcs by this means from the same table. Then if we find the pole of the Moon, and refer to the Table of Houses for equivalent latitude, we shall be able to take out all the directions of the Moon under its own pole. The directions of the Ascendant will, of course, be made under the pole of the place of birth, and those of the Midheaven by right ascension only. So that what appears at first a complex and exhaustive piece of work can readily be done by tables of houses, or tables of oblique ascension for various latitudes, in next to no time, as the saying is. And this, I think, may be adjudged the most popular contribution to the theory

and practice of primary directions that I have been able to make.

*Example.*—Direct the Sun under its own pole to the opposition of Uranus in the zodiac.

The Sun's pole is  $51^{\circ} 13'$ . Therefore take in hand the Tables of Houses or the Tables of Oblique Ascension for latitude  $51^{\circ} 13' N$ .

The opposition of Uranus falls in Gemini  $23^{\circ} 25'$ .

	h.	m.
S.T. on Midheaven when Gemini		
$23^{\circ} 25'$ rises . . . . .	21	21
S.T. when Sun's place rises . . . . .	16	43
	<hr/>	
	4	38

This converted into arc of R.A. =  $69^{\circ} 30'$  = arc of direction.

*Example.*—Direct the Sun under its own pole to Venus in the zodiac. Pole of Sun =  $51^{\circ} 13'$ .

	h.	m.
S.T. on Midheaven with Sun		
rising . . . . .	16	43
S.T. on Midheaven with Capri-		
corn $5^{\circ} 49'$ rising . . . . .	14	35
	<hr/>	
Arc of direction, Sun conj. Venus		
zodiac = difference . . . . .	2	8

This is equivalent to  $32^{\circ} 0'$ .

By exact calculation we found it formerly to be  $32^{\circ} 11'$ . The difference is inconsiderable from the point of view of probable time of the event.



As to the merits and demerits of these divergent systems of directing, I leave my readers to decide for themselves. *Experientia docet*. I hold no brief for either system, my business being merely to represent and to simplify. This I think I may claim to have done.

The system of directing under the semiarcs in the prime vertical is that which was followed by Ptolemy. The system of directing under the poles of the planets is of considerably more recent origin, and dates to the seventeenth century only. It consists, as will be seen, in directing in the circle of observation due to the pole of the significator or planet directed. The difference is that which one may note as between the tables of houses for one latitude and another. Nothing is simpler or more demonstrable. I leave it at that.

But in general practice it will be found that equally close results may be obtained by simple proportion and the use of the tables. Take the following hint for what it is worth. I am quite satisfied in my own mind that what we call primary directions seldom or never operate exactly to time, and if we correct the observed time of birth by one direction for an event we shall find that subsequent directions are not on schedule time. We have to allow a latitude for the operation of these directions. Such being the case, and, in the experience of the best artists, the import of primary directions being accelerated or retarded by the

secondary directions and transits, we do not need to observe scruples. Approximations are always valuable.

The following may be regarded as the *via latitia* in primary directing:—

*Rule 1.*—As the semiarc of the planet whose pole is required is to  $90^\circ$  of the prime vertical, so is the distance of the body in right ascension from the meridian (upper or lower as the case may be) to its proportional distance in the prime vertical.

*Rule 2.*—From the sine of their difference subtract the tangent of the planet's declination. The remainder is the tangent of its pole.

*Rule 3.*—For all directions under the pole of that planet or significator use the Tables of Houses for that latitude which answers to its pole.

*Rule 4.*—Find the difference between the ascension of the body (by sidereal time or right ascension on the Midheaven) and that of the planet directed to. This will be the arc of direction.

*Note.*—If the planets involved or the positions involved are between the tenth and fourth westward, take the ascensional degrees of the opposite places.

*Rule 5.*—Direct the Midheaven by right ascension only, and the Ascendant by oblique ascension under the latitude of birth. Direct the Sun under its own pole and the Moon under its own pole. This completes the entire scheme of primary directing.

*Example.*—In the horoscope of Ruskin the Sun

was found to have a pole equal to the latitude of  $51^{\circ} 13'$  N. (see p. 72). It must therefore be directed under the Ascendant of  $51^{\circ} 13'$ . Similarly, the Moon, whose pole is  $47^{\circ} 27'$ , must be directed under the latitude of that degree. A significator on the Midheaven would thus be directed by right ascension only, as stated by Ptolemy (see p. 64).

For directions of the Sun to other bodies, therefore, we use the Tables of Houses for  $51^{\circ} 13'$ . Those for Taunton are  $51^{\circ} 1'$ , which is deemed near enough.

1. Direct the Sun to Jupiter in the horoscope.

	h.	m.
S.T. on Midheaven with Sun rising	16	41
S.T. on Midheaven with Jupiter's long.		
rising . . . . .	15	55
		<hr style="width: 100%;"/>
Arc of direction = $11^{\circ} 30'$ , equi-		
valent to S.T. . . . .	0	46

2. Direct the Sun to Mars.

	h.	m.
Sun rising as before, S.T. on Midheaven	16	41
Mars rising, S.T. on Midheaven . . . . .	15	43
		<hr style="width: 100%;"/>
Arc of direction = $14^{\circ} 30'$ . . . . .	0	58

3. Direct the Sun to Mercury in zodiac.

	h.	m.
Sun's rising as before . . . . .	16	41
Mercury's longitude rising . . . . .	15	39
		<hr style="width: 100%;"/>
Arc of direction = $50^{\circ} 30'$ . . . . .	1	2



## 4. Direct the Sun to Venus' longitude.

	h.	m.
Sun's rising as above . . . . .	16	41
Place of Venus rising . . . . .	14	30
	<hr/>	
Arc of direction = $32^{\circ} 45'$ . . . . .	2	11

## 5. Direct the Sun to Neptune in zodiac.

	h.	m.
Sun's rising as before . . . . .	16	41
Neptune's long. rising . . . . .	13	59
	<hr/>	
Arc of direction = $40^{\circ} 30'$ . . . . .	2	42

## 6. Direct the Sun to Uranus in zodiac.

	h.	m.
Sun's rising as above . . . . .	16	41
Uranus' long. rising . . . . .	13	36
	<hr/>	
Arc of direction = $46^{\circ} 15'$ . . . . .	3	5

## 7. Direct the Sun to opposition of Moon in zodiac.

	h.	m.
Sun's rising as before . . . . .	16	41
Rising of Capricorn $27^{\circ} 8'$ , S.T. . . . .	15	47
	<hr/>	
Arc of direction = $13^{\circ} 30'$ . . . . .	0	54

The various aspects to these promissors can be picked up *en route* as we bring the Sun from the horizon to the Midheaven, which it reaches in an arc of  $69^{\circ} 59' = 70$  years nearly.

We cannot direct Sun to Saturn by the diurnal motion of the Earth, and so we must bring Saturn

up to the Sun's place. This involves knowing the pole of Saturn.

We may also bring Saturn to the Ascendant under its own pole. But if we were to bring the Sun to Saturn under the Sun's pole, that would be a *prenatal direction*, for the Sun cannot go back from the position it has attained and sink below the eastern horizon. We have therefore no alternative but to regard these directions as invalid, or to admit the thesis already suggested, that in these directions, made contrary to the apparent motion of the bodies in the heavens, we are dealing with the localised impress of the planet at the moment of birth, which impress is carried by the Earth up the western heavens and down the eastern heavens, so that the Sun's localised imprint is here carried down to the place of Saturn. And this is conformable to the theory of directions under the poles of the significators.

## CHAPTER XII

### THE PART OF FORTUNE

FOR a considerable time there was much discussion as to the correct method of finding the place of the Part of Fortune. This, it should be explained, is one of the old Arabic points, which, like the Pomegranate, the Sword, and others, were regulated by the distances of the several bodies from the Sun in the zodiac, the particular point referred to being the same distance in zodiacal degrees from the Ascendant.

It was when astrologers came to apply this theory to the system of primary directions in vogue that the trouble arose as to the correct method of computing this point.

I think that the easiest expression of the case is this :—the Part of Fortune is a mundane point answering to the distance of the Moon from the Sun in the zodiac. Thus in the horoscope of Ruskin the Moon wants  $21^{\circ} 38'$  from the opposition of the Sun, and therefore the Part of Fortune will be  $21^{\circ} 38'$  below the western horizon in mundo.



Its mundane position will therefore be  $8^{\circ} 22'$  inside the 6th house.

Its meridian distance will be  $68^{\circ} 22'$ , and its pole  $39^{\circ} 13'$ . Under this pole we may direct it to aspects in the zodiac, and in mundo. It has been suggested that the Part of Fortune cannot be directed, but can only receive directions from other significators and the planets. This is surely nonsense. Any point in the heavens having been defined and located is carried by the motion of the Earth on its axis from its radical place to others successively in a direction that is contrary to the rotation of the Earth. Hence the Part of Fortune will here be carried down the heavens from the 6th to the 5th and from that to the 4th house successively, forming both mundane and zodiacal aspects under its own pole. The pole of the Part of Fortune and that of Saturn being near to one another, they must be near a mundane parallel, on the same side of the horizon.

There are, however, other suggested methods of taking the place of the Part of Fortune.

Ptolemy says (bk. iii., ch. xii.): "The Part of Fortune is ascertained by computing the number of degrees between the Sun and Moon, and it is placed at an equal number of degrees from the Ascendant in the order of the signs. It is in all cases, both by day and night, to be computed and set down, that the Moon may hold with it the same relation as that which the Sun may hold with

the Ascendant; and it thus becomes, as it were, a lunar horoscope or Ascendant."

It is therefore clear that Ptolemy intended degrees of oblique ascension or descension, and not merely degrees in the zodiac, the relations of which, in regard to the horizon of any place, are continually changing.

Thus in the horoscope of Ruskin we have—

O.A. of Sun	. . .	341° 13'	
O.D. of Moon	157° 26'		
	add 180° 0'	337° 26'	
		3° 47'	Moon to oppos. Sun.
O.D. of 7th	. . .	159° 56'	
		156° 9'	O.D. of Part of Fortune.

This gives us a position answering to the 10th degree of Leo, and therefore close to the Moon.

Placidus says: "Let the Sun's oblique ascension taken in the Ascendant be subtracted always from the oblique ascension of the Ascendant, as well in the day as in the night, and the remaining difference be added to the Moon's right ascension; the sum will be the right ascension of the Part of Fortune, which will have the Moon's declination."

In the example horoscope the oblique ascension of the Ascendant is 339° 56', from which take the Sun's oblique ascension 341° 13' (adding 360 for subtraction), and the remainder is 358° 43', which

add to the right ascension of the Moon  $120^{\circ} 17'$ , and the sum is the right ascension of the Part of Fortune  $119^{\circ} 0'$ .

The right ascension of the *imaum cœli* being  $69^{\circ} 56'$ , the meridian distance of the Part of Fortune will be  $49^{\circ} 4'$ , and its semiarc will be that of the Moon,  $52^{\circ} 51'$ , as it has the same declination as the Moon in all cases. Then semiarc  $52^{\circ} 51' - 49^{\circ} 4' = 3^{\circ} 47'$ , which is the same as we derived from the method of Ptolemy. For there we found the oblique descension of the Part of Fortune to be  $156^{\circ} 9'$ ; and the oblique descension of the 7th being  $159^{\circ} 56'$ , the difference is  $3^{\circ} 47'$ .

The method of Placidus appears preferable in that we derive at once the right ascension and meridian distance of the Part of Fortune.

The question is, however, whether either is true, and only directions made by the position as thus derived can settle the point in debate.

To enable the student to at once work out the primary arcs, we here append the speculum in the example horoscope :

R.A.	Ner. Dist.	Semiarc.	Horiz. Arc.	Cusp. Dist.
$119^{\circ} 0'$	$49^{\circ} 4'$	$52^{\circ} 51'$	$3^{\circ} 47'$	$3^{\circ} 47'$

These elements at once suggest that the pole of the Part of Fortune can be found, and direction made by the Part of Fortune in mundo and



zodiac to the planets, just as if it were a definite body.

The fact that it is merely a symbol, a point in space, does not in the least invalidate its significance in human affairs, as some impulsive students have suggested. For what else are the degrees of the zodiac known as the Midheaven and Ascendant? They are points in space which bear a definite relationship to a particular place at a given time. They do not need to be identified with a star in the heavens in order to obtain a significance in the horoscope. Every tyro in astrology knows as an absolute fact that these points have a very demonstrable significance in a horoscope, and that transits of the major planets over these points, and the passing of these points by planets in direction, are attended by events which leave no shadow of doubt that they are an essential part of the signalling apparatus by which we are forewarned of coming events. And if these, why not the Part of Fortune? Call it a "myth" if you like, but understand that a myth is a "veil" designed to hide a truth which a symbol is said to embody. The symbol handed down to us is identical with that used in China and also in Egypt to indicate "land, territory, a field."

## CHAPTER XIII

### LUNAR PARALLAX AND SEMI-DIAMETER

AMONG the problems modernly confronting the student of directional astrology, that of the horizontal parallax of the Moon is perhaps one of the most important and at the same time most perplexing.

The places of the planets as indicated in the horoscope are the geocentric longitudes. They are computed from the standpoint of an observer. But as the place of observation is on the surface of the Earth and not at its centre, the observed position of the Moon will not exactly coincide with its computed geocentric longitude. In the case of the Sun and planets, the distances from the Earth are so great as to render the parallax inconsiderable, that of the Sun being only 9", and the parallaxes of other bodies beyond it being proportionately less. But in regard to the Moon, its nearness to the Earth renders its parallax of importance if we are to regard the Moon as affecting us by its direct ray. The nearer the Earth it may be, the greater is the angle of parallax. It is

therefore greatest at the perigee and least at the apogee of the Moon.

As the amount of parallax depends on the Moon's place in its orbit, we make use of the apogee as a point of departure, and the Moon's distance from that point in its orbit where it is furthest from the Earth is called its anomaly.

By comparing the calculated place with the observed place it has been found that the difference of the two at the apogee is  $53' 53''$ , and at perigee  $61' 23''$ . It will be sufficient for our purpose if we call these  $54'$  and  $61'$  respectively. By the use of the "Ready Reckoner" the amount of the anomaly can always be found for any date or hour, and the corresponding parallax is set against it. The table is here repeated for convenience.



TABLE OF ANOMALY.

Epoch 1800, Jan. 0<sup>d</sup> 0<sup>h</sup> 0<sup>m</sup> = 9<sup>s</sup> 20' 20".

Years.	Add.	Days.	Add.	Anom.	Hor. Par.
	s o /		s o /	s o /	'
1	2 28 43	1	0 13 4	0 0	54
2	5 27 27	2	0 26 8	6	55
3	8 26 10	3	1 9 12	12	55
4	0 7 57	4	1 22 16	18	55
5	3 6 40	5	2 5 19	24	55
6	6 5 24	6	2 18 23	1 0	55
7	9 4 7	7	3 1 27	6	55
8	0 15 54	8	3 14 31	12	55
9	3 14 38	9	3 27 35	18	55
10	6 13 21	10	4 10 39	24	56
20	1 9 46	11	4 23 43	2 0	56
40	2 19 32	12	5 6 47	6	56
50	9 2 53	13	5 19 51	12	56
60	3 29 18	14	6 2 55	18	57
70	10 12 39	15	6 15 58	24	57
80	5 9 3	16	6 29 2	3 0	57
90	11 22 24	17	7 12 6	6	58
100	6 18 49	18	7 25 10	12	58
Months.	Add.	19	8 8 14	18	59
		20	8 21 18	24	59
January .	0 0 0	21	9 4 22	4 0	59
February .	1 15 1	22	9 17 26	6	59
March .	1 20 50				
April .	3 5 51	23	10 0 30	12	60
May .	4 7 48	24	10 13 34	18	60
June .	5 22 49	25	10 26 37	24	60
		26	11 9 41	5 0	60
July .	6 24 46				
August .	8 9 47	27	11 22 45	6	60
September .	9 24 48	28	0 5 49	12	60
October .	10 26 45	29	0 18 53	18	61
November .	0 11 45	30	1 1 57	24	61
December .	1 13 42	31	1 15 1	6 0	61

*Example.*—Find the Moon's anomaly for 8th February 1819, and the corresponding horizontal parallax.

	°	'
Epoch 1800 . . . . .	9	20 20
Add 19 . . . . .	9	27 59
February . . . . .	1	15 1
8 days . . . . .	3	14 31
		<hr style="width: 50%; margin: 0 auto;"/>
Anomaly =	0	17 51

The Moon is therefore within  $18^\circ$  of its apogee or furthest distance from the Earth, and its parallax will therefore be near its minimum. Our table shows that the parallax due to this anomaly is  $55'$ . This would be the difference between the Moon's geocentric longitude and its observed position from the surface of the Earth if it were exactly on the horizon. At the meridian the parallax is 0, and at the horizon it differs, as stated, from  $54'$  to  $61'$  according to the distance of the Moon from the Earth, *i.e.* its place in its orbit.

Now, as the horizon is at all points  $90^\circ$  from the zenith or nadir, we can make one of these the apex of a triangle, of which the zenith distance of the Moon at transit is the perpendicular and the base its meridian distance. From these we may find the hypotenuse, which will be the Moon's zenith distance at the time of birth.

Thus, in the example horoscope the latitude of the place is  $51^\circ 30'$  N., and the Moon has latitude

$5^{\circ} 1' N.$ , which therefore must be subtracted, leaving  $46^{\circ} 29'$  as the zenith distance of the Moon at transit of the nadir. Its meridian distance is found from the speculum to be  $50^{\circ} 21'$ . Then

Log. cosine $50^{\circ} 21'$ .	. 9.80489
Log. cosine $46^{\circ} 29'$ .	. 9.83794
	<hr/>
Log. cosine $63^{\circ} 52'$ .	. 9.64283

And as  $90^{\circ}$  is to  $55'$ , so is  $63^{\circ} 52'$  to  $39'$ , which is the Moon's parallax, and by which amount she is apparently depressed further below the horizon than she is computed to be. This will affect its meridian distance, etc. The directions of the Moon, if operating dynamically by right lines of energy upon any part of the Earth instead of *via* the centre of the Earth, will hence be affected; and it remains a problem worth some close study and consideration as to what view ought to be taken. It is sufficient here to have indicated the method of calculation. It is one of the factors in the vexed problem of "the uncertain Moon," which has frequently been charged with an inconstancy altogether absent from the directions of the Sun and planets.

The semi-diameters of the Sun and Moon have often been resorted to in order to accommodate a directional arc to the date of an event. Allowing, as is undoubtedly the case, that primary directions have an orb of influence within the limits of which



it may be said they begin to operate, attain their maximum, and pass off, there yet remains the fact that one would naturally expect the maximum to coincide with the most marked phase of a crisis in the life. This appears to be acknowledged, inasmuch as practitioners in the art of directing make use of arcs of direction, measured from the centres of bodies as determined by their longitudes, in order to correct approximate times of birth. This correction can only be legitimately made on the supposition that arcs of direction are close, if not exact, to the time of the events they are held to signify.

And unless there were this fundamental integrity of the system of direction advocated, unless there was a close agreement throughout a life between the arcs of direction and the events portrayed, there would be no use in making the calculations.

Our longitudes are geocentric and apply to the apparent centre of the bodies. The apparent diameter of the larger planets, on account of their great distance from the Earth, is inconsiderable. But when we come to the Sun and Moon, which are the chief signifiers, and the bodies that are directed to form the aspects of the promissors, we are concerned with orbs that have a visible diameter. The Sun on account of its immense size, and the Moon on account of its close proximity, appear to have a diameter of about half a degree, or from the centre to the limb about 15'. This becomes an

important consideration when we are directing either of them to the aspect or conjunction of one of the planets, inasmuch as from first to last contact of the disc of the luminary with the said planet or aspect there will be an included arc of half a degree, and this means six months of time according to the Ptolemaic measure of  $1^{\circ}=1$  year. Hence it may well be that a direction is increscent for three months before it attains its actual centrality and maximum strength, and another three months may transpire before the effects wear off. And if to this we add the fact that directions formed at the tropics, *i.e.* near Cancer or Capricorn 0, are very slow in formation (as may be seen from the Tables of Declination),  $4^{\circ}$  of longitude including only  $1'$  of declination, it will readily be understood that there is ample room for "latitude" in the timing of events.

It seems desirable, therefore, that a few cases of very well-observed birth-times should be taken, and the arcs of direction computed very closely; and then that these arcs should be compared with the course of events, so that an estimate of the value of the semi-diameters of the Sun and Moon may be made.

The apparent semi-diameter of the Moon is controlled by the same factor as the parallax, namely, its place in the orbit and consequent distance from the Earth. It may be useful to mention that the semi-diameter of the Moon is

approximately twenty-seven one-hundredths of the parallax. Therefore multiply the parallax by 27 and divide by 100. Thus, when the parallax is 54', the semi-diameter of the Moon is  $54 \times 27 \div 100 = 14\frac{1}{2}'$ , and when the parallax is 60, the semi-diameter is  $60 \times 27 \div 100 = 16'$ .

The Moon directed to the opposition of the Ascendant in the example horoscope works out at  $2^{\circ} 30'$ ; but as the horizontal parallax of the Moon is 55', its semi-diameter will be nearly 15', and therefore the direction would read:

Asc. oppos. Moon in mundo,	first contact	$2^{\circ} 15'$
„ „	middle	$2^{\circ} 30'$
„ „	last contact	$2^{\circ} 45'$

thus giving a possible range of 30', or six months for the duration of this indication. This may help to account for the variability that has been noticed in regard to lunar directions, and possibly we may also have to consider taking the parallax into account. The solar directions will be affected by semi-diameter of the Sun, but not appreciably by parallax.



## CHAPTER XIV

### LUNAR EQUATIONS

UNDER this head I propose to examine a problem of some interest which appears to have escaped general recognition, but which may very well be considered with the questions of parallax and semi-diameter as having some connection with the noted irregularity of primary lunar directions.

Take an illustration from the horoscope already submitted. We would direct the Moon to conjunction with the nadir, which direction is known as "Midheaven opposition Moon in mundo." It is measured by the arc of the Moon's meridian distance,  $50^{\circ} 21'$ , and is formed by the rotation of the Earth on its axis, by which the Moon is carried down the western heavens until it makes its meridian transit.

The theory underlying this direction is that there is a permanent significance and value attaching to the radical positions of the Midheaven, Ascendant, and other significators, which is unaffected by the subsequent changes taking place amongst the planets, either on account of their apparent motions

in the heavens or their real motions in the zodiac. But we have now to consider whether there may not be some value attaching to these subsequent motions of the bodies in the zodiac. These motions, within the narrow limits of time comprised in the formation of directions in a life of ordinary length, would not be appreciable in the case of the planets or the Sun, but in the case of the Moon there would be a quite appreciable increment owing to the velocity of that body in its orbit.

Thus the arc of  $50^{\circ} 21'$  cited above would occupy the interval of 3 hours 25 minutes, during which the Moon will have increased its longitude by about  $1^{\circ} 42'$ , so that it would not actually make the meridian transit for another 7 minutes, although its radical place would then be exactly on the nadir. Its right ascension will be increased by about the same amount, and therefore the actual arc of direction from the time of birth until the bodily transit of the nadir would be about  $52^{\circ} 3'$ . So far as this case is concerned it is worthy of notice that this arc of the second distance of the Moon to the opposition of the Midheaven, and therefore to the mundane square of the Ascendant, coincided exactly with a period of serious illness and trouble in the life of Ruskin, whereas the arc M.C. opposition Moon in mundo,  $50^{\circ} 21'$ , exactly coincided with the election of Ruskin to the Slade Professorship of Fine Art, a distinction which brought him into the highest position in his sphere of life.

Obviously, therefore, the second distance of the Moon is by far the most appropriate.

Let us look at another direction from the same point of view. Direct the Moon under its own pole to the opposition of Saturn.

The Moon's pole is $47^{\circ} 27'$ , and its ascensional difference under that pole, derived in the process of finding the pole, is . . . . .	$31^{\circ} 32'$
Its right ascension . . . . .	$120^{\circ} 17'$
	<hr/>
Its oblique descension under its pole . . . . .	$151^{\circ} 49'$
Add . . . . .	$180^{\circ} 0'$
	<hr/>
Oblique ascension of opposition Moon	$= 331^{\circ} 49'$

Then for Saturn's oblique ascension under the same pole—

Pole of Moon	
tang. . . . .	$10.03712$
Tang. Saturn's	
decl. . . . .	$9.08283$
	<hr/>
Ascl. diff. Saturn	
sine . . . . .	$9.11995 = 7^{\circ} 31'$
R.A. of Saturn . . . . .	$348^{\circ} 54'$
	<hr/>
O.A. of Saturn . . . . .	$356^{\circ} 25'$ under Moon's pole.
O.A. of Moon's oppos. . . . .	$331^{\circ} 49'$
	<hr/>
Arc. of Moon oppos. Saturn =	$24^{\circ} 36'$



This corresponds with Ruskin's leap into public estimation and fame, for which we have the arc of direction Sun sextile Midheaven in mundo. Most certainly the Moon to opposition Saturn could not be regarded as in the least degree akin to the nature of events then current in the life of the great artist.

But this arc took 1h. 38m. 24s. to complete, and during that time the Moon had increased its R.A. by some 49'; and as we are bringing Saturn up to the opposition of the Moon under the pole of the Moon, we shall have to curtail the direction by 49', which results in an arc of  $23^{\circ} 47'$ . This is nearly a year in advance of Ruskin's great advent, and may very well have coincided with a period of stress and indisposition.

The Moon to the opposition of Venus comes into force at about thirty years of age, or in the thirtieth year of life, when he married; but by adding the increment due to the time of direction to the radical place of the Moon we get an arc which falls out a whole year later, when it is certain Ruskin realised his disappointment.

The directions of the Sun during the course of sixty years would only be affected by an increment of 10', and they can always be relied upon; but the directions of the Moon are at present very unsatisfactory, and it has been thought that this question of second distances may serve not only to indicate why lunar primary directions are inconstant, but why also they appear to have a more

durable influence than those of the Sun. The suggestion is that from the time the direction is formed to the radical position of the Moon to the time that it is formed to the actual position of that body in the heavens, may be the extent of its duration; and during this period, which naturally increases in length as the age increases, transits and other secondary indications may come up repeatedly to reinforce the portents of the lunar direction and bring them into play. Certain it is that there are many conditions affecting the directions of the Moon which arise out of its velocity, and to maintain its ancient reputation for inconstancy and fickleness it appears to have jealously guarded its secret even from the lynx eye of the practical astrologer. Whether we have succeeded in compassing the fickle goddess by this exposition remains to be decided by constant experiment conducted by several independent workers. In the cause of a scientific astrology this is worth carrying out, and it is to be hoped that qualified and unprejudiced students will communicate their experience.

It may assist the average student to know that all directions of the Moon to *succeedent* places will fall out sooner, while those to *precedent* places will fall out later, than indicated by the radical or first distance of the Moon, and the arc of direction must therefore be increased or decreased at the rate of 2' for every degree of the arc of direction. Thus an arc of  $39^{\circ} 15'$  requires  $1^{\circ} 18\frac{1}{2}'$ .

## CHAPTER XV

### CUSPAL DISTANCES

WHEN giving instructions as to the method of directing bodies to aspects of the Ascendant and Midheaven in mundo, it is customary to affirm that one-third of a planet's semiarc is equal to a house-space, so that a planet that is one-third of its semiarc above the horizon is held to be on the cusp of the 12th house, and when two-thirds of its semiarc above the horizon it is on the cusp of the 11th. But if this were actually the case, we should find that when on the cusp of a house the oblique ascension of an ascending planet is the same as the oblique ascension of the cusp of that house. Such is not the case.

*Example.*—Direct the Sun in Ruskin's horoscope to the sextile of the Midheaven in mundo. This aspect falls on the cusp of the 12th house.

The semiarc diurnal of the Sun is  $69^{\circ} 59'$ , and one-third of this is  $23^{\circ} 20'$ , to which add the Sun's distance under the horizon,  $1^{\circ} 17'$ , and we get the arc of direction =  $24^{\circ} 37'$ . The Sun is then on the cusp of the 12th house presumably. Let us see.



The R.A. of the Midheaven is  $249^{\circ} 56'$ , to which if we add 60 we shall have the oblique ascension of the cusp of the 12th house,  $309^{\circ} 56'$ . Now, when the R.A. of the Midheaven is increased by an arc of  $24^{\circ} 37'$ , the oblique ascension of the cusp of the 12th will be increased by the same amount, and will then be  $334^{\circ} 33'$ , while the oblique ascension of the Sun is  $341^{\circ} 13'$ . Wherein lies the error?

It lies in the fact that we are directing the Sun under the pole of the Ascendant, whereas we should direct it under the pole of the 12th house cusp. I here give a table of the polar elevation due to the various houses in several latitudes, from which, by proportion of their parts, we may derive the pole of any house for any minute of the included latitudes.

POLES OF HOUSES.

Lat.	Cusps of 3, 5, 9, 11.	Cusps of 2, 6, 8, 12.
45	18 <sup>o</sup> 57'	34 <sup>o</sup> 11'
46	19 37	35 10
47	20 19	36 10
48	21 2	37 10
49	21 46	38 12
50	22 33	39 15
51	23 21	40 19
52	24 12	41 24
53	25 5	42 31
54	26 1	43 39
55	26 59	44 48

The pole of the 12th house for the latitude  $51^{\circ} 30'$  N. is seen to be  $40^{\circ} 51'$ , and if we direct the Sun under this pole we shall have the

Ascensional difference of Sun	
under pole of 12th . . . .	$13^{\circ} 36'$
Right ascension of Sun . . . .	$321^{\circ} 12'$
	<hr/>
Oblique ascension of Sun under	
pole of 12th . . . . .	$334^{\circ} 48'$
Oblique ascension of cusp of the	
12th house . . . . .	$309^{\circ} 56'$
	<hr/>
Arc of direction . . . . .	$24^{\circ} 52'$

This, although not exact, is certainly nearer, and seems to justify the method of directing under the poles of planets.

The fact, however, is that if we take a fixed pole for any house in a given latitude we shall always be in some degree of error, and for the simple reason that the semi-arcs of the planets, being parallel to the equator, do not lie in the same plane as the prime vertical, which is the circle we divide into twelve equal parts to form the houses of the heavens. Therefore an equal division of the prime vertical will not result in an equal division of the semi-arcs, and either we have to consider the poles of the houses as movable, or, as seems more consistent with the facts, we must regard the house-spaces as unequal. In other words, we shall find that the

time (measured by degrees of R.A.) that the Sun remains in successive houses is unequal, and the same is to be said of any other body. When, therefore, we take one-third of the semiarc of a planet as equal to one house-space, we are indulging in a free use of the metaphysical concept that "all circles are equal to one another," as defined by the doctrine of Correspondences. Against this I have nothing to say except that it is not mathematics.

Now, just as we take the Sun's oblique ascension under the pole of the Ascendant in order to find its distance from the horizon, so we must take its oblique ascension under the pole of the 12th house in order to find its distance from the cusp of the 12th, and its oblique ascension under the pole of the 11th to find its distance from the cusp of the 11th. Its right distance from the cusp of the 10th will be its arc to that cusp, since the meridian has no polar elevation. Thus :

The pole of the Ascendant is	. 51° 30'
The pole of the 12th house .	. 40° 51'
The pole of the 11th house .	. 23° 46'

The Sun's declination is 15° 13', log. tang. 9.64380, and if to this we add the tangent of the poles of the houses successively we shall have the sine of the ascensional differences of the Sun under these poles, which, added to its right ascension, will give its oblique ascension under those poles. These are :



O.A. of Sun under pole of 1st house .	341° 13'
O.A. of Sun under pole of 12th house	334° 48'
O.A. of Sun under pole of 11th house	327° 59'
R.A. of Sun under pole of 10th house	321° 12'

Then, to find the arc of direction between the Sun and any of these cusps, we merely subtract the oblique ascension of the one from the other. The oblique ascensions of the cusps are :

Of the Ascendant . . .	339° 56'
Of the 12th . . .	309° 56'
Of the 11th . . .	279° 56'
Of the Midheaven R.A.	249° 56'

Thus we have the following true arcs of direction of the Sun in mundo :

O.A. Sun under pole of Ascendant .	341° 13'
O.A. of the Ascendant . . .	339° 56'
<hr/>	
Arc of Sun to conjunction Ascendant	1° 17'
O.A. of Sun under pole of 12th . . .	334° 48'
O.A. of 12th house cusp . . .	309° 56'
<hr/>	
Arc of Sun to sextile Midheaven mundo	24° 52'
O.A. of Sun under pole of 11th . . .	327° 59'
O.A. of cusp of 11th . . .	279° 56'
<hr/>	
Arc of Sun to sextile Ascendant mundo	48° 3'
R.A. of Sun under Meridian . . .	321° 12'
R.A. of Midheaven . . .	249° 56'
<hr/>	
	71° 16'

And in all these cases the Sun will have the same oblique ascension as the cusp of the house to which it is directed, at the time of direction being completed. This is what we argue for and obtain.

Also we may find the degrees of R.A. which pass under the meridian while the Sun passes from the cusp of one house to the next, and thus the house-space of the Sun at its present declination.

As the whole diurnal arc of the Sun is less than 90, the house-space will be less than  $30^{\circ}$ .

Subtract the arc of direction of Sun conjunct Ascendant from the arc of direction Sun conjunct 12th = Sun sextile Midheaven. There remains  $23^{\circ} 35'$ , the house-space of 12th house.

Subtract the direction of the Sun to the 12th from that to the 11th; there remains  $23^{\circ} 11'$ , the house-space of the Sun in the 11th. Subtract the arc of direction Sun cusp of the 11th from the Sun conjunct Midheaven; there remains  $23^{\circ} 13'$ , the house-space of the Sun in the 10th.

And the three house-spaces added together =  $69^{\circ} 59'$ , which is the diurnal semiarc of the Sun.

Hence it appears that the mundane directions of planets must be taken in terms of the pole of the cusp to which they are directed. The cuspal distances of the planets must also be measured according to the same rule. This will affect all directions calculated by primary arcs on the semi-arc method now commonly in vogue.

But what appears of most vital importance as

a legitimate conclusion drawn from this critique is that the correct method of directing to any body is by oblique ascension under the pole of that body, which is quite different from taking the direction under the pole of the body directed. At the same time, it appears to dispose of the semiarc method, except as a valuable approximation. For nothing can be more certain than that the cusps of the houses, measured in the prime vertical, are  $30^\circ$  distant from one another by oblique ascension.

These conclusions agree entirely with our mathematics, for we have seen that the house-space of the Sun in the 12th, due to its declination, is  $23^\circ 35'$ ; and if to this we add the Sun's direction (from below) to the Ascendant= $1^\circ 17'$ , we have an arc of direction, Sun to conjunction cusp of 12th=Midheaven sextile Sun in mundo,  $24^\circ 52'$ , which is exactly what we found the direction of the Sun to be by oblique ascension when taken under the pole of the 12th house.

This proves, if anything can, not only that the correct method of directing is under the pole of the planet or position directed to, but also that the house-spaces are variable and depend on the several declinations of the planets, and thus on their oblique ascensions and descensions, taken under the poles of the successive houses.

By the semiarc method, taking one-third of a semiarc as equal to a house-space, we are dealing with an approximation which, although useful



and facile, is not mathematically correct. Rather than that bad habits should become popular, I have undertaken a somewhat lengthy demonstration of this point, which I consider to be now settled beyond further debate.

## CHAPTER XVI

### SUGGESTED METHOD OF TRUE DIRECTING

As the result of this examination of the various methods of directing, both by semiarc proportions and by oblique ascensions under the poles, we may come to the conclusion that all the disparities which vitiate the present methods can be disposed of if we proceed along the lines to which our conclusions point. For this purpose we shall require a speculum containing :

1. The right ascension of a planet.
2. Its declination.
3. Its pole.
4. Its ascensional difference under its own pole.

The first of these will, of course, be worked as usual. The declination will be that given in the ephemeris. The pole of the planet will be that derived in the usual way from the ascensional difference of its proportional place in the prime vertical taken under its own declination, as already shown. Its cuspal distance will be the difference between its oblique

ascension (or descension) taken under the pole of the cusp to which it is nearest and the oblique ascension of the cusp in the prime vertical. These are all the elements required for a complete calculation of all legitimate arcs of direction.

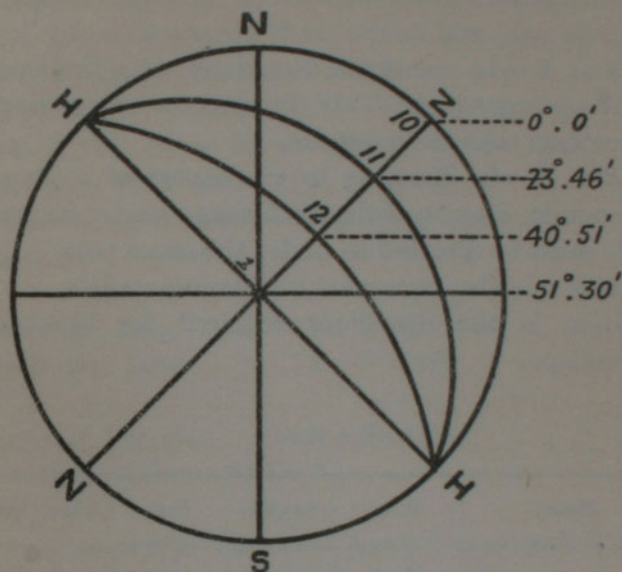
Directions must be made under the pole of the body to which we are directing another. The pole is the same as geographical latitude. It represents the latitude (geographical) or polar elevation (astronomical) at which the cusp of the house cuts into the circle of the prime vertical, or at which a circle of position cuts into it.

Thus in the following diagram let the great circle NZHS, etc., be the sphere of the Earth, of which N is the north pole, S the south pole. Also let ZN be the great circle of the prime vertical at an elevation from the Equator of  $51^{\circ} 30' N.$ , and H-H the horizon intersecting it at right angles. Then HNZH will be the upper meridian and HSNH will be the lower meridian, the points Z and N marking the zenith and the nadir. The cusps of the 10th, 11th, and 12th houses are shown by the great circles cutting through the prime vertical at different elevations, and these answer exactly to the geographical latitudes (north) of the same values. Thus the pole of the Ascendant is  $51^{\circ} 30'$ , that of the 12th,  $40^{\circ} 51'$ , that of the 11th,  $23^{\circ} 46'$ , and that of the 10th,  $0^{\circ} 0'$ , as shown in the diagram, the ascensional difference being the arc in R.A. between N-S and H-H.



## SUGGESTED METHOD OF TRUE DIRECTING 109

A circle of position is thus seen to be one which passes through a body and converges upon the



horizon north and south exactly like an intermediate cusp of a house.

### *Rules for Directing*

*Rule 1.*—Find the pole of the body or ecliptic position to which direction is to be made. Find the ascensional difference under this pole of the body to be directed. Apply this ascensional difference to the right ascension of the body to be directed, and obtain its oblique ascension (or descension, as the case may require) under the

pole of the body to which direction is made. The difference between this and the oblique ascension of the body to which direction is made, taken under its own pole, will be the *arc of direction*.

*Rule 2.*—In mundane directions take the body of the promittor, *i.e.* body directed to. In zodiacal directions take its longitude.

*Rule 3.*—In directing to the aspect of a planet in mundo, its cuspal distance taken under its own pole must be directed to under the same pole.

This rule also serves for mundane parallels.

Here is the Speculum required for Ruskin's horoscope.

## SPECULUM

Planet.	R.A.	Declin.	Pole.	Ascen. Diff.
Sun . . .	321 12	15 13 9-43458	51 13 10-09493	19 47
Moon . . .	120 17	25 39 9-68142	50 21 10-08147	35 24
Mercury . . .	296 47	21 34 9-59688	44 55 9-99885	23 13
Venus . . .	276 6	18 10 9-51606	27 13 9-71125	9 43
Mars . . .	299 6	21 45 9-60013	46 22 10-02066	24 44
Jupiter . . .	302 37	20 26 9-57119	47 13 10-03355	23 44
Saturn . . .	348 54	6 54 9-08283	45 56 10-01423	7 11
Uranus . . .	262 49	23 24 9-63623	3 13 8-74904	7 27
Neptune . . .	267 47	22 14 9-61148	3 48 8-82147	9 20

## SUGGESTED METHOD OF TRUE DIRECTING 111

### *Examples*

Direct the Sun in mundo to the conjunction with Venus mundo. The pole of Venus is  $27^{\circ} 13'$ , its ascensional difference under that pole is  $9^{\circ} 43'$ , which added to its R.A.,  $276^{\circ} 6'$  (as Venus' declination is S.), gives its oblique ascension under its own pole =  $285^{\circ} 49'$ .

The oblique ascension of Sun under the same pole is—

Pole, log. tang. .	$27^{\circ} 13'$	9.71125
Decl., log. tang. .	$15^{\circ} 13'$	9.43458
		—————
Asc. diff. log. sine	$8^{\circ} 2'$	9.14583
R.A. of Sun .	$321^{\circ} 12'$	
		—————
O.A. of Sun .	$329^{\circ} 14'$	under Venus' pole.
O.A. Venus .	$285^{\circ} 49'$	,, ,, ,,
		—————
Arc of direction = $43^{\circ} 25'$ Sun conj. Venus in mun.		

*Note.*—All the tangents being inserted in the speculum under the declinations and poles of the planets, they can be extracted as required.

Direct Uranus to the conjunction with the Moon in mundo.

The pole of the Moon is  $50^{\circ} 21'$ , its ascensional difference under that pole is  $35^{\circ} 24'$ , and its oblique descension  $155^{\circ} 41'$ .



The declin. of Uranus is  $23^{\circ} 24'$  tan. 9.63623  
 Pole of Moon . . .  $50^{\circ} 21'$  tan. 0.08147

Asc. diff. under pole .  $31^{\circ} 28'$  sine 9.71770  
 Uranus' R.A. . .  $262^{\circ} 49'$

O.D. Uranus . .  $231^{\circ} 21'$  under Moon's pole.  
 O.D. of Moon. .  $155^{\circ} 41'$  „ „ „

Arc of direction =  $75^{\circ} 40'$  Uranus conj. Moon  
 in mundo.

These directions take very much less time to calculate than to set out in writing, and with the speculum at hand they are readily figured out in a minute or two.

Direct the Moon to opposition of Venus in mundo.

Oblique descension of the opposition of Venus =  $105^{\circ} 49'$ .

This is taken under the pole of Venus, from Venus' oblique ascension less  $180^{\circ}$  = oblique ascension of the opposite point.

Oblique descension of Moon under Venus'  
 pole . . . . .  $134^{\circ} 37'$   
 Oblique descension of Venus under same  
 pole . . . . .  $105^{\circ} 49'$

Arc of Direction, Moon oppos. Venus  
 mundo . . . . .  $28^{\circ} 48'$

These examples will doubtless serve for all conjunctions in mundo. For zodiacal directions it will be necessary to find the declination of the degree of the ecliptic held by a planet to which direction is made, or of its aspect, and add the log. tang. of this declination to the log. tang. of its pole. This will give the ascensional difference under that pole. Apply this to the right ascension to get its oblique ascension or oblique descension under that pole. The difference between this and the oblique ascension (or descension) of the planet directed, taken under the same pole, will be the arc of direction.

Planets having the same pole are either in mundane conjunction or in mundane parallel. This gives us the hint as to the calculation of mundane parallels.

Find the oblique ascension or oblique descension of the planet on which the parallel is formed, taken under its own pole. Find the oblique ascension or oblique descension (as the case may require) of the planet forming the parallel, under the same pole. The difference will be the arc of direction.

*Example 1.* — Bring Saturn in the example horoscope to the mundane parallel of the Moon.

This direction is formed by Saturn coming up to the pole of the Moon on the other side of the meridian.

Right ascension of the Midheaven . . . . .	249° 56'
Oblique descension of Moon under its own pole . . . . .	155° 45'
Moon's distance from Midheaven, westward . . . . .	94° 11'
Added to R.A. of M.C. . . . .	249° 56'
Oblique ascension of the parallel, eastward . . . . .	344° 7'
Oblique ascension of Saturn under Moon's pole . . . . .	357° 18'
Arc of direction = difference . . . . .	13° 11'

This arc of direction, when computed by the semiarc method, is seen to be 8' short of the actual figures, which throws the time out nearly two months. The arc by that method is 13° 3' as compared with 13° 11', the true arc.

*Example 2.*—Bring Uranus to the mundane parallel of Sun in mundo. Here the planet descends the western horizon until it comes to the same pole westward as the Sun holds eastward.

Oblique ascension of the Sun under its own pole, 51° 13' . . . . .	340° 59'
Subtract 180 . . . . .	180° 0'
Oblique descension of aspect below west horizon . . . . .	160° 59'
Oblique descension of Uranus under pole of Sun . . . . .	230° 14'
Arc of direction, Uranus parallel Sun mundo . . . . .	69° 15'



This arc of direction by the semiarc method is found to be  $70^{\circ} 57'$ , which shows an error of  $1^{\circ} 42'$ , equal to one year and eight months of time.

*Time Measure for Arcs*

This remark brings me back again to the question of the equation of time, so much in dispute among astrologers. I think there can be little doubt that the true method is "a day for a year," which is certainly the most ancient method, as it is also the most uniform. In twenty-four hours the Earth revolves on its axis and the Sun comes again to the same meridian, having in the interval increased its longitude by more or less than a degree according to its apparent place in its orbit, *i.e.* the season of the year. The mean rate of its motion is  $59' 8''$ . Then, as all our calculations are made in terms of equatorial degrees, we have to make a proportion  $59' 8''$  to  $60'$ , and this gives  $24\text{h. } 21\text{m.} = 1$  year  $5\cdot334$  days  $= 1$  year  $5\text{d. } 8\text{h.}$  for each  $1^{\circ}$  in the arc of direction. Thus every  $6^{\circ}$  in the arc of direction will give an extra month, to be added to the time at the rate of  $1^{\circ} = 1$  year, which is the measure of time used in the semiarc method. If we add  $5'$  for every  $6^{\circ}$  of arc it will come to the same thing approximately. The measure of a degree of R.A. for a year is due to Placidus. That of the Sun's mean motion, or  $1^{\circ}$  R.A.  $= 1$  year  $5$  days, is due to Valentine Naibod. Both are a compromise with facts. The probability is that we ought to

take the measure according to the season of the year in which the birth takes place, and hence the Sun's actual increase of R.A. on that date, since the Sun is in every natural sense the great chronocrater, or time-maker. Thus, in the case of Ruskin, who was born on the 8th February, the Sun's diurnal increase of R.A. is  $3' 57'' = 59' 15''$  in arc, but its increase in longitude is  $60' 43''$ , and this being an excess  $1' 35''$  over the mean motion in the zodiac, an arc of direction, at the rate of a day for a year, would measure to so much less, at the rate of about  $1\frac{1}{2}$  minutes for every complete degree of the arc. It will thus be seen that the question of the validity of one method over another in primary directions does not rest entirely on the astronomical facts, but also upon the value we attach to the arcs of direction when obtained. As to the astronomy of the case, there is not the slightest doubt in my mind that the method of directing under the pole of the significator is the correct mathematical scheme. But as to the measure of time from arcs thus derived, this is a matter of experiment, and one needs to exhaust all the evidence before coming to a conclusion.

## CHAPTER XVII

### CONCLUSION

IN the foregoing pages I have endeavoured to set out and critically examine the methods of directing advocated by Ptolemy and Placidus as modernly represented ; and I have further sought to establish their validity on general principles. I have not been blind to their imperfections, and have clearly indicated my view of the semiarc method, derived from the principles laid down by these great pioneers of a scientific astrology, when I speak of them as valuable approximations. The discrepancies are those due to incorrect use of words in describing the facts. The term "corresponding to" should be more frequently used in the semiarc method in place of the term "equal to." It is admitted that in both systems—that of proportional semiarcs and that of direction under poles—we are concerned with the apparent places of the planets in the prime vertical, and therefore when we speak of planets as being directed to a conjunction we mean an apparent conjunction as seen from the place of birth, and not either in the zodiac or by

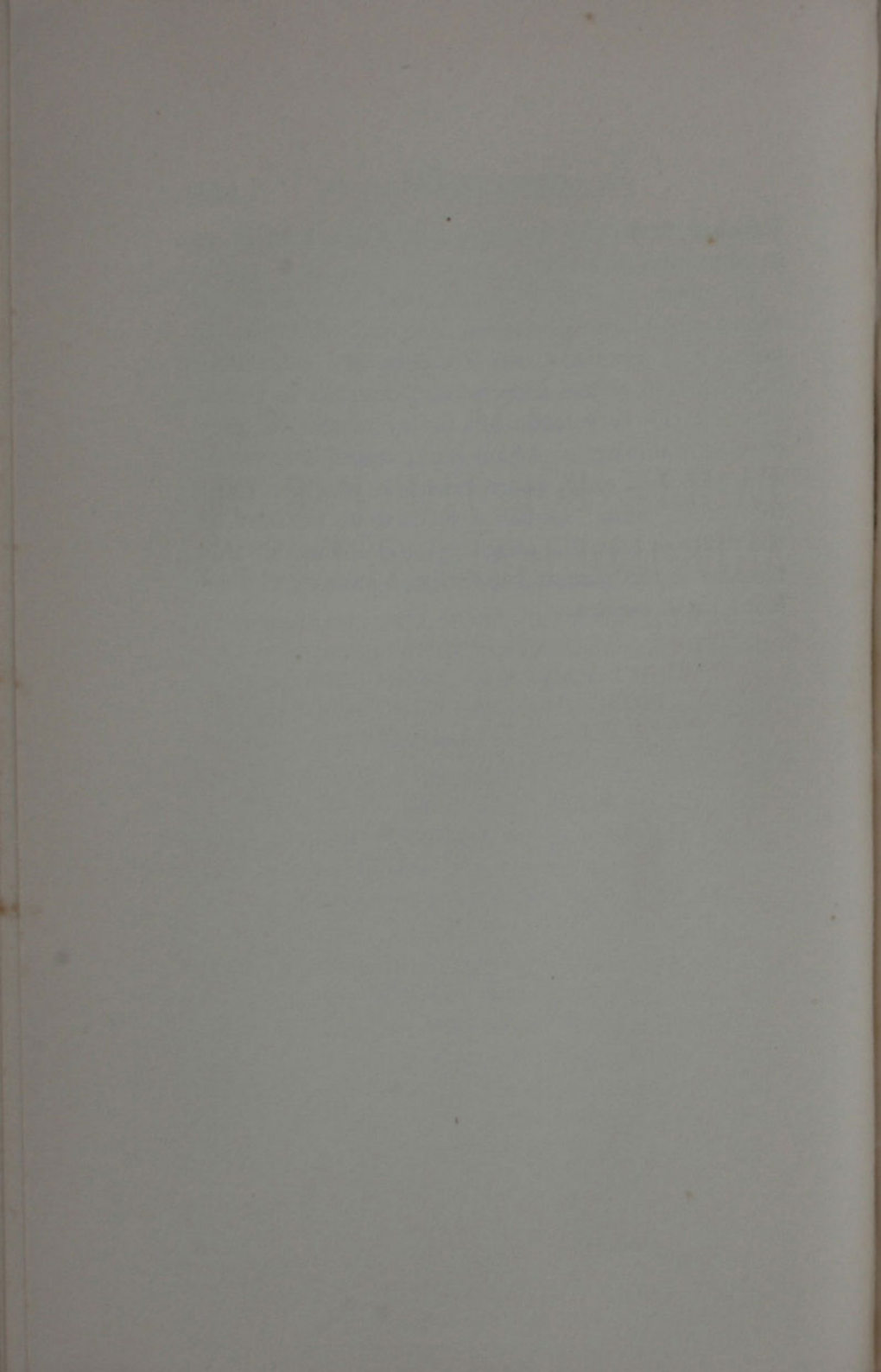


right ascension, but solely in the prime vertical or circle of observation, which coincides neither with the Equator nor the Ecliptic. Therefore, when we come to the test we find without doubt that the only way of doing this is to bring the directed body along its own arc or parallel of declination to the same pole as the promittor or body directed to. Also, it is apparent that as polar elevation is measured from the zenith in the plane of the prime vertical, planets having the same pole must be in mundane conjunction if on the same side of the meridian, or in mundane parallel if on opposite sides, which fact renders the calculation of mundane parallels a process of such extreme simplicity that I wonder it has never been pointed out before.

To correct the errors arising out of the methods of Ptolemy and Placidus, I have made a complete statement of the true doctrine of polar directions in the plane of the prime vertical, and have supplemented this by a speculum drawn according to the principles laid down, so that by mere inspection of the same, and very little figuring, all directions in mundo can be calculated. For directions in the zodiac it will be necessary to have the pole of the aspect or position in the zodiac, which can be determined by the longitudinal distance from the cusp of the house taken in proportion to the degrees of the ecliptic included in that house from the Table of Poles of the Houses, and from this we get its oblique ascension or oblique de-

scension under its own pole, and direct to it as in mundane direction.

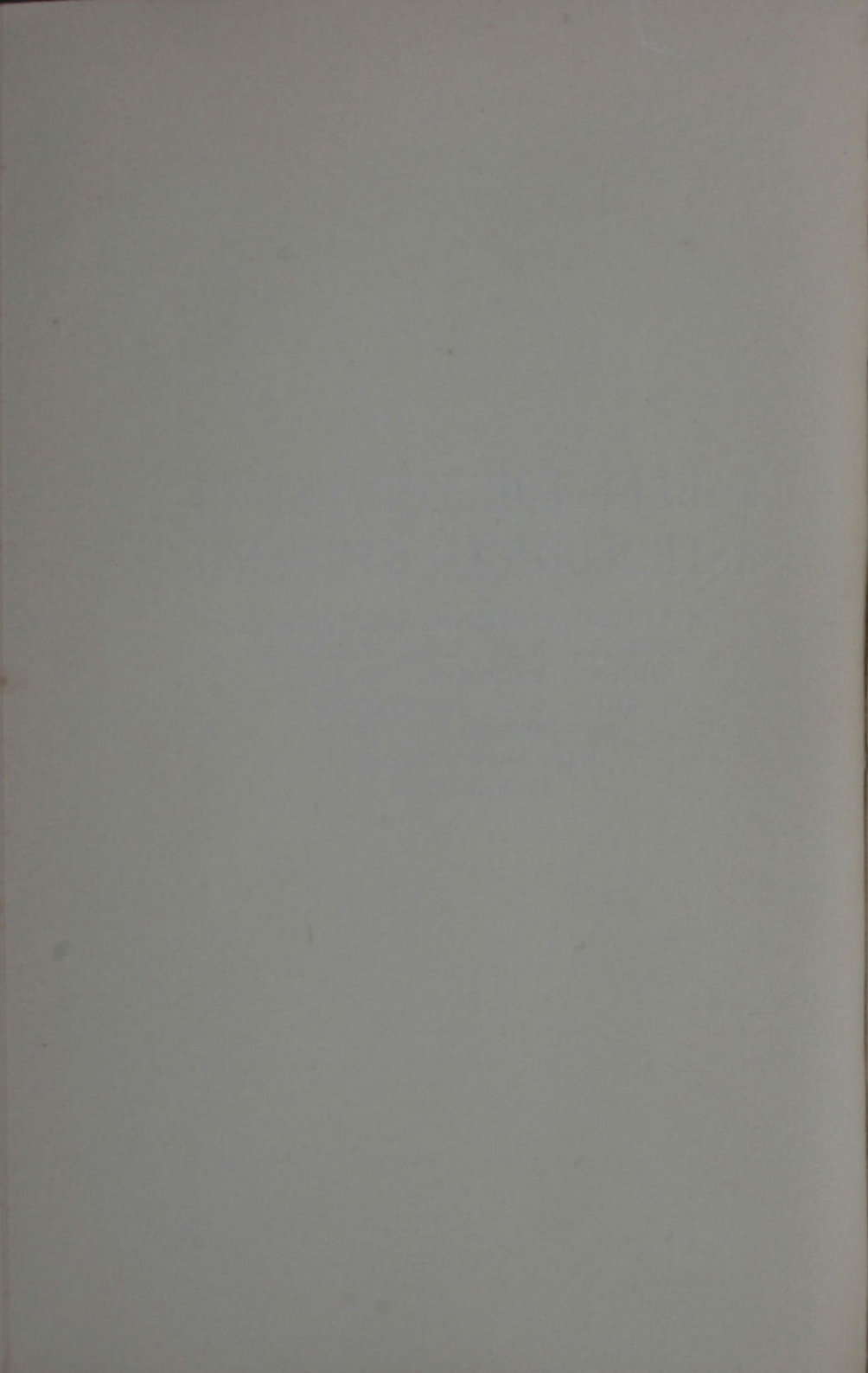
In effect, it will be found that with a set of tables of oblique ascension, and one of tables of poles, all directions can be correctly calculated in a fraction of the time usually devoted to them, even by the very facile but faulty method of proportion of semiarcs. I have fairly stated both cases, and criticised only where criticism was necessary to correct error. In this I have done no hurt to the cause of scientific astrology, and I conclude this treatise in the earnest belief that I have even done some small service.





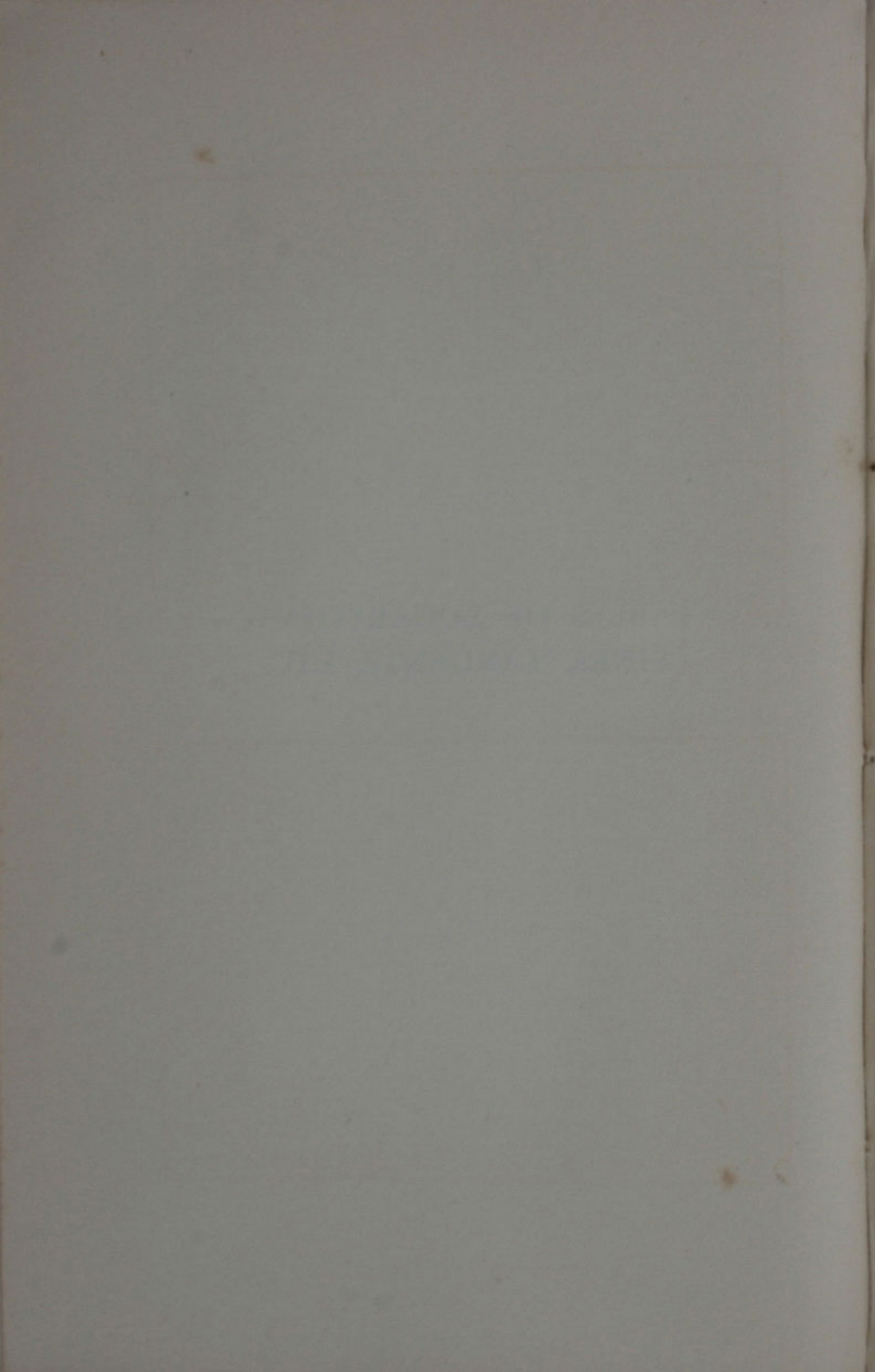
# TABLES FOR THE USE OF ASTROLOGICAL STUDENTS

INCLUDING TABLES OF LOGARITHMIC  
SINES, TANGENTS, ETC., TABLES OF  
RIGHT ASCENSION, DECLINA-  
TION, AND ASCENSIONAL  
DIFFERENCE, AND TER-  
NARY PROPORTIONAL  
LOGARITHMS



TABLES OF LOGARITHMIC  
SINES, TANGENTS, ETC.





[0 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Contin.
30	7.94084	1474	7.94086	1474	7.94086	1474	7.94086	9.99998
31	7.95508	1379	7.95510	1379	7.95510	1379	7.95510	9.99998
32	7.96887	1336	7.96889	1336	7.96889	1336	7.96889	9.99998
33	7.98225	1297	7.98225	1297	7.98225	1297	7.98225	9.99998
34	7.99520	1259	7.99520	1259	7.99520	1259	7.99520	9.99998
35	8.00779	1223	8.00779	1223	8.00779	1223	8.00779	9.99998
36	8.02002	1190	8.02004	1190	8.02004	1190	8.02004	9.99998
37	8.03192	1158	8.03194	1158	8.03194	1158	8.03194	9.99997
38	8.04350	1128	8.04352	1128	8.04352	1128	8.04352	9.99997
39	8.05478	1100	8.05481	1100	8.05481	1100	8.05481	9.99997
40	8.06578	1072	8.06581	1072	8.06581	1072	8.06581	9.99997
41	8.07650	1046	8.07653	1046	8.07653	1046	8.07653	9.99997
42	8.08696	1022	8.08700	1022	8.08700	1022	8.08700	9.99997
43	8.09718	999	8.09722	999	8.09722	999	8.09722	9.99997
44	8.10717	976	8.10720	976	8.10720	976	8.10720	9.99996
45	8.11693	954	8.11696	954	8.11696	954	8.11696	9.99996
46	8.12647	934	8.12651	934	8.12651	934	8.12651	9.99996
47	8.13581	914	8.13585	914	8.13585	914	8.13585	9.99996
48	8.14495	896	8.14500	896	8.14500	896	8.14500	9.99996
49	8.15391	877	8.15395	877	8.15395	877	8.15395	9.99996
50	8.16268	860	8.16273	860	8.16273	860	8.16273	9.99995
51	8.17128	843	8.17133	843	8.17133	843	8.17133	9.99995
52	8.17971	827	8.17976	827	8.17976	827	8.17976	9.99995
53	8.18798	812	8.18804	812	8.18804	812	8.18804	9.99995
54	8.19610	797	8.19616	797	8.19616	797	8.19616	9.99995
55	8.20407	782	8.20413	782	8.20413	782	8.20413	9.99994
56	8.21189	769	8.21195	769	8.21195	769	8.21195	9.99994
57	8.21958	755	8.21964	755	8.21964	755	8.21964	9.99994
58	8.22713	743	8.22720	743	8.22720	743	8.22720	9.99994
59	8.23456	730	8.23462	730	8.23462	730	8.23462	9.99994
60	8.24186	718	8.24192	718	8.24192	718	8.24192	9.99993

[89 degrees.]

[0 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Contin.
0	6.46173	30103	6.46173	30103	11.53627	11.53627	0.00000	60
1	6.46747	17609	6.46747	17609	13.23524	13.23524	0.00000	59
2	6.47319	16609	6.47319	16609	13.23524	13.23524	0.00000	58
3	6.47885	12494	6.47885	12494	13.05915	13.05915	0.00000	57
4	6.48459	9691	6.48459	9691	12.93421	12.93421	0.00000	56
5	6.49027	7918	6.49027	7918	12.83730	12.83730	0.00000	55
6	6.49588	6694	6.49588	6694	12.75812	12.75812	0.00000	54
7	6.50142	5800	6.50142	5800	12.69118	12.69118	0.00000	53
8	6.50689	5115	6.50689	5115	12.63318	12.63318	0.00000	52
9	6.51229	4576	6.51229	4576	12.58203	12.58203	0.00000	51
10	6.51763	4139	6.51763	4139	12.53627	12.53627	0.00000	50
11	6.52281	3779	6.52281	3779	12.49488	12.49488	0.00000	49
12	6.52784	3476	6.52784	3476	12.45709	12.45709	0.00000	48
13	6.53272	3218	6.53272	3218	12.42233	12.42233	0.00000	47
14	6.53745	2997	6.53745	2997	12.39014	12.39014	0.00000	46
15	6.54202	2802	6.54202	2802	12.36018	12.36018	0.00000	45
16	6.54644	2633	6.54644	2633	12.33215	12.33215	0.00000	44
17	6.55071	2483	6.55071	2483	12.30582	12.30582	9.99999	43
18	6.55484	2348	6.55484	2348	12.28100	12.28100	9.99999	42
19	6.55882	2228	6.55882	2228	12.25752	12.25752	9.99999	41
20	6.56265	2119	6.56265	2119	12.23524	12.23524	9.99999	40
21	6.56634	2021	6.56634	2021	12.21405	12.21405	9.99999	39
22	6.56988	1931	6.56988	1931	12.19385	12.19385	9.99999	38
23	6.57327	1848	6.57327	1848	12.17454	12.17454	9.99999	37
24	6.57651	1773	6.57651	1773	12.15606	12.15606	9.99999	36
25	6.57961	1704	6.57961	1704	12.13833	12.13833	9.99999	35
26	6.58257	1639	6.58257	1639	12.12129	12.12129	9.99999	34
27	6.58540	1579	6.58540	1579	12.10490	12.10490	9.99999	33
28	6.58810	1524	6.58810	1524	12.08921	12.08921	9.99999	32
29	6.59068	1472	6.59068	1472	12.07387	12.07387	9.99998	31
30	6.59314	1423	6.59314	1423	12.05914	12.05914	9.99998	30

[89 degrees.]

[1 degree.]

'	Sine.	Tangent.	Diff.	Secant.	Diff.	Cotang.	Cosine.	'
30	8.41792	8.41807	480	8.41792	480	11.58191	9.99985	30
31	8.42272	8.42287	475	8.42272	475	11.57713	9.99985	29
32	8.42746	8.42761	470	8.42746	470	11.57238	9.99984	28
33	8.43216	8.43231	464	8.43216	464	11.56768	9.99984	27
34	8.43680	8.43695	460	8.43680	460	11.56304	9.99984	26
35	8.44139	8.44154	455	8.44139	455	11.55844	9.99983	25
36	8.44594	8.44609	450	8.44594	450	11.55389	9.99983	24
37	8.45044	8.45059	445	8.45044	445	11.54939	9.99982	23
38	8.45489	8.45504	441	8.45489	441	11.54493	9.99982	22
39	8.45930	8.45945	436	8.45930	436	11.54052	9.99982	21
40	8.46368	8.46383	432	8.46368	432	11.53615	9.99982	20
41	8.46799	8.46814	427	8.46799	427	11.53183	9.99981	19
42	8.47226	8.47241	424	8.47226	424	11.52755	9.99981	18
43	8.47650	8.47665	419	8.47650	419	11.52331	9.99981	17
44	8.48069	8.48084	416	8.48069	416	11.51911	9.99980	16
45	8.48485	8.48500	412	8.48485	412	11.51495	9.99980	15
46	8.48896	8.48911	408	8.48896	408	11.51083	9.99979	14
47	8.49304	8.49319	404	8.49304	404	11.50675	9.99979	13
48	8.49708	8.49723	401	8.49708	401	11.50271	9.99979	12
49	8.50108	8.50123	396	8.50108	396	11.49870	9.99978	11
50	8.50504	8.50519	393	8.50504	393	11.49473	9.99978	10
51	8.50897	8.50912	389	8.50897	389	11.49080	9.99977	9
52	8.51287	8.51302	386	8.51287	386	11.48690	9.99977	8
53	8.51673	8.51688	383	8.51673	383	11.48304	9.99977	7
54	8.52055	8.52070	380	8.52055	380	11.47921	9.99976	6
55	8.52434	8.52449	376	8.52434	376	11.47541	9.99976	5
56	8.52810	8.52825	373	8.52810	373	11.47165	9.99975	4
57	8.53183	8.53198	369	8.53183	369	11.46792	9.99975	3
58	8.53552	8.53567	367	8.53552	367	11.46422	9.99974	2
59	8.53919	8.53934	363	8.53919	363	11.46055	9.99974	1
60	8.54282	8.54297	360	8.54282	360	11.45692	9.99974	0

[88 degrees.]

[1 degree.]

'	Sine.	Tangent.	Diff.	Secant.	Diff.	Cotang.	Cosine.	'
0	8.24186	8.24192	718	11.75208	9.99991	60	9.99991	60
1	8.24493	8.24501	706	11.75090	9.99991	59	9.99991	59
2	8.24809	8.24816	696	11.74974	9.99991	58	9.99991	58
3	8.25124	8.25132	684	11.74868	9.99991	57	9.99991	57
4	8.25438	8.25446	673	11.74764	9.99991	56	9.99991	56
5	8.25761	8.25769	663	11.74661	9.99991	55	9.99991	55
6	8.26084	8.26092	654	11.74568	9.99991	54	9.99991	54
7	8.26407	8.26415	644	11.74474	9.99991	53	9.99991	53
8	8.26721	8.26729	634	11.74381	9.99991	52	9.99991	52
9	8.27035	8.27043	625	11.74288	9.99991	51	9.99991	51
10	8.27349	8.27357	616	11.74195	9.99991	50	9.99991	50
11	8.27663	8.27671	607	11.74102	9.99991	49	9.99991	49
12	8.27977	8.27985	599	11.74009	9.99990	48	9.99990	48
13	8.28291	8.28299	591	11.67888	9.99990	47	9.99990	47
14	8.28605	8.28613	584	11.67789	9.99990	46	9.99990	46
15	8.28919	8.28927	575	11.66698	9.99990	45	9.99990	45
16	8.29233	8.29241	568	11.66114	9.99990	44	9.99990	44
17	8.29547	8.29555	561	11.65539	9.99989	43	9.99989	43
18	8.29861	8.29869	553	11.64971	9.99989	42	9.99989	42
19	8.30175	8.30183	546	11.64410	9.99989	41	9.99989	41
20	8.30489	8.30497	540	11.63857	9.99989	40	9.99989	40
21	8.30803	8.30811	533	11.63311	9.99988	40	9.99988	40
22	8.31117	8.31125	527	11.62771	9.99988	39	9.99988	39
23	8.31431	8.31439	520	11.62238	9.99987	37	9.99987	37
24	8.31745	8.31753	514	11.61711	9.99987	36	9.99987	36
25	8.32059	8.32067	509	11.61191	9.99987	35	9.99987	35
26	8.32373	8.32381	502	11.60678	9.99986	34	9.99986	34
27	8.32687	8.32695	496	11.60168	9.99986	33	9.99986	33
28	8.33001	8.33009	491	11.59666	9.99986	32	9.99986	32
29	8.33315	8.33323	486	11.59170	9.99986	31	9.99986	31
30	8.33629	8.33637	481	11.58679	9.99985	30	9.99985	30
31	8.33943	8.33951	475	11.58193	9.99985	30	9.99985	30

[88 degrees.]



[2 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	°
30	8.63968	288	8.64009	9.99959	11.35991	9.99959	30		
31	8.64256	287	8.64298	9.99958	11.35702	9.99958	29		
32	8.64543	284	8.64585	9.99957	11.35415	9.99957	28		
33	8.64827	283	8.64870	9.99957	11.35130	9.99957	27		
34	8.65110	281	8.65154	9.99956	11.34846	9.99956	26		
35	8.65391	279	8.65435	9.99956	11.34565	9.99956	25		
36	8.65670	277	8.65915	9.99955	11.34285	9.99955	24		
37	8.65947	276	8.65993	9.99955	11.34007	9.99955	23		
38	8.66223	274	8.66269	9.99954	11.33731	9.99954	22		
39	8.66497	272	8.66543	9.99954	11.33457	9.99954	21		
40	8.66769	270	8.66816	9.99953	11.33184	9.99953	20		
41	8.67039	269	8.67087	9.99952	11.32913	9.99952	19		
42	8.67308	267	8.67356	9.99951	11.32644	9.99951	18		
43	8.67575	266	8.67624	9.99951	11.32376	9.99951	17		
44	8.67841	263	8.67890	9.99951	11.32110	9.99951	16		
45	8.68104	263	8.68154	9.99950	11.31846	9.99950	15		
46	8.68367	260	8.68417	9.99949	11.31583	9.99949	14		
47	8.68627	259	8.68678	9.99949	11.31322	9.99949	13		
48	8.68886	258	8.68938	9.99948	11.31062	9.99948	12		
49	8.69144	256	8.69196	9.99948	11.30804	9.99948	11		
50	8.69400	254	8.69453	9.99947	11.30547	9.99947	10		
51	8.69654	253	8.69708	9.99946	11.30292	9.99946	9		
52	8.69907	252	8.69962	9.99946	11.30038	9.99946	8		
53	8.70159	250	8.70214	9.99945	11.29786	9.99945	7		
54	8.70409	250	8.70465	9.99944	11.29535	9.99944	6		
55	8.70658	249	8.70714	9.99944	11.29286	9.99944	5		
56	8.70905	247	8.70963	9.99943	11.29038	9.99943	4		
57	8.71151	246	8.71210	9.99942	11.28792	9.99942	3		
58	8.71395	243	8.71453	9.99942	11.28547	9.99942	2		
59	8.71638	242	8.71697	9.99941	11.28305	9.99941	1		
60	8.71880	242	8.71940	9.99940	11.28066	9.99940	0		

[87 degrees.]

[2 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	°
0	8.54282	360	8.54308	9.99974	11.45692	9.99974	60		
1	8.54642	357	8.54669	9.99973	11.45331	9.99973	59		
2	8.54999	355	8.55027	9.99973	11.44973	9.99973	58		
3	8.55354	353	8.55382	9.99972	11.44618	9.99972	57		
4	8.55705	349	8.55734	9.99972	11.44266	9.99972	56		
5	8.56054	346	8.56083	9.99971	11.43917	9.99971	55		
6	8.56400	343	8.56429	9.99971	11.43571	9.99971	54		
7	8.56743	341	8.56773	9.99970	11.43227	9.99970	53		
8	8.57084	338	8.57114	9.99970	11.42886	9.99970	52		
9	8.57421	336	8.57452	9.99969	11.42548	9.99969	51		
10	8.57757	332	8.57788	9.99969	11.42212	9.99969	50		
11	8.58092	330	8.58121	9.99968	11.41879	9.99968	49		
12	8.58419	328	8.58451	9.99968	11.41549	9.99968	48		
13	8.58747	325	8.58779	9.99967	11.41221	9.99967	47		
14	8.59072	323	8.59105	9.99967	11.40895	9.99967	46		
15	8.59395	320	8.59428	9.99967	11.40572	9.99967	45		
16	8.59715	318	8.59749	9.99966	11.40251	9.99966	44		
17	8.60033	316	8.60068	9.99966	11.39932	9.99966	43		
18	8.60349	313	8.60384	9.99965	11.39616	9.99965	42		
19	8.60662	311	8.60699	9.99964	11.39302	9.99964	41		
20	8.60973	309	8.61009	9.99964	11.38991	9.99964	40		
21	8.61282	307	8.61319	9.99963	11.38681	9.99963	39		
22	8.61589	305	8.61626	9.99963	11.38374	9.99963	38		
23	8.61894	302	8.61931	9.99962	11.38069	9.99962	37		
24	8.62196	302	8.62234	9.99962	11.37766	9.99962	36		
25	8.62497	298	8.62535	9.99961	11.37465	9.99961	35		
26	8.62795	296	8.62834	9.99961	11.37166	9.99961	34		
27	8.63091	294	8.63131	9.99960	11.36869	9.99960	33		
28	8.63385	293	8.63426	9.99959	11.36574	9.99959	32		
29	8.63678	290	8.63718	9.99959	11.36282	9.99959	31		
30	8.63968	290	8.64009	9.99959	11.35991	9.99959	30		

[87 degrees.]

[ 3 degrees.]

°	Sine.	Tangent.	Diff.	Cotang.	Co-sine.	°
0	8-71880	8-71040	541	11-28060	9-99940	60
1	8-72120	8-72181	541	11-27819	9-99940	59
2	8-72359	8-72420	539	11-27580	9-99939	58
3	8-72597	8-72659	537	11-27341	9-99938	57
4	8-72834	8-72896	536	11-27104	9-99938	56
5	8-73069	8-73132	534	11-26868	9-99937	55
6	8-73303	8-73366	534	11-26634	9-99936	54
7	8-73535	8-73600	532	11-26400	9-99936	53
8	8-73767	8-73832	531	11-26168	9-99935	52
9	8-73997	8-74063	529	11-25937	9-99934	51
10	8-74226	8-74292	529	11-25708	9-99934	50
11	8-74454	8-74521	527	11-25479	9-99933	49
12	8-74680	8-74748	526	11-25252	9-99932	48
13	8-74906	8-74974	525	11-25026	9-99932	47
14	8-75130	8-75199	524	11-24801	9-99931	46
15	8-75353	8-75423	522	11-24577	9-99930	45
16	8-75575	8-75645	522	11-24355	9-99929	44
17	8-75795	8-75867	520	11-24133	9-99929	43
18	8-76015	8-76087	520	11-23913	9-99928	42
19	8-76234	8-76306	519	11-23694	9-99927	41
20	8-76451	8-76523	517	11-23475	9-99926	40
21	8-76667	8-76740	516	11-23258	9-99926	39
22	8-76883	8-76958	515	11-23042	9-99925	38
23	8-77097	8-77173	514	11-22827	9-99924	37
24	8-77310	8-77387	513	11-22613	9-99923	36
25	8-77522	8-77600	511	11-22400	9-99923	35
26	8-77733	8-77811	511	11-22189	9-99922	34
27	8-77943	8-78022	510	11-21978	9-99921	33
28	8-78152	8-78232	509	11-21768	9-99920	32
29	8-78360	8-78441	508	11-21559	9-99920	31
30	8-78568	8-78649	508	11-21351	9-99919	30
°	Co-sine.	Cotang.	Tangent.	Cotang.	Co-sine.	°

[ 86 degrees.]

[ 3 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Co-sine.
30	8-78568	206	8-78649	206	11-21351	9-99919
31	8-78774	205	8-78855	206	11-21145	9-99918
32	8-78979	204	8-79061	205	11-20939	9-99917
33	8-79183	203	8-79266	204	11-20734	9-99917
34	8-79386	202	8-79470	203	11-20530	9-99916
35	8-79588	201	8-79673	202	11-20327	9-99915
36	8-79789	201	8-79875	201	11-20125	9-99914
37	8-79990	199	8-80076	201	11-19924	9-99913
38	8-80189	199	8-80277	199	11-19723	9-99913
39	8-80388	197	8-80476	198	11-19522	9-99912
40	8-80585	197	8-80674	198	11-19320	9-99911
41	8-80782	196	8-80872	196	11-19118	9-99910
42	8-80978	195	8-81068	196	11-18916	9-99909
43	8-81173	194	8-81264	195	11-18714	9-99909
44	8-81367	193	8-81459	194	11-18511	9-99908
45	8-81560	192	8-81653	193	11-18307	9-99907
46	8-81753	192	8-81846	192	11-18104	9-99906
47	8-81944	190	8-82038	192	11-17901	9-99905
48	8-82134	190	8-82230	190	11-17700	9-99904
49	8-82324	189	8-82420	190	11-17500	9-99904
50	8-82513	188	8-82610	189	11-17300	9-99903
51	8-82701	187	8-82799	188	11-17101	9-99902
52	8-82888	187	8-82987	188	11-17013	9-99901
53	8-83075	186	8-83175	186	11-16825	9-99900
54	8-83261	185	8-83361	186	11-16639	9-98999
55	8-83446	184	8-83547	185	11-16453	9-98998
56	8-83630	183	8-83732	184	11-16268	9-98998
57	8-83813	183	8-83916	184	11-16084	9-98997
58	8-83996	182	8-84100	182	11-15900	9-98996
59	8-84177	181	8-84282	182	11-15718	9-98995
60	8-84358	181	8-84464	182	11-15538	9-98994
°	Co-sine.	Cotang.	Tangent.	Cotang.	Sine.	°

[ 86 degrees.]







[ 5 degrees.]

°	Sines.		Tangents.		Cotang.		Cosines.	
	°	'	Diff.	Diff.	Diff.	Diff.	Cotang.	Sines.
30	8° 9' 51.7	131	8° 9' 53.8	11° 0' 16.4	9° 9' 80.0	30	9° 9' 80.0	30
31	8° 9' 52.8	132	8° 9' 54.9	11° 0' 15.0	9° 9' 79.8	29	9° 9' 79.8	29
32	8° 9' 54.9	133	8° 9' 56.9	11° 0' 13.7	9° 9' 79.7	28	9° 9' 79.7	28
33	8° 9' 57.0	134	8° 9' 58.9	11° 0' 12.4	9° 9' 79.6	27	9° 9' 79.6	27
34	8° 9' 59.1	135	8° 9' 60.9	11° 0' 11.1	9° 9' 79.5	26	9° 9' 79.5	26
35	8° 9' 61.2	136	8° 9' 62.9	11° 0' 9.8	9° 9' 79.4	25	9° 9' 79.4	25
36	8° 9' 63.3	137	8° 9' 64.9	11° 0' 8.5	9° 9' 79.3	24	9° 9' 79.3	24
37	8° 9' 65.4	138	8° 9' 66.9	11° 0' 7.2	9° 9' 79.2	23	9° 9' 79.2	23
38	8° 9' 67.5	139	8° 9' 68.9	11° 0' 5.9	9° 9' 79.1	22	9° 9' 79.1	22
39	8° 9' 69.6	140	8° 9' 70.9	11° 0' 4.6	9° 9' 79.0	21	9° 9' 79.0	21
40	8° 9' 71.7	141	8° 9' 72.9	11° 0' 3.3	9° 9' 78.9	20	9° 9' 78.9	20
41	8° 9' 73.8	142	8° 9' 74.9	11° 0' 2.0	9° 9' 78.8	19	9° 9' 78.8	19
42	8° 9' 75.9	143	8° 9' 76.9	11° 0' 0.7	9° 9' 78.7	18	9° 9' 78.7	18
43	8° 9' 78.0	144	8° 9' 78.9	10° 59' 54.4	9° 9' 78.6	17	9° 9' 78.6	17
44	8° 9' 80.1	145	8° 9' 80.9	10° 59' 52.6	9° 9' 78.5	16	9° 9' 78.5	16
45	8° 9' 82.2	146	8° 9' 82.9	10° 59' 50.8	9° 9' 78.4	15	9° 9' 78.4	15
46	8° 9' 84.3	147	8° 9' 84.9	10° 59' 49.0	9° 9' 78.3	14	9° 9' 78.3	14
47	8° 9' 86.4	148	8° 9' 86.9	10° 59' 47.2	9° 9' 78.2	13	9° 9' 78.2	13
48	8° 9' 88.5	149	8° 9' 88.9	10° 59' 45.4	9° 9' 78.1	12	9° 9' 78.1	12
49	8° 9' 90.6	150	8° 9' 90.9	10° 59' 43.6	9° 9' 78.0	11	9° 9' 78.0	11
50	8° 9' 92.7	151	8° 9' 92.9	10° 59' 41.8	9° 9' 77.9	10	9° 9' 77.9	10
51	8° 9' 94.8	152	8° 9' 94.9	10° 59' 40.0	9° 9' 77.8	9	9° 9' 77.8	9
52	8° 9' 96.9	153	8° 9' 96.9	10° 59' 38.2	9° 9' 77.7	8	9° 9' 77.7	8
53	8° 9' 99.0	154	8° 9' 98.9	10° 59' 36.4	9° 9' 77.6	7	9° 9' 77.6	7
54	8° 9' 101.1	155	8° 9' 100.9	10° 59' 34.6	9° 9' 77.5	6	9° 9' 77.5	6
55	8° 9' 103.2	156	8° 9' 102.9	10° 59' 32.8	9° 9' 77.4	5	9° 9' 77.4	5
56	8° 9' 105.3	157	8° 9' 104.9	10° 59' 31.0	9° 9' 77.3	4	9° 9' 77.3	4
57	8° 9' 107.4	158	8° 9' 106.9	10° 59' 29.2	9° 9' 77.2	3	9° 9' 77.2	3
58	8° 9' 109.5	159	8° 9' 108.9	10° 59' 27.4	9° 9' 77.1	2	9° 9' 77.1	2
59	8° 9' 111.6	160	8° 9' 110.9	10° 59' 25.6	9° 9' 77.0	1	9° 9' 77.0	1
60	8° 9' 113.7	161	8° 9' 112.9	10° 59' 23.8	9° 9' 76.9	0	9° 9' 76.9	0

[ 84 degrees.]

[ 5 degrees.]

°	Sines.		Tangents.		Cotang.		Cosines.	
	°	'	Diff.	Diff.	Diff.	Diff.	Cotang.	Sines.
0	8° 9' 40.10	144	8° 9' 41.95	11° 0' 58.05	9° 9' 84.94	60	9° 9' 84.94	60
1	8° 9' 41.74	145	8° 9' 43.40	11° 0' 56.60	9° 9' 83.33	59	9° 9' 83.33	59
2	8° 9' 43.17	146	8° 9' 44.85	11° 0' 55.15	9° 9' 81.72	58	9° 9' 81.72	58
3	8° 9' 44.61	147	8° 9' 46.30	11° 0' 53.70	9° 9' 80.11	57	9° 9' 80.11	57
4	8° 9' 46.03	148	8° 9' 47.73	11° 0' 52.25	9° 9' 78.50	56	9° 9' 78.50	56
5	8° 9' 47.46	149	8° 9' 49.17	11° 0' 50.80	9° 9' 76.89	55	9° 9' 76.89	55
6	8° 9' 48.88	150	8° 9' 50.60	11° 0' 49.35	9° 9' 75.28	54	9° 9' 75.28	54
7	8° 9' 50.29	151	8° 9' 52.02	11° 0' 47.90	9° 9' 73.67	53	9° 9' 73.67	53
8	8° 9' 51.70	152	8° 9' 53.44	11° 0' 46.45	9° 9' 72.06	52	9° 9' 72.06	52
9	8° 9' 53.10	153	8° 9' 54.86	11° 0' 45.00	9° 9' 70.45	51	9° 9' 70.45	51
10	8° 9' 54.50	154	8° 9' 56.27	11° 0' 43.55	9° 9' 68.84	50	9° 9' 68.84	50
11	8° 9' 55.89	155	8° 9' 57.67	11° 0' 42.10	9° 9' 67.23	49	9° 9' 67.23	49
12	8° 9' 57.28	156	8° 9' 59.08	11° 0' 40.65	9° 9' 65.62	48	9° 9' 65.62	48
13	8° 9' 58.67	157	8° 9' 60.47	11° 0' 39.20	9° 9' 64.01	47	9° 9' 64.01	47
14	8° 9' 60.05	158	8° 9' 61.87	11° 0' 37.75	9° 9' 62.40	46	9° 9' 62.40	46
15	8° 9' 61.43	159	8° 9' 63.25	11° 0' 36.30	9° 9' 60.79	45	9° 9' 60.79	45
16	8° 9' 62.80	160	8° 9' 64.64	11° 0' 34.85	9° 9' 59.18	44	9° 9' 59.18	44
17	8° 9' 64.17	161	8° 9' 66.03	11° 0' 33.40	9° 9' 57.57	43	9° 9' 57.57	43
18	8° 9' 65.53	162	8° 9' 67.41	11° 0' 31.95	9° 9' 55.96	42	9° 9' 55.96	42
19	8° 9' 66.89	163	8° 9' 68.79	11° 0' 30.50	9° 9' 54.35	41	9° 9' 54.35	41
20	8° 9' 68.25	164	8° 9' 70.17	11° 0' 29.05	9° 9' 52.74	40	9° 9' 52.74	40
21	8° 9' 69.60	165	8° 9' 71.55	11° 0' 27.60	9° 9' 51.13	39	9° 9' 51.13	39
22	8° 9' 70.95	166	8° 9' 72.93	11° 0' 26.15	9° 9' 49.52	38	9° 9' 49.52	38
23	8° 9' 72.29	167	8° 9' 74.31	11° 0' 24.70	9° 9' 47.91	37	9° 9' 47.91	37
24	8° 9' 73.63	168	8° 9' 75.69	11° 0' 23.25	9° 9' 46.30	36	9° 9' 46.30	36
25	8° 9' 74.96	169	8° 9' 77.07	11° 0' 21.80	9° 9' 44.69	35	9° 9' 44.69	35
26	8° 9' 76.29	170	8° 9' 78.45	11° 0' 20.35	9° 9' 43.08	34	9° 9' 43.08	34
27	8° 9' 77.62	171	8° 9' 79.83	11° 0' 18.90	9° 9' 41.47	33	9° 9' 41.47	33
28	8° 9' 78.94	172	8° 9' 81.21	11° 0' 17.45	9° 9' 39.86	32	9° 9' 39.86	32
29	8° 9' 80.26	173	8° 9' 82.59	11° 0' 16.00	9° 9' 38.25	31	9° 9' 38.25	31
30	8° 9' 81.57	174	8° 9' 83.97	11° 0' 14.55	9° 9' 36.64	30	9° 9' 36.64	30

[ 84 degrees.]

[6 degrees.]

°	Sine.	Tangent.	Diff.	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.
30	9°05386	9°05666	111	9°05386	111	9°05666	111	10°94334	9°99720
31	9°05497	9°05778	112	9°05497	112	9°05778	112	10°94222	9°99718
32	9°05607	9°05890	110	9°05607	110	9°05890	112	10°94110	9°99717
33	9°05717	9°06002	111	9°05717	110	9°06002	111	10°93998	9°99716
34	9°05827	9°06113	110	9°05827	110	9°06113	111	10°93887	9°99714
35	9°05937	9°06224	109	9°05937	109	9°06224	111	10°93776	9°99713
36	9°06046	9°06335	109	9°06046	109	9°06335	110	10°93665	9°99711
37	9°06155	9°06445	108	9°06155	108	9°06445	110	10°93555	9°99710
38	9°06264	9°06556	108	9°06264	108	9°06556	110	10°93444	9°99708
39	9°06372	9°06666	109	9°06372	109	9°06666	109	10°93334	9°99707
40	9°06481	9°06775	108	9°06481	108	9°06775	110	10°93223	9°99705
41	9°06589	9°06885	107	9°06589	107	9°06885	109	10°93113	9°99704
42	9°06696	9°06994	107	9°06696	107	9°06994	109	10°93006	9°99702
43	9°06804	9°07103	107	9°06804	107	9°07103	108	10°92897	9°99701
44	9°06911	9°07211	107	9°06911	107	9°07211	109	10°92789	9°99699
45	9°07018	9°07320	106	9°07018	106	9°07320	108	10°92680	9°99698
46	9°07124	9°07428	107	9°07124	107	9°07428	108	10°92572	9°99696
47	9°07231	9°07536	106	9°07231	106	9°07536	107	10°92464	9°99695
48	9°07337	9°07643	105	9°07337	105	9°07643	108	10°92357	9°99693
49	9°07442	9°07751	105	9°07442	105	9°07751	107	10°92249	9°99692
50	9°07548	9°07858	105	9°07548	105	9°07858	106	10°92142	9°99690
51	9°07653	9°07964	105	9°07653	105	9°07964	107	10°92036	9°99689
52	9°07758	9°08071	105	9°07758	105	9°08071	106	10°91929	9°99687
53	9°07863	9°08177	105	9°07863	105	9°08177	106	10°91823	9°99686
54	9°07968	9°08283	105	9°07968	105	9°08283	106	10°91717	9°99684
55	9°08072	9°08389	104	9°08072	104	9°08389	105	10°91611	9°99683
56	9°08176	9°08495	104	9°08176	104	9°08495	105	10°91505	9°99682
57	9°08280	9°08600	103	9°08280	103	9°08600	105	10°91400	9°99680
58	9°08383	9°08705	103	9°08383	103	9°08705	105	10°91295	9°99678
59	9°08486	9°08810	103	9°08486	103	9°08810	104	10°91190	9°99677
60	9°08589	9°08914	103	9°08589	103	9°08914	104	10°91086	9°99675

[83 degrees.]

°	Sine.	Tangent.	Diff.	Cotang.	Cosine.
60	9°08589	9°08914	103	10°91086	9°99675
61	9°08691	9°09018	103	10°90982	9°99673
62	9°08793	9°09122	103	10°90878	9°99671
63	9°08895	9°09226	103	10°90774	9°99669
64	9°08997	9°09330	103	10°90670	9°99667
65	9°09099	9°09434	103	10°90566	9°99665
66	9°09201	9°09538	103	10°90462	9°99663
67	9°09303	9°09642	103	10°90358	9°99661
68	9°09405	9°09746	103	10°90254	9°99659
69	9°09507	9°09850	103	10°90150	9°99657
70	9°09609	9°09954	103	10°90046	9°99655
71	9°09711	9°10058	103	10°89942	9°99653
72	9°09813	9°10162	103	10°89838	9°99651
73	9°09915	9°10266	103	10°89734	9°99649
74	9°10017	9°10370	103	10°89630	9°99647
75	9°10119	9°10474	103	10°89526	9°99645
76	9°10221	9°10578	103	10°89422	9°99643
77	9°10323	9°10682	103	10°89318	9°99641
78	9°10425	9°10786	103	10°89214	9°99639
79	9°10527	9°10890	103	10°89110	9°99637
80	9°10629	9°10994	103	10°89006	9°99635
81	9°10731	9°11098	103	10°88902	9°99633
82	9°10833	9°11202	103	10°88798	9°99631
83	9°10935	9°11306	103	10°88694	9°99629
84	9°11037	9°11410	103	10°88590	9°99627
85	9°11139	9°11514	103	10°88486	9°99625
86	9°11241	9°11618	103	10°88382	9°99623
87	9°11343	9°11722	103	10°88278	9°99621
88	9°11445	9°11826	103	10°88174	9°99619
89	9°11547	9°11930	103	10°88070	9°99617
90	9°11649	9°12034	103	10°87966	9°99615

[83 degrees.]



[7 degrees.]

'	''	Sine.	Diff.	Tangent.	Diff.	Co-tang.	Co-sine.	D.	'
30	0	9°11570	96	9°11943	97	10°88057	9°99627	1	30
31	1	9°11666	95	9°12040	97	10°87960	9°99625	2	29
32	2	9°11761	96	9°12138	97	10°87862	9°99624	3	28
33	3	9°11857	95	9°12235	97	10°87765	9°99622	4	27
34	4	9°11952	95	9°12332	97	10°87668	9°99620	5	26
35	5	9°12048	95	9°12428	97	10°87572	9°99618	6	25
36	6	9°12142	94	9°12524	97	10°87475	9°99617	7	24
37	7	9°12236	95	9°12621	96	10°87379	9°99615	8	23
38	8	9°12331	95	9°12717	96	10°87283	9°99613	9	22
39	9	9°12425	94	9°12813	96	10°87187	9°99612	10	21
40	10	9°12519	93	9°12909	95	10°87091	9°99610	11	20
41	11	9°12612	94	9°13004	95	10°86996	9°99608	12	19
42	12	9°12706	93	9°13099	95	10°86901	9°99607	13	18
43	13	9°12799	93	9°13194	95	10°86806	9°99605	14	17
44	14	9°12892	93	9°13289	95	10°86711	9°99603	15	16
45	15	9°12985	93	9°13384	94	10°86616	9°99601	16	15
46	16	9°13078	93	9°13478	94	10°86522	9°99600	17	14
47	17	9°13171	92	9°13573	94	10°86427	9°99598	18	13
48	18	9°13263	92	9°13667	94	10°86333	9°99596	19	12
49	19	9°13355	92	9°13761	93	10°86239	9°99595	20	11
50	20	9°13447	92	9°13854	93	10°86146	9°99593	21	10
51	21	9°13539	91	9°13948	93	10°86052	9°99591	22	9
52	22	9°13630	92	9°14041	93	10°85959	9°99589	23	8
53	23	9°13722	91	9°14134	93	10°85866	9°99588	24	7
54	24	9°13813	91	9°14227	93	10°85773	9°99586	25	6
55	25	9°13904	90	9°14320	92	10°85680	9°99584	26	5
56	26	9°13994	91	9°14412	92	10°85588	9°99582	27	4
57	27	9°14085	90	9°14504	93	10°85496	9°99581	28	3
58	28	9°14175	91	9°14597	91	10°85403	9°99579	29	2
59	29	9°14266	90	9°14688	92	10°85312	9°99577	30	1
60	30	9°14356	90	9°14780	92	10°85220	9°99575	31	0

[82 degrees.]

[7 degrees.]

'	''	Sine.	Diff.	Tangent.	Diff.	Co-tang.	Co-sine.	'
0	0	9°08589	103	9°08914	105	10°91086	9°99675	60
1	1	9°08692	103	9°09019	104	10°90981	9°99674	59
2	2	9°08795	102	9°09123	104	10°90877	9°99672	58
3	3	9°08897	102	9°09227	103	10°90773	9°99670	57
4	4	9°08999	102	9°09330	104	10°90670	9°99669	56
5	5	9°09101	101	9°09434	103	10°90566	9°99667	55
6	6	9°09202	102	9°09537	103	10°90463	9°99666	54
7	7	9°09304	101	9°09640	102	10°90360	9°99664	53
8	8	9°09405	101	9°09742	103	10°90258	9°99663	52
9	9	9°09506	100	9°09845	102	10°90155	9°99661	51
10	10	9°09608	101	9°09947	102	10°90053	9°99659	50
11	11	9°09707	100	9°10049	101	10°89951	9°99658	49
12	12	9°09807	100	9°10150	102	10°89850	9°99656	48
13	13	9°09907	99	9°10252	101	10°89748	9°99655	47
14	14	9°10006	100	9°10353	101	10°89647	9°99653	46
15	15	9°10106	99	9°10454	101	10°89546	9°99651	45
16	16	9°10205	99	9°10555	101	10°89445	9°99650	44
17	17	9°10304	98	9°10656	100	10°89344	9°99648	43
18	18	9°10402	98	9°10756	100	10°89244	9°99647	42
19	19	9°10501	98	9°10856	100	10°89144	9°99645	41
20	20	9°10599	98	9°10956	100	10°89044	9°99643	40
21	21	9°10697	98	9°11056	99	10°88944	9°99642	39
22	22	9°10795	98	9°11155	99	10°88845	9°99640	38
23	23	9°10893	97	9°11254	99	10°88746	9°99638	37
24	24	9°10990	97	9°11353	99	10°88647	9°99637	36
25	25	9°11087	97	9°11452	99	10°88548	9°99635	35
26	26	9°11184	97	9°11551	98	10°88449	9°99633	34
27	27	9°11281	96	9°11649	98	10°88351	9°99632	33
28	28	9°11377	97	9°11747	98	10°88253	9°99630	32
29	29	9°11474	96	9°11845	98	10°88155	9°99629	31
30	30	9°11570	96	9°11943	98	10°88057	9°99627	30

[82 degrees.]



[8 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Co-tang.	Co-sine.	D.	'
10	0	9.16970	85	9.17450	86	10.82550	9.99520	2	10
11	0	9.17055	84	9.17536	86	10.82464	9.99518	2	29
12	0	9.17139	84	9.17622	86	10.82378	9.99517	2	28
13	0	9.17223	84	9.17708	86	10.82292	9.99515	2	27
14	0	9.17307	84	9.17794	86	10.82206	9.99513	2	26
15	0	9.17391	83	9.17880	85	10.82120	9.99511	2	25
16	0	9.17474	84	9.17965	86	10.82035	9.99509	2	24
17	0	9.17558	83	9.18051	85	10.81949	9.99507	2	23
18	0	9.17641	83	9.18136	85	10.81864	9.99505	2	22
19	0	9.17724	83	9.18221	85	10.81779	9.99503	2	21
20	0	9.17809	83	9.18306	85	10.81694	9.99501	2	20
21	0	9.17890	83	9.18391	85	10.81609	9.99499	2	19
22	0	9.17973	82	9.18475	85	10.81525	9.99497	2	18
23	0	9.18055	82	9.18560	84	10.81440	9.99495	2	17
24	0	9.18137	83	9.18644	84	10.81356	9.99494	2	16
25	0	9.18220	82	9.18728	84	10.81272	9.99492	2	15
26	0	9.18302	81	9.18812	84	10.81188	9.99490	2	14
27	0	9.18383	82	9.18896	83	10.81104	9.99488	2	13
28	0	9.18465	82	9.18979	83	10.81021	9.99486	2	12
29	0	9.18547	81	9.19063	83	10.80937	9.99484	2	11
30	0	9.18628	81	9.19146	83	10.80854	9.99482	2	10
31	0	9.18709	81	9.19229	83	10.80771	9.99480	2	9
32	0	9.18790	81	9.19312	83	10.80688	9.99478	2	8
33	0	9.18871	81	9.19395	83	10.80605	9.99476	2	7
34	0	9.18952	80	9.19478	83	10.80522	9.99474	2	6
35	0	9.19033	80	9.19561	82	10.80439	9.99472	2	5
36	0	9.19113	80	9.19643	82	10.80357	9.99470	2	4
37	0	9.19193	80	9.19725	82	10.80275	9.99468	2	3
38	0	9.19273	80	9.19807	82	10.80193	9.99466	2	2
39	0	9.19353	80	9.19889	82	10.80111	9.99464	2	1
40	0	9.19433		9.19971		10.80029	9.99462	2	0

[81 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Co-tang.	Co-sine.	D.	'
60	0	9.14356	89	9.14780	92	10.85220	9.99375	1	60
61	0	9.14445	90	9.14872	91	10.85128	9.99374	1	59
62	0	9.14535	89	9.14963	91	10.85037	9.99372	1	58
63	0	9.14624	90	9.15054	91	10.84946	9.99370	1	57
64	0	9.14714	89	9.15145	91	10.84855	9.99368	1	56
65	0	9.14803	88	9.15236	91	10.84764	9.99366	1	55
66	0	9.14891	89	9.15327	90	10.84673	9.99365	1	54
67	0	9.14980	89	9.15417	90	10.84583	9.99363	1	53
68	0	9.15069	88	9.15508	91	10.84492	9.99361	1	52
69	0	9.15157	88	9.15598	90	10.84402	9.99359	1	51
70	0	9.15245	88	9.15688	89	10.84312	9.99357	1	50
71	0	9.15333	88	9.15777	90	10.84223	9.99356	1	49
72	0	9.15421	87	9.15867	89	10.84133	9.99354	1	48
73	0	9.15508	88	9.15956	90	10.84044	9.99352	1	47
74	0	9.15596	87	9.16046	89	10.83954	9.99350	1	46
75	0	9.15683	87	9.16135	89	10.83865	9.99348	1	45
76	0	9.15770	87	9.16224	88	10.83776	9.99346	1	44
77	0	9.15857	87	9.16312	89	10.83688	9.99345	1	43
78	0	9.15944	86	9.16401	88	10.83599	9.99343	1	42
79	0	9.16030	86	9.16489	88	10.83511	9.99341	1	41
80	0	9.16116	87	9.16577	88	10.83423	9.99339	1	40
81	0	9.16203	86	9.16665	88	10.83335	9.99337	1	39
82	0	9.16289	85	9.16753	88	10.83247	9.99335	1	38
83	0	9.16374	86	9.16841	87	10.83159	9.99333	1	37
84	0	9.16460	85	9.16928	87	10.83072	9.99332	1	36
85	0	9.16545	86	9.17016	87	10.82984	9.99330	1	35
86	0	9.16631	85	9.17103	87	10.82897	9.99328	1	34
87	0	9.16716	85	9.17190	87	10.82810	9.99326	1	33
88	0	9.16801	85	9.17277	86	10.82723	9.99324	1	32
89	0	9.16886	84	9.17363	86	10.82637	9.99322	1	31
90	0	9.16970		9.17450		10.82550	9.99320	1	30

[81 degrees.]

[9 degrees.]

'	Sine.	Tangent.	Diff.	Contang.	Cotang.	Diff.	Tangent.	Contang.	Cotang.	D.	'
30	0.51761	0.99971	82	10.78029	9.99463	60	0.99971	10.77639	9.99463	30	
31	0.51836	0.99987	81	10.78047	9.99456	59	0.99987	10.77562	9.99398	29	
32	0.51912	0.99994	81	10.78066	9.99451	58	0.99994	10.77484	9.99396	28	
33	0.51987	0.99998	81	10.78084	9.99446	57	0.99998	10.77407	9.99394	27	
34	0.52062	0.99999	81	10.78103	9.99442	56	0.99999	10.77330	9.99392	26	
35	0.52137	0.99999	81	10.78122	9.99438	55	0.99999	10.77253	9.99390	25	
36	0.52211	0.99999	81	10.78141	9.99435	54	0.99999	10.77176	9.99388	24	
37	0.52286	0.99999	81	10.78160	9.99432	53	0.99999	10.77099	9.99385	23	
38	0.52361	0.99999	81	10.78179	9.99429	52	0.99999	10.77023	9.99383	22	
39	0.52435	0.99999	81	10.78198	9.99426	51	0.99999	10.76946	9.99381	21	
40	0.52509	0.99999	81	10.78217	9.99423	50	0.99999	10.76870	9.99379	20	
41	0.52583	0.99999	81	10.78236	9.99420	49	0.99999	10.76794	9.99377	19	
42	0.52657	0.99999	81	10.78255	9.99417	48	0.99999	10.76717	9.99375	18	
43	0.52731	0.99999	81	10.78274	9.99414	47	0.99999	10.76641	9.99373	17	
44	0.52805	0.99999	81	10.78293	9.99411	46	0.99999	10.76565	9.99370	16	
45	0.52878	0.99999	81	10.78312	9.99408	45	0.99999	10.76490	9.99368	15	
46	0.52952	0.99999	81	10.78331	9.99405	44	0.99999	10.76414	9.99366	14	
47	0.53025	0.99999	81	10.78350	9.99402	43	0.99999	10.76339	9.99364	13	
48	0.53098	0.99999	81	10.78369	9.99399	42	0.99999	10.76263	9.99362	12	
49	0.53171	0.99999	81	10.78388	9.99396	41	0.99999	10.76188	9.99359	11	
50	0.53244	0.99999	81	10.78407	9.99393	40	0.99999	10.76113	9.99357	10	
51	0.53317	0.99999	81	10.78426	9.99390	39	0.99999	10.76038	9.99355	9	
52	0.53390	0.99999	81	10.78445	9.99387	38	0.99999	10.75963	9.99353	8	
53	0.53463	0.99999	81	10.78464	9.99384	37	0.99999	10.75888	9.99351	7	
54	0.53536	0.99999	81	10.78483	9.99381	36	0.99999	10.75814	9.99348	6	
55	0.53609	0.99999	81	10.78502	9.99378	35	0.99999	10.75739	9.99346	5	
56	0.53682	0.99999	81	10.78521	9.99375	34	0.99999	10.75665	9.99344	4	
57	0.53755	0.99999	81	10.78540	9.99372	33	0.99999	10.75590	9.99342	3	
58	0.53828	0.99999	81	10.78559	9.99369	32	0.99999	10.75516	9.99340	2	
59	0.53901	0.99999	81	10.78578	9.99366	31	0.99999	10.75442	9.99337	1	
60	0.53974	0.99999	81	10.78597	9.99363	30	0.99999	10.75368	9.99335	0	

[80 degrees.]

[9 degrees.]

'	Sine.	Tangent.	Diff.	Contang.	Cotang.	Diff.	Tangent.	Contang.	Cotang.	D.	'
0	0.19433	0.99971	82	10.78029	9.99463	60	0.99971	10.77639	9.99463	30	
1	0.19513	0.99987	81	10.78047	9.99456	59	0.99987	10.77562	9.99398	29	
2	0.19592	0.99994	81	10.78066	9.99451	58	0.99994	10.77484	9.99396	28	
3	0.19672	0.99998	81	10.78084	9.99446	57	0.99998	10.77407	9.99394	27	
4	0.19751	0.99999	81	10.78103	9.99442	56	0.99999	10.77330	9.99392	26	
5	0.19830	0.99999	81	10.78122	9.99438	55	0.99999	10.77253	9.99390	25	
6	0.19909	0.99999	81	10.78141	9.99435	54	0.99999	10.77176	9.99388	24	
7	0.19988	0.99999	81	10.78160	9.99432	53	0.99999	10.77099	9.99385	23	
8	0.20067	0.99999	81	10.78179	9.99429	52	0.99999	10.77023	9.99383	22	
9	0.20145	0.99999	81	10.78198	9.99426	51	0.99999	10.76946	9.99381	21	
10	0.20224	0.99999	81	10.78217	9.99423	50	0.99999	10.76870	9.99379	20	
11	0.20302	0.99999	81	10.78236	9.99420	49	0.99999	10.76794	9.99377	19	
12	0.20380	0.99999	81	10.78255	9.99417	48	0.99999	10.76717	9.99375	18	
13	0.20458	0.99999	81	10.78274	9.99414	47	0.99999	10.76641	9.99373	17	
14	0.20535	0.99999	81	10.78293	9.99411	46	0.99999	10.76565	9.99370	16	
15	0.20613	0.99999	81	10.78312	9.99408	45	0.99999	10.76490	9.99368	15	
16	0.20691	0.99999	81	10.78331	9.99405	44	0.99999	10.76414	9.99366	14	
17	0.20768	0.99999	81	10.78350	9.99402	43	0.99999	10.76339	9.99364	13	
18	0.20845	0.99999	81	10.78369	9.99399	42	0.99999	10.76263	9.99362	12	
19	0.20922	0.99999	81	10.78388	9.99396	41	0.99999	10.76188	9.99359	11	
20	0.20999	0.99999	81	10.78407	9.99393	40	0.99999	10.76113	9.99357	10	
21	0.21076	0.99999	81	10.78426	9.99390	39	0.99999	10.76038	9.99355	9	
22	0.21153	0.99999	81	10.78445	9.99387	38	0.99999	10.75963	9.99353	8	
23	0.21229	0.99999	81	10.78464	9.99384	37	0.99999	10.75888	9.99351	7	
24	0.21306	0.99999	81	10.78483	9.99381	36	0.99999	10.75814	9.99348	6	
25	0.21382	0.99999	81	10.78502	9.99378	35	0.99999	10.75739	9.99346	5	
26	0.21458	0.99999	81	10.78521	9.99375	34	0.99999	10.75665	9.99344	4	
27	0.21534	0.99999	81	10.78540	9.99372	33	0.99999	10.75590	9.99342	3	
28	0.21610	0.99999	81	10.78559	9.99369	32	0.99999	10.75516	9.99340	2	
29	0.21685	0.99999	81	10.78578	9.99366	31	0.99999	10.75442	9.99337	1	
30	0.21761	0.99999	81	10.78597	9.99363	30	0.99999	10.75368	9.99335	0	

[80 degrees.]



[10 degrés.]

°	′	″	Diff.	Tangenti.	Diff.	Cotang.	Cosino.	″	D.
0	0	0	9°23067	9°24612	74	10°75368	9°99335	60	30
1	0	0	9°24039	9°25706	73	10°75294	9°99333	59	29
2	0	0	9°24110	9°26779	71	10°75221	9°99331	58	28
3	0	0	9°24181	9°27853	74	10°75147	9°99328	57	27
4	0	0	9°24253	9°28926	71	10°75074	9°99326	56	26
5	0	0	9°24324	9°30000	74	10°75000	9°99324	55	25
6	0	0	9°24395	9°31073	73	10°74927	9°99322	54	24
7	0	0	9°24466	9°32146	73	10°74854	9°99319	53	23
8	0	0	9°24536	9°33219	73	10°74781	9°99317	52	22
9	0	0	9°24607	9°34292	73	10°74708	9°99315	51	21
10	0	0	9°24677	9°35365	73	10°74635	9°99313	50	20
11	0	0	9°24748	9°36437	72	10°74563	9°99310	49	19
12	0	0	9°24818	9°37510	73	10°74490	9°99308	48	18
13	0	0	9°24888	9°38582	73	10°74418	9°99306	47	17
14	0	0	9°24958	9°39655	72	10°74345	9°99304	46	16
15	0	0	9°25028	9°40727	72	10°74273	9°99301	45	15
16	0	0	9°25098	9°41799	72	10°74201	9°99299	44	14
17	0	0	9°25168	9°42871	72	10°74129	9°99297	43	13
18	0	0	9°25237	9°43943	71	10°74057	9°99294	42	12
19	0	0	9°25307	9°45015	71	10°73985	9°99292	41	11
20	0	0	9°25376	9°46086	72	10°73914	9°99290	40	10
21	0	0	9°25445	9°47158	71	10°73842	9°99288	39	9
22	0	0	9°25514	9°48229	72	10°73771	9°99285	38	8
23	0	0	9°25583	9°49301	71	10°73699	9°99283	37	7
24	0	0	9°25652	9°50372	71	10°73628	9°99281	36	6
25	0	0	9°25721	9°51443	71	10°73557	9°99278	35	5
26	0	0	9°25790	9°52514	71	10°73486	9°99276	34	4
27	0	0	9°25858	9°53585	70	10°73415	9°99274	33	3
28	0	0	9°25927	9°54655	71	10°73345	9°99271	32	2
29	0	0	9°25995	9°55726	71	10°73274	9°99269	31	1
30	0	0	9°26063	9°56797	71	10°73203	9°99267	30	0

[79 degrees.]

[10 degrés.]

°	′	″	Diff.	Tangenti.	Diff.	Cotang.	Cosino.	″	D.
30	0	0	9°26063	9°56797	70	10°73133	9°99267	30	30
31	0	0	9°26131	9°57868	68	10°73133	9°99264	29	29
32	0	0	9°26199	9°58937	71	10°73063	9°99262	28	28
33	0	0	9°26267	9°59998	70	10°72992	9°99260	27	27
34	0	0	9°26335	9°61057	70	10°72922	9°99257	26	26
35	0	0	9°26403	9°62114	70	10°72852	9°99255	25	25
36	0	0	9°26470	9°63172	70	10°72782	9°99252	24	24
37	0	0	9°26538	9°64228	69	10°72712	9°99250	23	23
38	0	0	9°26605	9°65285	70	10°72643	9°99248	22	22
39	0	0	9°26672	9°66342	69	10°72573	9°99245	21	21
40	0	0	9°26739	9°67396	69	10°72504	9°99243	20	20
41	0	0	9°26806	9°68456	69	10°72434	9°99241	19	19
42	0	0	9°26873	9°69513	69	10°72365	9°99238	18	18
43	0	0	9°26940	9°70569	69	10°72296	9°99236	17	17
44	0	0	9°27007	9°71627	66	10°72227	9°99233	16	16
45	0	0	9°27073	9°72682	69	10°72158	9°99231	15	15
46	0	0	9°27144	9°73731	69	10°72089	9°99229	14	14
47	0	0	9°27206	9°74780	69	10°72020	9°99226	13	13
48	0	0	9°27273	9°75829	68	10°71951	9°99224	12	12
49	0	0	9°27339	9°76877	69	10°71883	9°99221	11	11
50	0	0	9°27405	9°77926	68	10°71814	9°99219	10	10
51	0	0	9°27471	9°78974	69	10°71746	9°99217	9	9
52	0	0	9°27537	9°80022	68	10°71677	9°99214	8	8
53	0	0	9°27603	9°81070	68	10°71609	9°99212	7	7
54	0	0	9°27668	9°82118	68	10°71541	9°99209	6	6
55	0	0	9°27734	9°83166	68	10°71473	9°99207	5	5
56	0	0	9°27799	9°84214	65	10°71405	9°99204	4	4
57	0	0	9°27864	9°85262	67	10°71338	9°99202	3	3
58	0	0	9°27930	9°86310	68	10°71270	9°99200	2	2
59	0	0	9°27995	9°87358	68	10°71202	9°99197	1	1
60	0	0	9°28060	9°88406	67	10°71135	9°99195	0	0

[79 degrees.]



[11 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Sine.	Diff.	Tangent.	Diff.	Cotang.	Co-sine.	D.	✓
30	0	9.50966	61	9.30846	61	9.50966	61	9.30846	61	10.69154	9.99119	2	30
31	0	9.50028	62	9.30911	62	9.50028	62	9.30911	62	10.69089	9.99117	3	29
32	0	9.50090	61	9.30975	61	9.50090	61	9.30975	61	10.69023	9.99114	3	28
33	0	9.50151	61	9.31040	61	9.50151	61	9.31040	61	10.68960	9.99112	2	27
34	0	9.50213	62	9.31104	62	9.50213	62	9.31104	62	10.68896	9.99109	3	26
35	0	9.50275	61	9.31168	61	9.50275	61	9.31168	61	10.68832	9.99106	3	25
36	0	9.50336	62	9.31233	62	9.50336	62	9.31233	62	10.68767	9.99104	2	24
37	0	9.50398	61	9.31297	61	9.50398	61	9.31297	61	10.68703	9.99101	3	23
38	0	9.50459	62	9.31361	62	9.50459	62	9.31361	62	10.68639	9.99099	3	22
39	0	9.50521	61	9.31425	61	9.50521	61	9.31425	61	10.68575	9.99096	3	21
40	0	9.50582	61	9.31489	61	9.50582	61	9.31489	61	10.68511	9.99093	3	20
41	0	9.50643	61	9.31552	61	9.50643	61	9.31552	61	10.68448	9.99091	3	19
42	0	9.50704	61	9.31616	61	9.50704	61	9.31616	61	10.68384	9.99088	3	18
43	0	9.50765	61	9.31679	61	9.50765	61	9.31679	61	10.68321	9.99086	3	17
44	0	9.50826	61	9.31743	61	9.50826	61	9.31743	61	10.68257	9.99083	3	16
45	0	9.50887	60	9.31806	60	9.50887	60	9.31806	60	10.68194	9.99080	3	15
46	0	9.50947	60	9.31870	60	9.50947	60	9.31870	60	10.68130	9.99078	3	14
47	0	9.51008	60	9.31933	60	9.51008	60	9.31933	60	10.68067	9.99075	3	13
48	0	9.51068	61	9.31996	61	9.51068	61	9.31996	61	10.68004	9.99072	3	12
49	0	9.51129	60	9.32059	60	9.51129	60	9.32059	60	10.67941	9.99070	3	11
50	0	9.51189	61	9.32122	61	9.51189	61	9.32122	61	10.67878	9.99067	3	10
51	0	9.51250	60	9.32185	60	9.51250	60	9.32185	60	10.67815	9.99064	3	9
52	0	9.51310	60	9.32248	60	9.51310	60	9.32248	60	10.67752	9.99062	3	8
53	0	9.51370	60	9.32311	60	9.51370	60	9.32311	60	10.67689	9.99059	3	7
54	0	9.51430	60	9.32373	60	9.51430	60	9.32373	60	10.67627	9.99056	3	6
55	0	9.51490	59	9.32436	59	9.51490	59	9.32436	59	10.67564	9.99054	3	5
56	0	9.51549	60	9.32499	60	9.51549	60	9.32499	60	10.67502	9.99051	3	4
57	0	9.51609	60	9.32561	60	9.51609	60	9.32561	60	10.67439	9.99048	3	3
58	0	9.51669	59	9.32623	59	9.51669	59	9.32623	59	10.67377	9.99045	3	2
59	0	9.51728	60	9.32685	60	9.51728	60	9.32685	60	10.67315	9.99043	3	1
60	0	9.51788	60	9.32747	60	9.51788	60	9.32747	60	10.67253	9.99040	3	0

[78 degrees.]

[11 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Co-sine.	D.	✓
0	0	9.28060	65	9.28865	68	10.71135	9.99195	3	60
1	0	9.28125	65	9.28933	67	10.71067	9.99192	3	59
2	0	9.28190	64	9.29000	67	10.71000	9.99190	3	58
3	0	9.28254	65	9.29067	67	10.70933	9.99187	3	57
4	0	9.28319	65	9.29134	66	10.70866	9.99185	3	56
5	0	9.28384	64	9.29201	67	10.70799	9.99182	3	55
6	0	9.28448	64	9.29268	67	10.70732	9.99180	3	54
7	0	9.28512	65	9.29335	67	10.70665	9.99177	3	53
8	0	9.28577	64	9.29402	66	10.70598	9.99175	3	52
9	0	9.28641	64	9.29468	67	10.70532	9.99172	3	51
10	0	9.28705	64	9.29535	67	10.70465	9.99170	3	50
11	0	9.28769	64	9.29601	67	10.70399	9.99167	3	49
12	0	9.28833	63	9.29668	66	10.70332	9.99165	3	48
13	0	9.28896	64	9.29734	66	10.70266	9.99162	3	47
14	0	9.28960	64	9.29800	66	10.70200	9.99160	3	46
15	0	9.29024	63	9.29866	66	10.70134	9.99157	3	45
16	0	9.29087	63	9.29932	66	10.70068	9.99155	3	44
17	0	9.29150	64	9.29998	66	10.70002	9.99152	3	43
18	0	9.29214	63	9.30064	66	10.69936	9.99150	3	42
19	0	9.29277	63	9.30130	65	10.69870	9.99147	3	41
20	0	9.29340	63	9.30195	66	10.69805	9.99145	3	40
21	0	9.29403	63	9.30261	65	10.69739	9.99142	3	39
22	0	9.29466	63	9.30326	65	10.69674	9.99140	3	38
23	0	9.29529	62	9.30391	66	10.69609	9.99137	3	37
24	0	9.29591	63	9.30457	65	10.69543	9.99135	3	36
25	0	9.29654	62	9.30522	65	10.69478	9.99132	3	35
26	0	9.29716	63	9.30587	65	10.69413	9.99130	3	34
27	0	9.29779	62	9.30652	65	10.69348	9.99127	3	33
28	0	9.29841	62	9.30717	65	10.69283	9.99124	3	32
29	0	9.29903	63	9.30782	64	10.69218	9.99122	3	31
30	0	9.29966	63	9.30846	64	10.69154	9.99119	3	30

[78 degrees.]

[12 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	D.	'
0	0	9'31788	59	9'32747	61	10'67253	9'99040	2	60
0	1	9'31847	60	9'32810	62	10'67190	9'99038	3	59
0	2	9'31907	59	9'32872	61	10'67128	9'99035	3	58
0	3	9'31966	59	9'32933	61	10'67067	9'99032	3	57
0	4	9'32025	59	9'32995	62	10'67005	9'99030	3	56
0	5	9'32084	59	9'33057	62	10'66943	9'99027	3	55
0	6	9'32143	59	9'33119	61	10'66881	9'99024	3	54
0	7	9'32202	59	9'33180	62	10'66820	9'99022	3	53
0	8	9'32261	58	9'33242	61	10'66758	9'99019	3	52
0	9	9'32319	59	9'33303	62	10'66697	9'99016	3	51
0	10	9'32378	59	9'33365	61	10'66635	9'99013	3	50
0	11	9'32437	58	9'33426	61	10'66574	9'99011	3	49
0	12	9'32495	58	9'33487	61	10'66513	9'99008	3	48
0	13	9'32553	59	9'33548	61	10'66452	9'99005	3	47
0	14	9'32612	58	9'33609	61	10'66391	9'99002	3	46
0	15	9'32670	58	9'33670	61	10'66330	9'99000	3	45
0	16	9'32728	58	9'33731	61	10'66269	9'98997	3	44
0	17	9'32786	58	9'33792	61	10'66208	9'98994	3	43
0	18	9'32844	58	9'33853	60	10'66147	9'98991	3	42
0	19	9'32902	58	9'33913	61	10'66087	9'98989	3	41
0	20	9'32960	58	9'33974	60	10'66026	9'98986	3	40
0	21	9'33018	58	9'34034	61	10'65966	9'98983	3	39
0	22	9'33075	57	9'34095	60	10'65905	9'98980	3	38
0	23	9'33133	57	9'34155	60	10'65845	9'98978	3	37
0	24	9'33190	58	9'34215	61	10'65785	9'98975	3	36
0	25	9'33248	57	9'34276	60	10'65724	9'98972	3	35
0	26	9'33305	57	9'34336	60	10'65664	9'98969	3	34
0	27	9'33362	58	9'34396	60	10'65604	9'98967	3	33
0	28	9'33420	57	9'34456	60	10'65544	9'98964	3	32
0	29	9'33477	57	9'34516	60	10'65484	9'98961	3	31
0	30	9'33534	57	9'34576	60	10'65424	9'98958	3	30
		Cosine.	Cotang.	Tangent.	Diff.	Cotang.	Sine.		

[77 degrees.]

[12 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	D.	'
0	30	9'33534	57	9'34576	59	10'65444	9'98958	3	10
0	31	9'33591	56	9'34635	60	10'65385	9'98955	3	29
0	32	9'33647	57	9'34695	60	10'65326	9'98952	3	28
0	33	9'33704	57	9'34755	59	10'65267	9'98949	3	27
0	34	9'33761	57	9'34814	60	10'65208	9'98947	3	26
0	35	9'33818	56	9'34874	59	10'65149	9'98944	3	25
0	36	9'33874	57	9'34933	59	10'65090	9'98941	3	24
0	37	9'33931	56	9'34992	59	10'65031	9'98938	3	23
0	38	9'33987	56	9'35051	60	10'64972	9'98936	3	22
0	39	9'34043	57	9'35111	59	10'64913	9'98933	3	21
0	40	9'34100	56	9'35170	59	10'64854	9'98930	3	20
0	41	9'34156	56	9'35229	59	10'64795	9'98927	3	19
0	42	9'34212	56	9'35288	58	10'64736	9'98924	3	18
0	43	9'34268	56	9'35347	58	10'64677	9'98921	3	17
0	44	9'34324	56	9'35405	59	10'64618	9'98919	3	16
0	45	9'34380	56	9'35464	59	10'64559	9'98916	3	15
0	46	9'34436	55	9'35523	58	10'64500	9'98913	3	14
0	47	9'34491	56	9'35581	59	10'64441	9'98910	3	13
0	48	9'34547	55	9'35640	58	10'64382	9'98907	3	12
0	49	9'34602	56	9'35698	59	10'64323	9'98904	3	11
0	50	9'34658	55	9'35757	58	10'64264	9'98901	3	10
0	51	9'34713	56	9'35815	58	10'64205	9'98898	3	9
0	52	9'34769	55	9'35873	58	10'64146	9'98896	3	8
0	53	9'34824	55	9'35931	58	10'64087	9'98893	3	7
0	54	9'34879	55	9'35989	58	10'64028	9'98890	3	6
0	55	9'34934	55	9'36047	58	10'63969	9'98887	3	5
0	56	9'34989	55	9'36105	58	10'63910	9'98884	3	4
0	57	9'35044	55	9'36163	58	10'63851	9'98881	3	3
0	58	9'35099	55	9'36221	58	10'63792	9'98878	3	2
0	59	9'35154	55	9'36279	57	10'63733	9'98875	3	1
0	60	9'35209	55	9'36336	57	10'63674	9'98872	3	0
		Cosine.	Cotang.	Tangent.	Diff.	Cotang.	Sine.		

[77 degrees.]



[13 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Co-sine.	D.
10	0	9'36819	52	9'38035	56	10'61965	9'98783	3	30	
11	0	9'36871	53	9'38091	56	10'61909	9'98780	3	29	
12	0	9'36924	52	9'38147	55	10'61853	9'98777	3	28	
13	0	9'36976	52	9'38202	55	10'61798	9'98774	3	27	
14	0	9'37028	53	9'38257	56	10'61743	9'98771	3	26	
15	0	9'37081	52	9'38313	55	10'61687	9'98768	3	25	
16	0	9'37133	52	9'38368	55	10'61632	9'98765	3	24	
17	0	9'37185	52	9'38423	56	10'61577	9'98762	3	23	
18	0	9'37237	52	9'38479	55	10'61521	9'98759	3	22	
19	0	9'37289	52	9'38534	55	10'61466	9'98756	3	21	
20	0	9'37341	52	9'38589	55	10'61411	9'98753	3	20	
21	0	9'37393	52	9'38644	55	10'61356	9'98750	3	19	
22	0	9'37445	52	9'38699	55	10'61301	9'98746	3	18	
23	0	9'37497	52	9'38754	54	10'61246	9'98743	3	17	
24	0	9'37549	51	9'38808	54	10'61192	9'98740	3	16	
25	0	9'37600	51	9'38863	55	10'61137	9'98737	3	15	
26	0	9'37652	51	9'38918	54	10'61082	9'98734	3	14	
27	0	9'37703	52	9'38972	55	10'61028	9'98731	3	13	
28	0	9'37755	51	9'39027	55	10'60973	9'98728	3	12	
29	0	9'37806	52	9'39082	54	10'60918	9'98725	3	11	
30	0	9'37858	51	9'39136	54	10'60864	9'98722	3	10	
31	0	9'37909	51	9'39190	55	10'60810	9'98719	3	9	
32	0	9'37960	51	9'39245	54	10'60755	9'98715	3	8	
33	0	9'38011	51	9'39299	54	10'60701	9'98712	3	7	
34	0	9'38062	51	9'39353	54	10'60647	9'98709	3	6	
35	0	9'38113	51	9'39407	54	10'60593	9'98706	3	5	
36	0	9'38164	51	9'39461	54	10'60539	9'98703	3	4	
37	0	9'38215	51	9'39515	54	10'60485	9'98700	3	3	
38	0	9'38266	51	9'39569	54	10'60431	9'98697	3	2	
39	0	9'38317	51	9'39623	54	10'60377	9'98694	3	1	
40	0	9'38368	51	9'39677	54	10'60323	9'98690	3	0	

[76 degrees.]

[13 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Co-sine.	D.	
0	0	9'35209	54	9'36336	58	10'65664	9'98872	3	60
1	0	9'35261	55	9'36391	58	10'65608	9'98869	3	59
2	0	9'35313	55	9'36445	58	10'65552	9'98867	3	58
3	0	9'35373	55	9'36509	57	10'65497	9'98864	3	57
4	0	9'35431	54	9'36566	58	10'65443	9'98861	3	56
5	0	9'35481	55	9'36624	57	10'65387	9'98858	3	55
6	0	9'35536	54	9'36681	57	10'65332	9'98855	3	54
7	0	9'35590	54	9'36741	57	10'65276	9'98852	3	53
8	0	9'35644	54	9'36795	57	10'65220	9'98849	3	52
9	0	9'35698	54	9'36852	57	10'65164	9'98846	3	51
10	0	9'35752	54	9'36909	57	10'65109	9'98843	3	50
11	0	9'35806	54	9'36966	57	10'65054	9'98840	3	49
12	0	9'35860	54	9'37023	57	10'64997	9'98837	3	48
13	0	9'35914	54	9'37080	57	10'64940	9'98834	3	47
14	0	9'35968	54	9'37137	56	10'64883	9'98831	3	46
15	0	9'36022	53	9'37193	57	10'64827	9'98828	3	45
16	0	9'36075	54	9'37250	56	10'64770	9'98825	3	44
17	0	9'36129	53	9'37306	57	10'64714	9'98822	3	43
18	0	9'36182	54	9'37363	56	10'64657	9'98819	3	42
19	0	9'36236	53	9'37419	57	10'64601	9'98816	3	41
20	0	9'36289	53	9'37476	56	10'64544	9'98813	3	40
21	0	9'36342	54	9'37532	56	10'64488	9'98810	3	39
22	0	9'36395	54	9'37588	56	10'64432	9'98807	3	38
23	0	9'36449	53	9'37644	56	10'64375	9'98804	3	37
24	0	9'36502	53	9'37700	56	10'64319	9'98801	3	36
25	0	9'36555	53	9'37756	56	10'64262	9'98798	3	35
26	0	9'36608	52	9'37812	56	10'64206	9'98795	3	34
27	0	9'36660	53	9'37868	56	10'64150	9'98792	3	33
28	0	9'36713	53	9'37924	56	10'64094	9'98789	3	32
29	0	9'36766	53	9'37980	55	10'64038	9'98786	3	31
30	0	9'36819	53	9'38035	55	10'63982	9'98783	3	30

[76 degrees.]



[14 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Secant.	Diff.	Cotang.	Diff.	Cosine.	D.
10	0	9°3860	49	9°41266	52	10°58734	9°8594	3	10		
11	0	9°3909	49	9°41318	52	10°58682	9°8601	3	20		
12	0	9°3958	48	9°41370	52	10°58630	9°8608	3	30		
13	0	9°4006	48	9°41422	52	10°58578	9°8615	3	40		
14	0	9°4055	48	9°41474	52	10°58526	9°8622	3	50		
15	0	9°4103	49	9°41526	52	10°58474	9°8629	3	25		
16	0	9°4152	48	9°41578	52	10°58422	9°8636	3	24		
17	0	9°4200	49	9°41629	52	10°58371	9°8643	3	23		
18	0	9°4249	48	9°41681	52	10°58319	9°8650	3	22		
19	0	9°4297	49	9°41733	52	10°58267	9°8657	3	21		
20	0	9°4346	48	9°41784	52	10°58216	9°8664	3	20		
21	0	9°4394	48	9°41836	52	10°58164	9°8671	3	19		
22	0	9°4442	48	9°41887	52	10°58113	9°8678	3	18		
23	0	9°4490	48	9°41939	52	10°58061	9°8685	3	17		
24	0	9°4538	48	9°41990	52	10°58010	9°8692	3	16		
25	0	9°4586	48	9°42041	52	10°57959	9°8699	3	15		
26	0	9°4634	48	9°42093	52	10°57907	9°8706	3	14		
27	0	9°4682	48	9°42144	52	10°57856	9°8713	3	13		
28	0	9°4730	48	9°42195	52	10°57805	9°8720	3	12		
29	0	9°4778	47	9°42246	52	10°57754	9°8727	3	11		
30	0	9°4825	48	9°42297	52	10°57703	9°8734	3	10		
31	0	9°4873	48	9°42348	52	10°57652	9°8741	3	9		
32	0	9°4921	47	9°42399	52	10°57601	9°8748	3	8		
33	0	9°4968	48	9°42450	52	10°57550	9°8755	3	7		
34	0	9°5016	47	9°42501	52	10°57499	9°8762	3	6		
35	0	9°5063	48	9°42552	52	10°57448	9°8769	3	5		
36	0	9°5111	47	9°42603	50	10°57397	9°8776	3	4		
37	0	9°5158	47	9°42653	52	10°57347	9°8783	3	3		
38	0	9°5205	47	9°42704	52	10°57296	9°8790	3	2		
39	0	9°5252	48	9°42755	50	10°57245	9°8797	3	1		
40	0	9°5299	48	9°42805	50	10°57195	9°8804	3	0		

[75 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Secant.	Diff.	Cotang.	Diff.	Cosine.	D.
60	0	9°3868	50	9°39677	54	10°60333	9°8690	3	60		
61	0	9°3848	50	9°39721	54	10°60269	9°8687	3	59		
62	0	9°3849	50	9°39785	53	10°60215	9°8684	3	58		
63	0	9°3859	50	9°39838	54	10°60162	9°8681	3	57		
64	0	9°3870	51	9°39892	54	10°60108	9°8678	3	56		
65	0	9°3880	50	9°39945	54	10°60055	9°8675	3	55		
66	0	9°3890	51	9°39999	53	10°60001	9°8672	3	54		
67	0	9°3871	50	9°40052	54	10°59948	9°8669	3	53		
68	0	9°3871	50	9°40106	53	10°59894	9°8666	3	52		
69	0	9°3881	50	9°40159	53	10°59841	9°8663	3	51		
70	0	9°3871	50	9°40212	54	10°59788	9°8660	3	50		
71	0	9°3891	50	9°40266	53	10°59734	9°8657	3	49		
72	0	9°3871	50	9°40319	53	10°59681	9°8654	3	48		
73	0	9°39021	50	9°40372	53	10°59628	9°8651	3	47		
74	0	9°39071	50	9°40425	53	10°59575	9°8648	3	46		
75	0	9°39122	49	9°40478	53	10°59522	9°8645	3	45		
76	0	9°39170	50	9°40531	53	10°59469	9°8642	3	44		
77	0	9°39220	50	9°40584	52	10°59416	9°8639	3	43		
78	0	9°39270	49	9°40636	53	10°59364	9°8636	3	42		
79	0	9°39319	50	9°40689	53	10°59311	9°8633	3	41		
80	0	9°39369	49	9°40742	53	10°59258	9°8630	3	40		
81	0	9°39418	49	9°40795	52	10°59205	9°8627	3	39		
82	0	9°39467	50	9°40847	53	10°59153	9°8624	3	38		
83	0	9°39517	49	9°40900	52	10°59100	9°8621	3	37		
84	0	9°39566	49	9°40952	53	10°59048	9°8618	3	36		
85	0	9°39615	49	9°41005	53	10°58995	9°8615	3	35		
86	0	9°39664	49	9°41057	52	10°58943	9°8612	3	34		
87	0	9°39713	49	9°41109	52	10°58891	9°8609	3	33		
88	0	9°39762	49	9°41161	53	10°58839	9°8606	3	32		
89	0	9°39811	49	9°41214	52	10°58786	9°8603	3	31		
90	0	9°39860	49	9°41266	52	10°58734	9°8599	3	30		

[75 degrees.]

[15 degrees.]

°	Sine.	Tangent.	Diff.	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cothob.	D.	°
30	9.42690	9.44299	45	9.42690	9.44299	45	9.42690	9.44299	9.98391	3	30
31	9.42735	9.44348	46	9.42735	9.44348	46	9.42735	9.44348	9.98388	3	29
32	9.42781	9.44397	45	9.42781	9.44397	45	9.42781	9.44397	9.98384	3	28
33	9.42826	9.44446	46	9.42826	9.44446	46	9.42826	9.44446	9.98381	3	27
34	9.42872	9.44495	45	9.42872	9.44495	45	9.42872	9.44495	9.98377	4	26
35	9.42917	9.44544	45	9.42917	9.44544	45	9.42917	9.44544	9.98373	4	25
36	9.42962	9.44592	46	9.42962	9.44592	46	9.42962	9.44592	9.98370	3	24
37	9.43008	9.44641	45	9.43008	9.44641	45	9.43008	9.44641	9.98366	3	23
38	9.43053	9.44690	45	9.43053	9.44690	45	9.43053	9.44690	9.98363	4	22
39	9.43098	9.44738	45	9.43098	9.44738	45	9.43098	9.44738	9.98359	3	21
40	9.43143	9.44787	45	9.43143	9.44787	45	9.43143	9.44787	9.98356	4	20
41	9.43188	9.44836	45	9.43188	9.44836	45	9.43188	9.44836	9.98352	4	19
42	9.43233	9.44884	45	9.43233	9.44884	45	9.43233	9.44884	9.98349	3	18
43	9.43278	9.44933	45	9.43278	9.44933	45	9.43278	9.44933	9.98345	3	17
44	9.43323	9.44981	44	9.43323	9.44981	44	9.43323	9.44981	9.98342	3	16
45	9.43367	9.45029	45	9.43367	9.45029	45	9.43367	9.45029	9.98338	4	15
46	9.43412	9.45078	45	9.43412	9.45078	45	9.43412	9.45078	9.98334	3	14
47	9.43457	9.45126	45	9.43457	9.45126	45	9.43457	9.45126	9.98331	4	13
48	9.43502	9.45174	44	9.43502	9.45174	44	9.43502	9.45174	9.98327	3	12
49	9.43546	9.45222	45	9.43546	9.45222	45	9.43546	9.45222	9.98324	4	11
50	9.43591	9.45271	44	9.43591	9.45271	44	9.43591	9.45271	9.98320	3	10
51	9.43635	9.45319	45	9.43635	9.45319	45	9.43635	9.45319	9.98317	4	9
52	9.43680	9.45367	44	9.43680	9.45367	44	9.43680	9.45367	9.98313	4	8
53	9.43724	9.45415	45	9.43724	9.45415	45	9.43724	9.45415	9.98309	3	7
54	9.43769	9.45463	44	9.43769	9.45463	44	9.43769	9.45463	9.98306	4	6
55	9.43813	9.45511	44	9.43813	9.45511	44	9.43813	9.45511	9.98302	4	5
56	9.43857	9.45559	44	9.43857	9.45559	44	9.43857	9.45559	9.98299	3	4
57	9.43901	9.45606	45	9.43901	9.45606	45	9.43901	9.45606	9.98295	4	3
58	9.43946	9.45654	44	9.43946	9.45654	44	9.43946	9.45654	9.98291	4	2
59	9.43990	9.45702	44	9.43990	9.45702	44	9.43990	9.45702	9.98288	3	1
60	9.44034	9.45750	44	9.44034	9.45750	44	9.44034	9.45750	9.98284	3	0

[74 degrees.]

[15 degrees.]

°	Sine.	Tangent.	Diff.	Cotang.	Cothob.	D.	°
0	9.41300	9.42805	47	10.57195	9.98404	60	0
1	9.41347	9.42856	47	10.57144	9.98402	59	1
2	9.41394	9.42906	47	10.57093	9.98398	58	2
3	9.41441	9.42957	47	10.57043	9.98394	57	3
4	9.41488	9.43007	47	10.56993	9.98381	56	4
5	9.41535	9.43057	47	10.56943	9.98377	55	5
6	9.41582	9.43108	46	10.56892	9.98374	54	6
7	9.41628	9.43158	46	10.56842	9.98371	53	7
8	9.41675	9.43208	46	10.56792	9.98367	52	8
9	9.41722	9.43258	46	10.56742	9.98364	51	9
10	9.41767	9.43308	46	10.56692	9.98360	50	10
11	9.41815	9.43358	46	10.56642	9.98357	49	11
12	9.41861	9.43408	46	10.56592	9.98353	48	12
13	9.41908	9.43458	46	10.56542	9.98350	47	13
14	9.41954	9.43508	46	10.56492	9.98347	46	14
15	9.42001	9.43558	46	10.56442	9.98343	45	15
16	9.42047	9.43607	46	10.56393	9.98340	44	16
17	9.42093	9.43657	46	10.56343	9.98336	43	17
18	9.42140	9.43707	46	10.56293	9.98333	42	18
19	9.42186	9.43756	46	10.56244	9.98329	41	19
20	9.42232	9.43806	46	10.56194	9.98326	40	20
21	9.42278	9.43855	46	10.56145	9.98322	39	21
22	9.42324	9.43905	46	10.56095	9.98319	38	22
23	9.42370	9.43954	46	10.56046	9.98315	37	23
24	9.42416	9.44004	46	10.55996	9.98312	36	24
25	9.42461	9.44053	46	10.55947	9.98309	35	25
26	9.42507	9.44102	46	10.55898	9.98305	34	26
27	9.42553	9.44151	46	10.55849	9.98302	33	27
28	9.42599	9.44201	46	10.55799	9.98298	32	28
29	9.42644	9.44250	46	10.55750	9.98295	31	29
30	9.42690	9.44299	46	10.55701	9.98291	30	30

[74 degrees.]



[16 degrees.]

°	Sine	Diff.	Tangent.	Diff.	Cotang.	Co-sine.	°
0	9'44034	44	9'45750	47	10'54250	9'98284	60
1	9'44078	44	9'45797	48	10'54203	9'98281	59
2	9'44122	44	9'45845	48	10'54155	9'98277	58
3	9'44166	44	9'45892	47	10'54108	9'98273	57
4	9'44210	43	9'45940	47	10'54060	9'98270	56
5	9'44253	44	9'45987	48	10'54013	9'98266	55
6	9'44297	44	9'46035	47	10'53965	9'98262	54
7	9'44341	44	9'46082	48	10'53918	9'98259	53
8	9'44385	43	9'46130	47	10'53870	9'98255	52
9	9'44428	44	9'46177	47	10'53823	9'98251	51
10	9'44472	44	9'46224	47	10'53776	9'98248	50
11	9'44516	43	9'46271	48	10'53729	9'98244	49
12	9'44559	43	9'46319	47	10'53681	9'98240	48
13	9'44602	44	9'46366	47	10'53634	9'98237	47
14	9'44646	43	9'46413	47	10'53587	9'98233	46
15	9'44689	44	9'46460	47	10'53540	9'98229	45
16	9'44733	43	9'46507	47	10'53493	9'98226	44
17	9'44776	43	9'46554	47	10'53446	9'98222	43
18	9'44819	43	9'46601	47	10'53399	9'98218	42
19	9'44862	43	9'46648	46	10'53352	9'98215	41
20	9'44905	43	9'46694	47	10'53306	9'98211	40
21	9'44948	44	9'46741	47	10'53259	9'98207	39
22	9'44992	43	9'46788	47	10'53212	9'98204	38
23	9'45035	42	9'46835	46	10'53165	9'98200	37
24	9'45077	43	9'46881	47	10'53119	9'98196	36
25	9'45120	43	9'46928	47	10'53072	9'98192	35
26	9'45163	43	9'46975	46	10'53025	9'98189	34
27	9'45206	43	9'47021	47	10'52979	9'98185	33
28	9'45249	43	9'47068	46	10'52932	9'98181	32
29	9'45292	42	9'47114	46	10'52886	9'98177	31
30	9'45334		9'47160		10'52840	9'98174	30
	Co-sine.		Cotang.		Tangent.	Sine.	°

[73 degrees.]

°	Sine	Diff.	Tangent.	Diff.	Cotang.	Co-sine.	°
30	9'45334	43	9'47160	47	10'52840	9'98174	30
31	9'45377	43	9'47207	47	10'52793	9'98170	29
32	9'45419	43	9'47253	46	10'52747	9'98166	28
33	9'45462	43	9'47299	46	10'52701	9'98162	27
34	9'45504	43	9'47346	47	10'52654	9'98159	26
35	9'45547	42	9'47392	46	10'52608	9'98155	25
36	9'45589	43	9'47438	46	10'52562	9'98151	24
37	9'45631	43	9'47484	46	10'52516	9'98147	23
38	9'45674	42	9'47530	46	10'52470	9'98144	22
39	9'45716	42	9'47576	46	10'52424	9'98140	21
40	9'45758	43	9'47622	46	10'52378	9'98136	20
41	9'45801	42	9'47668	46	10'52332	9'98132	19
42	9'45843	42	9'47714	46	10'52286	9'98129	18
43	9'45885	42	9'47760	46	10'52240	9'98125	17
44	9'45927	42	9'47806	46	10'52194	9'98121	16
45	9'45969	42	9'47852	45	10'52148	9'98117	15
46	9'46011	42	9'47897	46	10'52103	9'98113	14
47	9'46053	42	9'47943	46	10'52057	9'98110	13
48	9'46095	41	9'47989	46	10'52011	9'98106	12
49	9'46136	42	9'48035	45	10'51965	9'98102	11
50	9'46178	42	9'48080	46	10'51920	9'98098	10
51	9'46220	42	9'48126	45	10'51874	9'98094	9
52	9'46262	41	9'48171	46	10'51828	9'98090	8
53	9'46303	42	9'48217	46	10'51783	9'98087	7
54	9'46345	41	9'48262	45	10'51738	9'98083	6
55	9'46386	42	9'48307	46	10'51693	9'98079	5
56	9'46428	41	9'48353	45	10'51647	9'98075	4
57	9'46469	42	9'48398	45	10'51602	9'98071	3
58	9'46511	41	9'48443	46	10'51557	9'98067	2
59	9'46552	42	9'48489	45	10'51511	9'98063	1
60	9'46594	42	9'48534	45	10'51466	9'98060	0
	Co-sine.		Cotang.		Tangent.	Sine.	°

[73 degrees.]



[17 degrees.]

°	Sines.	DIFF.	Tangent.	DIFF.	Sines.	DIFF.	Tangent.	DIFF.	Cotang.	Cotins.	D.
30	9.47814	40	9.49872	44	10.50128	44	9.97924	4	10.50128	9.97924	30
31	9.47854	40	9.49916	44	10.50084	44	9.97938	4	10.50084	9.97938	29
32	9.47894	40	9.49960	44	10.50040	44	9.97952	4	10.50040	9.97952	28
33	9.47934	40	9.50004	44	10.49996	44	9.97966	4	10.49996	9.97966	27
34	9.47974	40	9.50048	44	10.49952	44	9.97980	4	10.49952	9.97980	26
35	9.48014	40	9.50092	44	10.49908	44	9.97994	4	10.49908	9.97994	25
36	9.48054	40	9.50136	44	10.49864	44	9.98008	4	10.49864	9.98008	24
37	9.48094	39	9.50180	43	10.49820	43	9.98022	4	10.49820	9.98022	23
38	9.48134	39	9.50224	43	10.49776	43	9.98036	4	10.49776	9.98036	22
39	9.48174	39	9.50268	43	10.49732	43	9.98050	4	10.49732	9.98050	21
40	9.48214	39	9.50312	43	10.49688	43	9.98064	4	10.49688	9.98064	20
41	9.48254	40	9.50356	43	10.49644	43	9.98078	4	10.49644	9.98078	19
42	9.48294	40	9.50400	43	10.49600	43	9.98092	4	10.49600	9.98092	18
43	9.48334	39	9.50444	43	10.49556	43	9.98106	4	10.49556	9.98106	17
44	9.48374	39	9.50488	43	10.49512	43	9.98120	4	10.49512	9.98120	16
45	9.48414	39	9.50532	43	10.49468	43	9.98134	4	10.49468	9.98134	15
46	9.48454	40	9.50576	43	10.49424	43	9.98148	4	10.49424	9.98148	14
47	9.48494	40	9.50620	43	10.49380	43	9.98162	4	10.49380	9.98162	13
48	9.48534	39	9.50664	43	10.49336	43	9.98176	4	10.49336	9.98176	12
49	9.48574	39	9.50708	43	10.49292	43	9.98190	4	10.49292	9.98190	11
50	9.48614	40	9.50752	43	10.49248	43	9.98204	4	10.49248	9.98204	10
51	9.48654	39	9.50796	43	10.49204	43	9.98218	4	10.49204	9.98218	9
52	9.48694	39	9.50840	43	10.49160	43	9.98232	4	10.49160	9.98232	8
53	9.48734	39	9.50884	43	10.49116	43	9.98246	4	10.49116	9.98246	7
54	9.48774	39	9.50928	43	10.49072	43	9.98260	4	10.49072	9.98260	6
55	9.48814	39	9.50972	43	10.49028	43	9.98274	4	10.49028	9.98274	5
56	9.48854	39	9.51016	43	10.48984	43	9.98288	4	10.48984	9.98288	4
57	9.48894	39	9.51060	43	10.48940	43	9.98302	4	10.48940	9.98302	3
58	9.48934	39	9.51104	43	10.48896	43	9.98316	4	10.48896	9.98316	2
59	9.48974	39	9.51148	43	10.48852	43	9.98330	4	10.48852	9.98330	1
60	9.49014	39	9.51192	43	10.48808	43	9.98344	4	10.48808	9.98344	0

[72 degrees.]

[17 degrees.]

°	Sines.	DIFF.	Tangent.	DIFF.	Cotang.	Cotins.	D.
60	9.48660	45	10.51466	45	9.98060	9.98060	60
59	9.48635	45	10.51421	45	9.98056	9.98056	59
58	9.48610	45	10.51376	45	9.98052	9.98052	58
57	9.48585	45	10.51331	45	9.98048	9.98048	57
56	9.48560	45	10.51286	45	9.98044	9.98044	56
55	9.48535	45	10.51241	45	9.98040	9.98040	55
54	9.48510	45	10.51196	45	9.98036	9.98036	54
53	9.48485	45	10.51151	45	9.98032	9.98032	53
52	9.48460	45	10.51106	45	9.98028	9.98028	52
51	9.48435	45	10.51061	45	9.98024	9.98024	51
50	9.48410	45	10.51016	45	9.98020	9.98020	50
49	9.48385	45	10.50971	45	9.98016	9.98016	49
48	9.48360	45	10.50926	45	9.98012	9.98012	48
47	9.48335	45	10.50881	45	9.98008	9.98008	47
46	9.48310	45	10.50836	45	9.98004	9.98004	46
45	9.48285	45	10.50791	45	9.98000	9.98000	45
44	9.48260	45	10.50746	45	9.97996	9.97996	44
43	9.48235	45	10.50701	45	9.97992	9.97992	43
42	9.48210	45	10.50656	45	9.97988	9.97988	42
41	9.48185	45	10.50611	45	9.97984	9.97984	41
40	9.48160	45	10.50566	45	9.97980	9.97980	40
39	9.48135	45	10.50521	45	9.97976	9.97976	39
38	9.48110	45	10.50476	45	9.97972	9.97972	38
37	9.48085	45	10.50431	45	9.97968	9.97968	37
36	9.48060	45	10.50386	45	9.97964	9.97964	36
35	9.48035	45	10.50341	45	9.97960	9.97960	35
34	9.48010	45	10.50296	45	9.97956	9.97956	34
33	9.47985	45	10.50251	45	9.97952	9.97952	33
32	9.47960	45	10.50206	45	9.97948	9.97948	32
31	9.47935	45	10.50161	45	9.97944	9.97944	31
30	9.47910	45	10.50116	45	9.97940	9.97940	30

[72 degrees.]

[18 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Diff.	Secant.	Diff.
30	9° 50' 148	37	9° 52' 452	42	10° 47' 548	9° 97' 696	5	20		
31	9° 50' 185	38	9° 53' 494	42	10° 47' 556	9° 97' 691	5	20		
32	9° 50' 223	38	9° 54' 536	42	10° 47' 464	9° 97' 687	4	28		
33	9° 50' 261	38	9° 55' 578	42	10° 47' 422	9° 97' 683	4	27		
34	9° 50' 298	38	9° 56' 620	41	10° 47' 380	9° 97' 679	5	25		
35	9° 50' 336	38	9° 57' 661	42	10° 47' 339	9° 97' 674	4	26		
36	9° 50' 374	42	9° 58' 703	42	10° 47' 297	9° 97' 670	4	24		
37	9° 50' 411	38	9° 59' 745	42	10° 47' 255	9° 97' 666	4	23		
38	9° 50' 449	37	9° 59' 787	42	10° 47' 213	9° 97' 662	4	22		
39	9° 50' 486	37	9° 59' 829	41	10° 47' 171	9° 97' 657	4	21		
40	9° 50' 523	38	9° 59' 870	42	10° 47' 130	9° 97' 653	4	20		
41	9° 50' 561	37	9° 59' 912	41	10° 47' 088	9° 97' 649	4	19		
42	9° 50' 598	37	9° 59' 953	42	10° 47' 047	9° 97' 645	4	18		
43	9° 50' 635	38	9° 59' 995	42	10° 47' 005	9° 97' 640	5	17		
44	9° 50' 673	37	9° 59' 1037	42	10° 46' 963	9° 97' 636	4	16		
45	9° 50' 710	37	9° 59' 1078	42	10° 46' 922	9° 97' 632	4	15		
46	9° 50' 747	37	9° 59' 1120	41	10° 46' 880	9° 97' 628	5	14		
47	9° 50' 784	37	9° 59' 1161	42	10° 46' 839	9° 97' 623	4	13		
48	9° 50' 821	37	9° 59' 1202	42	10° 46' 798	9° 97' 619	4	12		
49	9° 50' 858	38	9° 59' 1244	42	10° 46' 756	9° 97' 615	5	11		
50	9° 50' 896	37	9° 59' 1285	42	10° 46' 715	9° 97' 610	4	10		
51	9° 50' 933	37	9° 59' 1327	41	10° 46' 673	9° 97' 606	4	9		
52	9° 50' 970	37	9° 59' 1368	41	10° 46' 632	9° 97' 602	5	8		
53	9° 51' 007	36	9° 59' 1409	41	10° 46' 591	9° 97' 597	4	7		
54	9° 51' 043	37	9° 59' 1450	42	10° 46' 550	9° 97' 593	4	6		
55	9° 51' 080	37	9° 59' 1492	41	10° 46' 508	9° 97' 589	5	5		
56	9° 51' 117	37	9° 59' 1533	41	10° 46' 467	9° 97' 584	5	4		
57	9° 51' 154	37	9° 59' 1574	41	10° 46' 426	9° 97' 580	4	3		
58	9° 51' 191	36	9° 59' 1615	41	10° 46' 385	9° 97' 576	5	2		
59	9° 51' 227	37	9° 59' 1656	41	10° 46' 344	9° 97' 571	4	1		
60	9° 51' 264	37	9° 59' 1697	41	10° 46' 303	9° 97' 567	4	0		

[71 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Diff.	Secant.	Diff.
0	9° 49' 998	39	9° 51' 178	43	10° 48' 822	9° 97' 821	4	60		
1	9° 49' 037	39	9° 51' 219	43	10° 48' 779	9° 97' 817	5	59		
2	9° 49' 076	39	9° 51' 264	42	10° 48' 736	9° 97' 812	5	58		
3	9° 49' 115	38	9° 51' 306	43	10° 48' 694	9° 97' 808	4	57		
4	9° 49' 153	39	9° 51' 349	43	10° 48' 651	9° 97' 804	4	56		
5	9° 49' 192	39	9° 51' 391	43	10° 48' 608	9° 97' 800	4	55		
6	9° 49' 231	38	9° 51' 433	43	10° 48' 565	9° 97' 796	4	54		
7	9° 49' 269	39	9° 51' 478	42	10° 48' 522	9° 97' 792	4	53		
8	9° 49' 308	39	9° 51' 520	43	10° 48' 480	9° 97' 788	4	52		
9	9° 49' 347	38	9° 51' 563	43	10° 48' 437	9° 97' 784	4	51		
10	9° 49' 385	39	9° 51' 608	42	10° 48' 394	9° 97' 779	4	50		
11	9° 49' 424	38	9° 51' 654	43	10° 48' 352	9° 97' 775	4	49		
12	9° 49' 462	38	9° 51' 691	43	10° 48' 309	9° 97' 771	4	48		
13	9° 49' 500	39	9° 51' 734	42	10° 48' 266	9° 97' 767	4	47		
14	9° 49' 539	38	9° 51' 776	43	10° 48' 224	9° 97' 763	4	46		
15	9° 49' 577	38	9° 51' 819	42	10° 48' 181	9° 97' 759	5	45		
16	9° 49' 615	39	9° 51' 861	42	10° 48' 139	9° 97' 754	4	44		
17	9° 49' 654	38	9° 51' 903	43	10° 48' 097	9° 97' 750	4	43		
18	9° 49' 692	38	9° 51' 946	42	10° 48' 054	9° 97' 746	4	42		
19	9° 49' 730	38	9° 51' 988	43	10° 48' 012	9° 97' 742	4	41		
20	9° 49' 768	38	9° 52' 031	42	10° 47' 969	9° 97' 738	4	40		
21	9° 49' 806	38	9° 52' 073	42	10° 47' 927	9° 97' 734	4	39		
22	9° 49' 844	38	9° 52' 115	42	10° 47' 885	9° 97' 729	5	38		
23	9° 49' 882	38	9° 52' 157	43	10° 47' 843	9° 97' 725	4	37		
24	9° 49' 920	38	9° 52' 200	42	10° 47' 800	9° 97' 721	4	36		
25	9° 49' 958	38	9° 52' 242	42	10° 47' 758	9° 97' 717	4	35		
26	9° 49' 996	38	9° 52' 284	42	10° 47' 716	9° 97' 713	4	34		
27	9° 50' 034	38	9° 52' 326	42	10° 47' 674	9° 97' 708	5	33		
28	9° 50' 072	38	9° 52' 368	42	10° 47' 632	9° 97' 704	4	32		
29	9° 50' 110	38	9° 52' 410	42	10° 47' 590	9° 97' 700	4	31		
30	9° 50' 148	38	9° 52' 452	42	10° 47' 548	9° 97' 696	4	30		

[71 degrees.]



[19 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Secant.	Diff.
30	0	9° 52' 30	35	9° 54' 01 5	40	10° 45' 08 5	9° 97' 43 5	30	
31	1	9° 52' 38	36	9° 54' 05 5	40	10° 45' 05 5	9° 97' 43 0	29	
32	2	9° 52' 42 1	35	9° 54' 09 5	40	10° 45' 00 5	9° 97' 42 6	28	
33	3	9° 52' 45 6	36	9° 55' 03 5	40	10° 44' 56 5	9° 97' 42 1	27	
34	4	9° 52' 49 2	35	9° 55' 07 5	40	10° 44' 51 5	9° 97' 41 7	26	
35	5	9° 52' 52 7	36	9° 55' 11 5	40	10° 44' 48 5	9° 97' 41 2	25	
36	6	9° 52' 56 3	35	9° 55' 15 5	40	10° 44' 44 5	9° 97' 40 8	24	
37	7	9° 52' 59 8	36	9° 55' 19 5	40	10° 44' 40 5	9° 97' 40 3	23	
38	8	9° 53' 03 4	35	9° 55' 23 5	40	10° 44' 37 5	9° 97' 39 9	22	
39	9	9° 53' 06 9	36	9° 55' 27 5	40	10° 44' 33 5	9° 97' 39 4	21	
40	10	9° 53' 10 5	35	9° 55' 31 5	40	10° 44' 30 5	9° 97' 39 0	20	
41	11	9° 53' 14 0	35	9° 55' 35 5	40	10° 44' 26 5	9° 97' 38 5	19	
42	12	9° 53' 17 5	36	9° 55' 39 5	40	10° 44' 23 5	9° 97' 38 1	18	
43	13	9° 53' 21 1	35	9° 55' 43 4	40	10° 44' 20 5	9° 97' 37 6	17	
44	14	9° 53' 24 6	35	9° 55' 47 4	40	10° 44' 16 5	9° 97' 37 2	16	
45	15	9° 53' 28 1	35	9° 55' 51 4	40	10° 44' 13 5	9° 97' 36 7	15	
46	16	9° 53' 31 6	35	9° 55' 55 4	39	10° 44' 10 5	9° 97' 36 3	14	
47	17	9° 53' 35 1	35	9° 55' 59 3	40	10° 44' 07 5	9° 97' 35 8	13	
48	18	9° 53' 38 6	35	9° 56' 03 3	40	10° 44' 04 5	9° 97' 35 3	12	
49	19	9° 53' 42 1	35	9° 56' 07 3	39	10° 44' 01 5	9° 97' 34 9	11	
50	20	9° 53' 45 6	36	9° 56' 11 2	40	10° 43' 58 5	9° 97' 34 4	10	
51	21	9° 53' 49 1	34	9° 56' 15 2	39	10° 43' 55 5	9° 97' 34 0	9	
52	22	9° 53' 52 6	35	9° 56' 19 1	40	10° 43' 52 5	9° 97' 33 5	8	
53	23	9° 53' 56 1	35	9° 56' 23 1	40	10° 43' 49 5	9° 97' 33 1	7	
54	24	9° 53' 59 6	35	9° 56' 27 0	39	10° 43' 46 5	9° 97' 32 6	6	
55	25	9° 54' 03 1	35	9° 56' 31 0	39	10° 43' 43 5	9° 97' 32 2	5	
56	26	9° 54' 06 6	35	9° 56' 34 9	40	10° 43' 40 5	9° 97' 31 7	4	
57	27	9° 54' 10 1	35	9° 56' 38 9	39	10° 43' 37 5	9° 97' 31 2	3	
58	28	9° 54' 13 6	35	9° 56' 42 8	39	10° 43' 34 5	9° 97' 30 8	2	
59	29	9° 54' 17 1	35	9° 56' 46 7	39	10° 43' 31 5	9° 97' 30 3	1	
60	30	9° 54' 20 6	35	9° 56' 50 7	40	10° 43' 28 5	9° 97' 29 9	0	

[70 degrees.]

[19 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Secant.	Diff.
60	0	9° 53' 30	35	9° 54' 01 5	40	10° 45' 08 5	9° 97' 43 5	30	
59	1	9° 52' 38	36	9° 54' 05 5	40	10° 45' 05 5	9° 97' 43 0	29	
58	2	9° 52' 42 1	35	9° 54' 09 5	40	10° 45' 00 5	9° 97' 42 6	28	
57	3	9° 52' 45 6	36	9° 54' 13 5	40	10° 44' 56 5	9° 97' 42 1	27	
56	4	9° 52' 49 2	35	9° 54' 17 5	40	10° 44' 51 5	9° 97' 41 7	26	
55	5	9° 52' 52 7	36	9° 54' 21 5	40	10° 44' 48 5	9° 97' 41 2	25	
54	6	9° 52' 56 3	35	9° 54' 25 5	40	10° 44' 44 5	9° 97' 40 8	24	
53	7	9° 52' 59 8	36	9° 54' 29 5	40	10° 44' 40 5	9° 97' 40 3	23	
52	8	9° 53' 03 4	35	9° 54' 33 5	40	10° 44' 37 5	9° 97' 39 9	22	
51	9	9° 53' 06 9	36	9° 54' 37 5	40	10° 44' 33 5	9° 97' 39 4	21	
50	10	9° 53' 10 5	35	9° 54' 41 5	40	10° 44' 30 5	9° 97' 39 0	20	
49	11	9° 53' 14 0	35	9° 54' 45 5	40	10° 44' 26 5	9° 97' 38 5	19	
48	12	9° 53' 17 5	36	9° 54' 49 5	40	10° 44' 23 5	9° 97' 38 1	18	
47	13	9° 53' 21 1	35	9° 54' 53 4	40	10° 44' 20 5	9° 97' 37 6	17	
46	14	9° 53' 24 6	35	9° 54' 57 4	40	10° 44' 16 5	9° 97' 37 2	16	
45	15	9° 53' 28 1	35	9° 55' 01 4	40	10° 44' 13 5	9° 97' 36 7	15	
44	16	9° 53' 31 6	35	9° 55' 05 4	39	10° 44' 10 5	9° 97' 36 3	14	
43	17	9° 53' 35 1	35	9° 55' 09 3	40	10° 44' 07 5	9° 97' 35 8	13	
42	18	9° 53' 38 6	35	9° 55' 13 3	40	10° 44' 04 5	9° 97' 35 3	12	
41	19	9° 53' 42 1	35	9° 55' 17 3	39	10° 44' 01 5	9° 97' 34 9	11	
40	20	9° 53' 45 6	36	9° 55' 21 2	40	10° 43' 58 5	9° 97' 34 4	10	
39	21	9° 53' 49 1	34	9° 55' 25 2	39	10° 43' 55 5	9° 97' 34 0	9	
38	22	9° 53' 52 6	35	9° 55' 29 1	40	10° 43' 52 5	9° 97' 33 5	8	
37	23	9° 53' 56 1	35	9° 55' 33 1	40	10° 43' 49 5	9° 97' 33 1	7	
36	24	9° 53' 59 6	35	9° 55' 37 0	39	10° 43' 46 5	9° 97' 32 6	6	
35	25	9° 54' 03 1	35	9° 55' 41 0	39	10° 43' 43 5	9° 97' 32 2	5	
34	26	9° 54' 06 6	35	9° 55' 44 9	40	10° 43' 40 5	9° 97' 31 7	4	
33	27	9° 54' 10 1	35	9° 55' 48 9	39	10° 43' 37 5	9° 97' 31 2	3	
32	28	9° 54' 13 6	35	9° 55' 52 8	39	10° 43' 34 5	9° 97' 30 8	2	
31	29	9° 54' 17 1	35	9° 55' 56 7	39	10° 43' 31 5	9° 97' 30 3	1	
30	30	9° 54' 20 6	35	9° 56' 00 7	40	10° 43' 28 5	9° 97' 29 9	0	

[70 degrees.]



[20 degrees.]

'	Sine.	Diff.	Tangent.	Cotang.	Co-sine.	D.
30	9.54433	33	9.57274		10.42726	30
31	9.54466	33	9.57312		10.42688	29
32	9.54500	34	9.57351		10.42649	28
33	9.54534	34	9.57389		10.42611	27
34	9.54567	33	9.57428		10.42572	26
35	9.54601	34	9.57466		10.42534	25
36	9.54635	33	9.57504		10.42496	24
37	9.54668	34	9.57543		10.42457	23
38	9.54702	34	9.57581		10.42419	22
39	9.54735	34	9.57619		10.42381	21
40	9.54768	33	9.57658		10.42342	20
41	9.54802	34	9.57696		10.42304	19
42	9.54836	33	9.57734		10.42266	18
43	9.54869	34	9.57772		10.42228	17
44	9.54903	33	9.57810		10.42190	16
45	9.54936	33	9.57849		10.42151	15
46	9.54969	34	9.57887		10.42113	14
47	9.55003	33	9.57925		10.42075	13
48	9.55036	33	9.57963		10.42037	12
49	9.55069	34	9.58001		10.41999	11
50	9.55102	34	9.58039		10.41961	10
51	9.55136	33	9.58077		10.41923	9
52	9.55169	33	9.58115		10.41885	8
53	9.55202	33	9.58153		10.41847	7
54	9.55235	33	9.58191		10.41809	6
55	9.55268	33	9.58229		10.41771	5
56	9.55301	33	9.58267		10.41733	4
57	9.55334	33	9.58304		10.41696	3
58	9.55367	33	9.58342		10.41658	2
59	9.55400	33	9.58380		10.41620	1
60	9.55433	33	9.58418		10.41582	0

[69 degrees.]

'	Sine.	Diff.	Tangent.	Cotang.	Co-sine.	D.
60	9.53405	35	9.56107	10.43893	9.97299	60
59	9.53440	35	9.56146	10.43854	9.97294	59
58	9.53475	35	9.56185	10.43815	9.97289	58
57	9.53509	35	9.56224	10.43776	9.97285	57
56	9.53544	34	9.56264	10.43736	9.97280	56
55	9.53578	34	9.56303	10.43697	9.97276	55
54	9.53613	34	9.56342	10.43658	9.97271	54
53	9.53647	35	9.56381	10.43619	9.97267	53
52	9.53682	35	9.56420	10.43580	9.97262	52
51	9.53716	34	9.56459	10.43541	9.97257	51
50	9.53751	34	9.56498	10.43502	9.97252	50
49	9.53785	34	9.56537	10.43463	9.97248	49
48	9.53819	35	9.56576	10.43424	9.97243	48
47	9.53854	34	9.56615	10.43385	9.97238	47
46	9.53888	34	9.56654	10.43346	9.97234	46
45	9.53922	35	9.56693	10.43307	9.97229	45
44	9.53957	34	9.56732	10.43268	9.97224	44
43	9.53991	34	9.56771	10.43229	9.97220	43
42	9.54025	34	9.56810	10.43190	9.97215	42
41	9.54059	34	9.56849	10.43151	9.97210	41
40	9.54093	34	9.56887	10.43113	9.97206	40
39	9.54127	34	9.56926	10.43074	9.97201	39
38	9.54161	34	9.56965	10.43035	9.97196	38
37	9.54195	34	9.57004	10.42996	9.97192	37
36	9.54229	34	9.57042	10.42958	9.97187	36
35	9.54263	34	9.57081	10.42919	9.97182	35
34	9.54297	34	9.57120	10.42880	9.97178	34
33	9.54331	34	9.57158	10.42842	9.97173	33
32	9.54365	34	9.57197	10.42803	9.97168	32
31	9.54399	34	9.57235	10.42765	9.97163	31
30	9.54433	34	9.57274	10.42726	9.97159	30

[69 degrees.]

[21 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Contang.	Diff.	Tangent.	Contang.	Co-sine.	D.
30	9'56408	32	9'59540	37	10'40460	9'96868				30
31	9'56440	32	9'59577	37	10'40423	9'96863				29
32	9'56472	32	9'59614	37	10'40386	9'96858				28
33	9'56504	32	9'59651	37	10'40349	9'96853				27
34	9'56536	32	9'59688	37	10'40312	9'96848				26
35	9'56568	32	9'59725	37	10'40275	9'96843				25
36	9'56599	32	9'59762	37	10'40238	9'96838				24
37	9'56631	32	9'59799	36	10'40201	9'96833				23
38	9'56663	32	9'59835	37	10'40165	9'96828				22
39	9'56695	32	9'59872	37	10'40128	9'96823				21
40	9'56727	32	9'59909	37	10'40091	9'96818				20
41	9'56759	32	9'59946	37	10'40054	9'96813				19
42	9'56790	32	9'59983	36	10'40017	9'96808				18
43	9'56822	32	9'60019	37	10'39981	9'96803				17
44	9'56854	32	9'60056	37	10'39944	9'96798				16
45	9'56886	32	9'60093	37	10'39907	9'96793				15
46	9'56917	32	9'60130	36	10'39870	9'96788				14
47	9'56949	32	9'60166	37	10'39834	9'96783				13
48	9'56980	32	9'60203	37	10'39797	9'96778				12
49	9'57012	32	9'60240	36	10'39760	9'96772				11
50	9'57044	32	9'60276	37	10'39724	9'96767				10
51	9'57075	32	9'60313	36	10'39687	9'96762				9
52	9'57107	32	9'60349	37	10'39651	9'96757				8
53	9'57138	32	9'60386	36	10'39614	9'96752				7
54	9'57169	32	9'60422	37	10'39578	9'96747				6
55	9'57201	32	9'60459	36	10'39541	9'96742				5
56	9'57232	32	9'60495	37	10'39505	9'96737				4
57	9'57264	32	9'60532	36	10'39468	9'96732				3
58	9'57295	32	9'60568	37	10'39432	9'96727				2
59	9'57326	32	9'60605	36	10'39395	9'96722				1
60	9'57358	32	9'60641	37	10'39359	9'96717				0

[68 degrees.]

[21 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Contang.	Co-sine.	D.
0	9'58433	33	9'58418	37	10'41582	9'97015	60
1	9'58466	33	9'58455	37	10'41545	9'97010	59
2	9'58499	33	9'58493	38	10'41507	9'97005	58
3	9'58532	33	9'58531	38	10'41469	9'97001	57
4	9'58564	33	9'58569	37	10'41431	9'96996	56
5	9'58597	33	9'58606	37	10'41394	9'96991	55
6	9'58630	33	9'58644	37	10'41356	9'96986	54
7	9'58663	33	9'58683	38	10'41319	9'96981	53
8	9'58695	33	9'58719	38	10'41281	9'96976	52
9	9'58728	33	9'58757	37	10'41243	9'96971	51
10	9'58761	32	9'58794	38	10'41206	9'96966	50
11	9'58793	33	9'58831	37	10'41168	9'96962	49
12	9'58826	32	9'58869	38	10'41131	9'96957	48
13	9'58858	33	9'58907	37	10'41093	9'96952	47
14	9'58891	33	9'58944	37	10'41056	9'96947	46
15	9'58923	33	9'58981	38	10'41019	9'96942	45
16	9'58956	32	9'59019	37	10'40981	9'96937	44
17	9'58988	33	9'59056	38	10'40944	9'96932	43
18	9'59021	32	9'59094	37	10'40906	9'96927	42
19	9'59053	32	9'59132	37	10'40869	9'96922	41
20	9'59085	33	9'59168	37	10'40832	9'96917	40
21	9'59118	32	9'59205	38	10'40795	9'96912	39
22	9'59150	32	9'59242	37	10'40757	9'96907	38
23	9'59182	33	9'59280	37	10'40720	9'96902	37
24	9'59215	32	9'59317	37	10'40683	9'96898	36
25	9'59247	32	9'59354	37	10'40646	9'96893	35
26	9'59279	32	9'59391	38	10'40609	9'96888	34
27	9'59311	32	9'59429	37	10'40571	9'96883	33
28	9'59343	32	9'59466	37	10'40534	9'96878	32
29	9'59375	32	9'59503	37	10'40497	9'96873	31
30	9'59408	33	9'59540	37	10'40460	9'96868	30

[68 degrees.]



[22 degrees.]

°	′	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Cosine.	′	D.
30	0	9° 58' 24	30	9° 61' 72	36	10° 38' 28	9° 58' 56	6	30		
31	0	9° 58' 34	31	9° 61' 58	36	10° 38' 42	9° 59' 51	5	28		
32	0	9° 58' 45	30	9° 61' 79	36	10° 38' 56	9° 60' 51	5	27		
33	0	9° 58' 57	31	9° 61' 30	35	10° 38' 13	9° 61' 46	5	26		
34	0	9° 59' 06	30	9° 61' 86	35	10° 38' 28	9° 62' 41	6	25		
35	0	9° 59' 16	31	9° 61' 90	35	10° 38' 43	9° 63' 35	5	24		
36	0	9° 59' 27	30	9° 61' 36	36	10° 38' 58	9° 64' 30	5	23		
37	0	9° 59' 37	30	9° 61' 92	36	10° 39' 12	9° 65' 25	5	22		
38	0	9° 59' 47	30	9° 62' 08	35	10° 39' 27	9° 66' 20	6	21		
39	0	9° 59' 57	31	9° 62' 04	36	10° 39' 42	9° 67' 14	5	20		
40	0	9° 59' 58	30	9° 62' 09	35	10° 39' 57	9° 68' 09	5	19		
41	0	9° 59' 59	30	9° 62' 11	36	10° 40' 12	9° 69' 04	6	18		
42	0	9° 59' 60	30	9° 62' 15	36	10° 40' 27	9° 70' 00	5	17		
43	0	9° 59' 61	31	9° 62' 18	36	10° 40' 42	9° 70' 96	5	16		
44	0	9° 59' 62	30	9° 62' 21	35	10° 40' 57	9° 71' 92	5	15		
45	0	9° 59' 63	30	9° 62' 25	35	10° 41' 12	9° 72' 88	6	14		
46	0	9° 59' 64	30	9° 62' 29	35	10° 41' 27	9° 73' 84	5	13		
47	0	9° 59' 65	30	9° 62' 33	35	10° 41' 42	9° 74' 80	5	12		
48	0	9° 59' 66	30	9° 62' 36	36	10° 41' 57	9° 75' 76	6	11		
49	0	9° 59' 67	30	9° 62' 39	35	10° 42' 12	9° 76' 72	5	10		
50	0	9° 59' 68	30	9° 62' 43	35	10° 42' 27	9° 77' 68	5	9		
51	0	9° 59' 69	30	9° 62' 46	36	10° 42' 42	9° 78' 64	6	8		
52	0	9° 59' 70	30	9° 62' 50	35	10° 42' 57	9° 79' 60	5	7		
53	0	9° 59' 71	30	9° 62' 53	35	10° 43' 12	9° 80' 56	5	6		
54	0	9° 59' 72	30	9° 62' 57	35	10° 43' 27	9° 81' 52	6	5		
55	0	9° 59' 73	30	9° 62' 59	36	10° 43' 42	9° 82' 48	5	4		
56	0	9° 59' 74	29	9° 63' 02	35	10° 43' 57	9° 83' 44	5	3		
57	0	9° 59' 75	30	9° 63' 06	35	10° 44' 12	9° 84' 40	6	2		
58	0	9° 59' 76	30	9° 63' 10	35	10° 44' 27	9° 85' 36	5	1		
59	0	9° 59' 77	30	9° 63' 14	35	10° 44' 42	9° 86' 32	5	0		
60	0	9° 59' 78	30	9° 63' 18	35	10° 44' 57	9° 87' 28	5	0		

[67 degrees.]

[22 degrees.]

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

[67 degrees.]



[23 degrees.]

'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	'
0	9.59188	30	9.61785	35	10.17215	9.96403	60
1	9.59218	29	9.61820	35	10.17180	9.96397	59
2	9.59247	29	9.61855	35	10.17145	9.96391	58
3	9.59277	30	9.61890	36	10.17110	9.96387	57
4	9.59307	29	9.61926	35	10.17074	9.96381	56
5	9.59336	29	9.61961	35	10.17039	9.96376	55
6	9.59366	30	9.61996	35	10.17004	9.96370	54
7	9.59395	29	9.62031	35	10.16969	9.96365	53
8	9.59425	29	9.62066	35	10.16934	9.96360	52
9	9.59455	29	9.62101	34	10.16899	9.96354	51
10	9.59484	30	9.62135	35	10.16865	9.96349	50
11	9.59514	29	9.62170	35	10.16830	9.96343	49
12	9.59543	30	9.62205	35	10.16795	9.96338	48
13	9.59573	29	9.62240	35	10.16760	9.96333	47
14	9.59602	29	9.62275	35	10.16725	9.96327	46
15	9.59632	29	9.62310	35	10.16690	9.96322	45
16	9.59661	29	9.62345	34	10.16655	9.96316	44
17	9.59690	30	9.62379	35	10.16621	9.96311	43
18	9.59720	29	9.62414	35	10.16586	9.96305	42
19	9.59749	29	9.62449	35	10.16551	9.96300	41
20	9.59778	29	9.62484	35	10.16516	9.96294	40
21	9.59808	29	9.62519	34	10.16481	9.96289	39
22	9.59837	29	9.62553	35	10.16446	9.96284	38
23	9.59866	29	9.62588	35	10.16411	9.96278	37
24	9.59895	29	9.62623	35	10.16377	9.96273	36
25	9.59924	30	9.62657	35	10.16342	9.96267	35
26	9.59954	29	9.62692	34	10.16308	9.96262	34
27	9.59983	29	9.62726	35	10.16274	9.96256	33
28	9.60012	29	9.62761	35	10.16239	9.96251	32
29	9.60041	29	9.62796	34	10.16204	9.96245	31
30	9.60070	29	9.62830	34	10.16170	9.96240	30
	Cotang.		Tangent.		Sine.		'

[66 degrees.]

[23 degrees.]

'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	'
30	9.60070	29	9.62865	35	10.16135	9.96234	60
31	9.60099	29	9.62899	34	10.16101	9.96234	59
32	9.60128	29	9.62933	35	10.16066	9.96233	58
33	9.60157	29	9.62967	34	10.16032	9.96232	57
34	9.60186	29	9.63001	35	10.15997	9.96231	56
35	9.60215	29	9.63034	34	10.15963	9.96230	55
36	9.60244	29	9.63067	35	10.15928	9.96229	54
37	9.60273	29	9.63101	34	10.15894	9.96228	53
38	9.60302	29	9.63134	35	10.15860	9.96227	52
39	9.60331	28	9.63167	34	10.15825	9.96226	51
40	9.60359	29	9.63201	35	10.15791	9.96225	50
41	9.60388	29	9.63234	34	10.15757	9.96224	49
42	9.60417	29	9.63267	35	10.15722	9.96223	48
43	9.60446	28	9.63301	34	10.15688	9.96222	47
44	9.60474	29	9.63334	35	10.15654	9.96221	46
45	9.60503	29	9.63367	34	10.15619	9.96220	45
46	9.60532	29	9.63401	35	10.15585	9.96219	44
47	9.60561	28	9.63434	34	10.15551	9.96218	43
48	9.60589	29	9.63467	35	10.15517	9.96217	42
49	9.60618	28	9.63501	34	10.15483	9.96216	41
50	9.60646	29	9.63534	35	10.15448	9.96215	40
51	9.60675	29	9.63567	34	10.15414	9.96214	39
52	9.60704	28	9.63601	35	10.15380	9.96213	38
53	9.60732	29	9.63634	34	10.15346	9.96212	37
54	9.60761	28	9.63667	35	10.15312	9.96211	36
55	9.60789	29	9.63701	34	10.15278	9.96210	35
56	9.60818	28	9.63734	35	10.15244	9.96209	34
57	9.60846	29	9.63767	34	10.15210	9.96208	33
58	9.60875	28	9.63801	35	10.15176	9.96207	32
59	9.60903	28	9.63834	34	10.15142	9.96206	31
60	9.60931	28	9.63868	34	10.15108	9.96205	30
	Cotang.		Tangent.		Sine.		'

[66 degrees.]

## [24 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Co-sine.	°
0	0.00000	0	0.00000	0	1.00000	1.00000	90
1	0.01746	19	0.03492	19	0.98254	0.98254	89
2	0.03492	38	0.06984	38	0.96508	0.96508	88
3	0.05237	57	0.10476	57	0.94762	0.94762	87
4	0.06984	76	0.13968	76	0.93016	0.93016	86
5	0.08730	95	0.17460	95	0.91270	0.91270	85
6	0.10476	114	0.20952	114	0.89524	0.89524	84
7	0.12223	133	0.24444	133	0.87778	0.87778	83
8	0.13968	152	0.27936	152	0.86032	0.86032	82
9	0.15714	171	0.31428	171	0.84286	0.84286	81
10	0.17460	190	0.34920	190	0.82540	0.82540	80
11	0.19206	209	0.38412	209	0.80794	0.80794	79
12	0.20952	228	0.41904	228	0.79048	0.79048	78
13	0.22698	247	0.45396	247	0.77302	0.77302	77
14	0.24444	266	0.48888	266	0.75556	0.75556	76
15	0.26190	285	0.52380	285	0.73810	0.73810	75
16	0.27936	304	0.55872	304	0.72064	0.72064	74
17	0.29682	323	0.59364	323	0.70318	0.70318	73
18	0.31428	342	0.62856	342	0.68572	0.68572	72
19	0.33174	361	0.66348	361	0.66826	0.66826	71
20	0.34920	380	0.69840	380	0.65080	0.65080	70
21	0.36666	399	0.73332	399	0.63334	0.63334	69
22	0.38412	418	0.76824	418	0.61588	0.61588	68
23	0.40158	437	0.80316	437	0.59842	0.59842	67
24	0.41904	456	0.83808	456	0.58096	0.58096	66
25	0.43650	475	0.87300	475	0.56350	0.56350	65
26	0.45396	494	0.90792	494	0.54604	0.54604	64
27	0.47142	513	0.94284	513	0.52858	0.52858	63
28	0.48888	532	0.97776	532	0.51112	0.51112	62
29	0.50634	551	1.01268	551	0.49366	0.49366	61
30	0.52380	570	1.04760	570	0.47620	0.47620	60

## [65 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Co-sine.	°
30	0.50000	0	0.50000	0	1.00000	0.50000	60
1	0.51746	19	0.53492	19	0.98254	0.48254	59
2	0.53492	38	0.56984	38	0.96508	0.46508	58
3	0.55237	57	0.60476	57	0.94762	0.44762	57
4	0.56984	76	0.63968	76	0.93016	0.43016	56
5	0.58730	95	0.67460	95	0.91270	0.41270	55
6	0.60476	114	0.70952	114	0.89524	0.39524	54
7	0.62223	133	0.74444	133	0.87778	0.37778	53
8	0.63968	152	0.77936	152	0.86032	0.36032	52
9	0.65714	171	0.81428	171	0.84286	0.34286	51
10	0.67460	190	0.84920	190	0.82540	0.32540	50
11	0.69206	209	0.88412	209	0.80794	0.30794	49
12	0.70952	228	0.91904	228	0.79048	0.29048	48
13	0.72698	247	0.95396	247	0.77302	0.27302	47
14	0.74444	266	0.98888	266	0.75556	0.25556	46
15	0.76190	285	1.02380	285	0.73810	0.23810	45
16	0.77936	304	1.05872	304	0.72064	0.22064	44
17	0.79682	323	1.09364	323	0.70318	0.20318	43
18	0.81428	342	1.12856	342	0.68572	0.18572	42
19	0.83174	361	1.16348	361	0.66826	0.16826	41
20	0.84920	380	1.19840	380	0.65080	0.15080	40
21	0.86666	399	1.23332	399	0.63334	0.13334	39
22	0.88412	418	1.26824	418	0.61588	0.11588	38
23	0.90158	437	1.30316	437	0.59842	0.09842	37
24	0.91904	456	1.33808	456	0.58096	0.08096	36
25	0.93650	475	1.37300	475	0.56350	0.06350	35
26	0.95396	494	1.40792	494	0.54604	0.04604	34
27	0.97142	513	1.44284	513	0.52858	0.02858	33
28	0.98888	532	1.47776	532	0.51112	0.01112	32
29	1.00634	551	1.51268	551	0.49366	0.00366	31
30	1.02380	570	1.54760	570	0.47620	0.00620	30

## [24 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Co-sine.	°
30	0.50000	0	0.50000	0	1.00000	0.50000	60
1	0.51746	19	0.53492	19	0.98254	0.48254	59
2	0.53492	38	0.56984	38	0.96508	0.46508	58
3	0.55237	57	0.60476	57	0.94762	0.44762	57
4	0.56984	76	0.63968	76	0.93016	0.43016	56
5	0.58730	95	0.67460	95	0.91270	0.41270	55
6	0.60476	114	0.70952	114	0.89524	0.39524	54
7	0.62223	133	0.74444	133	0.87778	0.37778	53
8	0.63968	152	0.77936	152	0.86032	0.36032	52
9	0.65714	171	0.81428	171	0.84286	0.34286	51
10	0.67460	190	0.84920	190	0.82540	0.32540	50
11	0.69206	209	0.88412	209	0.80794	0.30794	49
12	0.70952	228	0.91904	228	0.79048	0.29048	48
13	0.72698	247	0.95396	247	0.77302	0.27302	47
14	0.74444	266	0.98888	266	0.75556	0.25556	46
15	0.76190	285	1.02380	285	0.73810	0.23810	45
16	0.77936	304	1.05872	304	0.72064	0.22064	44
17	0.79682	323	1.09364	323	0.70318	0.20318	43
18	0.81428	342	1.12856	342	0.68572	0.18572	42
19	0.83174	361	1.16348	361	0.66826	0.16826	41
20	0.84920	380	1.19840	380	0.65080	0.15080	40
21	0.86666	399	1.23332	399	0.63334	0.13334	39
22	0.88412	418	1.26824	418	0.61588	0.11588	38
23	0.90158	437	1.30316	437	0.59842	0.09842	37
24	0.91904	456	1.33808	456	0.58096	0.08096	36
25	0.93650	475	1.37300	475	0.56350	0.06350	35
26	0.95396	494	1.40792	494	0.54604	0.04604	34
27	0.97142	513	1.44284	513	0.52858	0.02858	33
28	0.98888	532	1.47776	532	0.51112	0.01112	32
29	1.00634	551	1.51268	551	0.49366	0.00366	31
30	1.02380	570	1.54760	570	0.47620	0.00620	30



[25 degrees.]

°	'	Sines.	Diff.	Tangent.	Diff.	Cotang.	D.	'
30	0	9'63308	27	9'67850	32	10'31150	6	30
31	0	9'63445	26	9'67882	33	10'31188	6	29
32	0	9'63483	27	9'67915	32	10'31208	6	28
33	0	9'63478	26	9'67947	33	10'31203	6	27
34	0	9'63504	27	9'67980	32	10'31200	6	26
35	0	9'63531	26	9'68012	32	10'31198	6	25
36	0	9'63557	26	9'68044	32	10'31195	6	24
37	0	9'63583	27	9'68077	32	10'31192	6	23
38	0	9'63610	26	9'68109	32	10'31189	6	22
39	0	9'63636	26	9'68142	32	10'31185	6	21
40	0	9'63662	27	9'68174	32	10'31182	6	20
41	0	9'63689	26	9'68206	32	10'31179	6	19
42	0	9'63715	26	9'68239	32	10'31176	6	18
43	0	9'63741	26	9'68271	32	10'31172	6	17
44	0	9'63767	27	9'68303	32	10'31169	6	16
45	0	9'63794	26	9'68336	32	10'31166	6	15
46	0	9'63820	26	9'68368	32	10'31162	6	14
47	0	9'63846	26	9'68400	32	10'31158	6	13
48	0	9'63872	26	9'68432	32	10'31156	6	12
49	0	9'63898	26	9'68465	32	10'31153	6	11
50	0	9'63924	26	9'68497	32	10'31150	6	10
51	0	9'63950	26	9'68529	32	10'31147	6	9
52	0	9'63976	26	9'68561	32	10'31143	6	8
53	0	9'64002	26	9'68593	32	10'31140	6	7
54	0	9'64028	26	9'68626	32	10'31137	6	6
55	0	9'64054	26	9'68658	32	10'31134	6	5
56	0	9'64080	26	9'68690	32	10'31130	6	4
57	0	9'64106	26	9'68722	32	10'31127	6	3
58	0	9'64132	26	9'68754	32	10'31124	6	2
59	0	9'64158	26	9'68786	32	10'31121	6	1
60	0	9'64184		9'68818		10'31118		0

[64 degrees.]

[25 degrees.]

°	'	Sines.	Diff.	Tangent.	Diff.	Cotang.	D.	'
0	0	9'65095	27	9'66867	33	10'31313	6	60
1	0	9'65022	27	9'66900	33	10'31300	6	59
2	0	9'65049	27	9'66933	33	10'31287	6	58
3	0	9'65076	27	9'66966	33	10'31274	6	57
4	0	9'65103	27	9'66999	33	10'31261	6	56
5	0	9'65130	27	9'67032	33	10'31248	6	55
6	0	9'65157	27	9'67065	33	10'31235	6	54
7	0	9'65184	27	9'67098	33	10'31222	6	53
8	0	9'65211	27	9'67131	33	10'31209	6	52
9	0	9'65238	27	9'67163	33	10'31196	6	51
10	0	9'65265	27	9'67196	33	10'31183	6	50
11	0	9'65292	26	9'67229	33	10'31170	6	49
12	0	9'65318	27	9'67262	33	10'31157	6	48
13	0	9'65345	27	9'67295	33	10'31144	6	47
14	0	9'65372	27	9'67327	33	10'31131	6	46
15	0	9'65399	27	9'67360	33	10'31118	6	45
16	0	9'65426	26	9'67393	33	10'31105	6	44
17	0	9'65452	27	9'67426	32	10'31092	6	43
18	0	9'65479	27	9'67458	32	10'31079	6	42
19	0	9'65506	27	9'67491	32	10'31066	6	41
20	0	9'65533	26	9'67524	32	10'31053	6	40
21	0	9'65560	26	9'67556	32	10'31040	6	39
22	0	9'65587	27	9'67589	32	10'31027	6	38
23	0	9'65613	26	9'67622	32	10'31014	6	37
24	0	9'65640	26	9'67654	32	10'31001	6	36
25	0	9'65667	26	9'67687	32	10'30988	6	35
26	0	9'65692	27	9'67719	32	10'30975	6	34
27	0	9'65719	26	9'67752	32	10'30962	6	33
28	0	9'65745	26	9'67785	32	10'30949	6	32
29	0	9'65772	26	9'67817	32	10'30936	6	31
30	0	9'65798		9'67850		10'30923		30

[64 degrees.]



[26 degrees.]

r	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	r
30	9.64953	25	9.69774	31	10.30226	9.95179	6
31	9.64978	25	9.69805	32	10.30185	9.95173	6
32	9.65003	26	9.69837	31	10.30163	9.95176	6
33	9.65029	26	9.69868	32	10.30132	9.95160	7
34	9.65054	25	9.69890	32	10.30100	9.95154	6
35	9.65079	25	9.69912	31	10.30068	9.95148	6
36	9.65104	26	9.69935	32	10.30037	9.95141	7
37	9.65130	25	9.69959	31	10.30005	9.95135	6
38	9.65155	25	9.70026	32	10.29974	9.95129	7
39	9.65180	26	9.70038	31	10.29942	9.95122	6
40	9.65205	25	9.70089	32	10.29911	9.95116	6
41	9.65230	25	9.70121	31	10.29879	9.95110	7
42	9.65255	26	9.70152	32	10.29848	9.95103	6
43	9.65281	25	9.70184	31	10.29816	9.95097	7
44	9.65306	25	9.70215	32	10.29785	9.95090	6
45	9.65331	25	9.70247	31	10.29753	9.95084	6
46	9.65356	25	9.70278	32	10.29722	9.95078	7
47	9.65381	25	9.70309	31	10.29691	9.95071	6
48	9.65406	25	9.70341	32	10.29659	9.95065	6
49	9.65431	25	9.70372	31	10.29628	9.95059	7
50	9.65456	25	9.70404	32	10.29596	9.95052	6
51	9.65481	25	9.70435	31	10.29565	9.95046	7
52	9.65506	25	9.70466	32	10.29534	9.95039	6
53	9.65531	25	9.70498	31	10.29502	9.95033	6
54	9.65556	24	9.70529	32	10.29471	9.95027	7
55	9.65581	25	9.70560	31	10.29440	9.95020	6
56	9.65605	25	9.70592	32	10.29408	9.95014	7
57	9.65630	25	9.70623	31	10.29377	9.95007	6
58	9.65655	25	9.70654	32	10.29346	9.95001	6
59	9.65680	25	9.70685	31	10.29315	9.94995	7
60	9.65705	25	9.70717	32	10.29283	9.94988	7

[63 degrees.]

r	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	r
0	9.64184	26	9.68818	32	10.31182	9.95366	6
1	9.64210	26	9.68850	32	10.31151	9.95360	6
2	9.64236	26	9.68882	32	10.31118	9.95354	6
3	9.64262	26	9.68914	32	10.31086	9.95348	7
4	9.64288	25	9.68946	32	10.31054	9.95341	6
5	9.64313	26	9.68978	32	10.31022	9.95335	6
6	9.64339	26	9.69010	32	10.30990	9.95329	6
7	9.64365	26	9.69042	32	10.30958	9.95323	6
8	9.64391	26	9.69074	32	10.30926	9.95317	7
9	9.64417	25	9.69106	32	10.30894	9.95310	6
10	9.64442	26	9.69138	32	10.30862	9.95304	6
11	9.64468	26	9.69170	32	10.30830	9.95298	6
12	9.64494	25	9.69202	32	10.30798	9.95292	6
13	9.64519	26	9.69234	32	10.30766	9.95286	7
14	9.64545	26	9.69266	32	10.30734	9.95279	6
15	9.64571	25	9.69298	31	10.30702	9.95273	6
16	9.64596	26	9.69330	32	10.30671	9.95267	6
17	9.64622	25	9.69361	32	10.30639	9.95261	7
18	9.64647	26	9.69393	32	10.30607	9.95254	6
19	9.64671	25	9.69425	32	10.30575	9.95248	6
20	9.64698	26	9.69457	31	10.30543	9.95242	6
21	9.64724	25	9.69488	32	10.30512	9.95236	7
22	9.64749	26	9.69520	32	10.30480	9.95229	6
23	9.64775	25	9.69552	32	10.30448	9.95223	6
24	9.64800	26	9.69584	31	10.30416	9.95217	6
25	9.64826	25	9.69615	32	10.30385	9.95211	7
26	9.64851	26	9.69647	32	10.30353	9.95204	6
27	9.64877	25	9.69679	31	10.30321	9.95198	6
28	9.64902	25	9.69710	32	10.30290	9.95192	6
29	9.64927	26	9.69742	32	10.30258	9.95185	7
30	9.64953	26	9.69774	32	10.30226	9.95179	7

[63 degrees.]

[ 27 degrees. ]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Co sine.	D.
30	0.66441	24	9.71648	31	10.28352	31	9.94793	7	30
31	0.66465	24	9.71679	30	10.28321	30	9.94786	6	29
32	0.66489	24	9.71709	31	10.28291	30	9.94780	6	28
33	0.66513	24	9.71740	31	10.28260	30	9.94773	6	27
34	0.66537	25	9.71771	31	10.28229	30	9.94767	7	26
35	0.66562	24	9.71802	31	10.28198	30	9.94760	7	25
36	0.66586	24	9.71833	30	10.28167	30	9.94753	7	24
37	0.66610	24	9.71863	31	10.28137	30	9.94747	7	23
38	0.66634	24	9.71894	31	10.28106	30	9.94740	7	22
39	0.66658	24	9.71925	31	10.28075	30	9.94734	7	21
40	0.66682	24	9.71955	31	10.28045	30	9.94727	7	20
41	0.66706	25	9.71986	31	10.28014	30	9.94720	7	19
42	0.66731	24	9.72017	31	10.27983	30	9.94714	7	18
43	0.66755	24	9.72048	30	10.27952	30	9.94707	7	17
44	0.66779	24	9.72078	31	10.27922	30	9.94700	7	16
45	0.66803	24	9.72109	31	10.27891	30	9.94694	7	15
46	0.66827	24	9.72140	30	10.27860	30	9.94687	7	14
47	0.66851	24	9.72170	31	10.27830	30	9.94680	7	13
48	0.66875	24	9.72201	30	10.27799	30	9.94674	7	12
49	0.66899	23	9.72231	31	10.27769	30	9.94667	7	11
50	0.66922	24	9.72262	31	10.27738	30	9.94660	7	10
51	0.66946	24	9.72293	31	10.27707	30	9.94654	7	9
52	0.66970	24	9.72323	31	10.27677	30	9.94647	7	8
53	0.66994	24	9.72354	30	10.27646	30	9.94640	7	7
54	0.67018	24	9.72384	31	10.27616	30	9.94634	7	6
55	0.67042	24	9.72415	30	10.27585	30	9.94627	7	5
56	0.67066	24	9.72445	31	10.27555	30	9.94620	7	4
57	0.67090	23	9.72476	31	10.27524	30	9.94614	7	3
58	0.67113	24	9.72506	31	10.27494	30	9.94607	7	2
59	0.67137	24	9.72537	30	10.27463	30	9.94600	7	1
60	0.67161	25	9.72567	30	10.27433	30	9.94593	7	0

[ 62 degrees. ]

[ 27 degrees. ]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Co sine.	D.
0	0.65705	24	9.70717	31	10.29283	31	9.94988	6	60
1	0.65729	25	9.70748	31	10.29252	31	9.94982	7	59
2	0.65754	25	9.70779	31	10.29221	31	9.94975	7	58
3	0.65779	25	9.70810	31	10.29190	31	9.94969	6	57
4	0.65804	24	9.70841	31	10.29159	31	9.94962	6	56
5	0.65828	25	9.70873	31	10.29127	31	9.94956	6	55
6	0.65853	25	9.70904	31	10.29096	31	9.94949	7	54
7	0.65878	25	9.70935	31	10.29065	31	9.94943	6	53
8	0.65902	24	9.70966	31	10.29034	31	9.94936	7	52
9	0.65927	25	9.70997	31	10.29003	31	9.94930	6	51
10	0.65952	24	9.71028	31	10.28972	31	9.94923	6	50
11	0.65976	24	9.71059	31	10.28941	31	9.94917	6	49
12	0.66001	25	9.71090	31	10.28910	31	9.94911	7	48
13	0.66025	25	9.71121	31	10.28879	31	9.94904	6	47
14	0.66050	25	9.71153	31	10.28847	31	9.94898	7	46
15	0.66075	24	9.71184	31	10.28816	31	9.94891	6	45
16	0.66099	25	9.71215	31	10.28785	31	9.94885	7	44
17	0.66124	24	9.71246	31	10.28754	31	9.94878	7	43
18	0.66148	25	9.71277	31	10.28723	31	9.94871	6	42
19	0.66173	24	9.71308	31	10.28692	31	9.94865	7	41
20	0.66197	24	9.71339	31	10.28661	31	9.94858	7	40
21	0.66221	25	9.71370	31	10.28630	31	9.94852	6	39
22	0.66246	24	9.71401	30	10.28599	31	9.94845	6	38
23	0.66270	25	9.71433	31	10.28569	31	9.94839	6	37
24	0.66295	24	9.71464	31	10.28538	31	9.94832	7	36
25	0.66319	24	9.71495	31	10.28507	31	9.94826	6	35
26	0.66343	25	9.71526	31	10.28476	31	9.94819	7	34
27	0.66368	24	9.71557	31	10.28445	31	9.94813	7	33
28	0.66392	24	9.71588	31	10.28414	31	9.94806	7	32
29	0.66416	24	9.71618	31	10.28383	31	9.94799	7	31
30	0.66441	25	9.71648	31	10.28352	31	9.94793	6	30

[ 62 degrees. ]



## [28 degrees.]

'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	D.	'
0	9°67'61	24	9°72'567	31	10°27433	9°94593	6	60
1	9°67'185	23	9°72'598	31	10°27402	9°94587	7	59
2	9°67'208	24	9°72'628	31	10°27372	9°94580	7	58
3	9°67'232	24	9°72'659	30	10°27341	9°94573	7	57
4	9°67'256	24	9°72'689	31	10°27311	9°94567	6	56
5	9°67'280	24	9°72'720	30	10°27280	9°94560	7	55
6	9°67'303	24	9°72'750	30	10°27250	9°94553	7	54
7	9°67'327	23	9°72'780	31	10°27220	9°94546	6	53
8	9°67'350	23	9°72'811	30	10°27189	9°94540	7	52
9	9°67'374	24	9°72'841	31	10°27159	9°94533	7	51
10	9°67'398	24	9°72'872	30	10°27128	9°94526	7	50
11	9°67'421	23	9°72'902	30	10°27098	9°94519	6	49
12	9°67'445	23	9°72'932	31	10°27068	9°94513	7	48
13	9°67'468	24	9°72'963	31	10°27037	9°94506	7	47
14	9°67'492	23	9°72'993	30	10°27007	9°94499	7	46
15	9°67'515	24	9°73'023	31	10°26977	9°94492	7	45
16	9°67'539	23	9°73'054	30	10°26946	9°94485	6	44
17	9°67'562	24	9°73'084	30	10°26916	9°94479	7	43
18	9°67'586	23	9°73'114	30	10°26886	9°94472	7	42
19	9°67'609	24	9°73'144	31	10°26856	9°94465	7	41
20	9°67'633	23	9°73'175	30	10°26825	9°94458	7	40
21	9°67'656	24	9°73'205	30	10°26795	9°94451	6	39
22	9°67'680	23	9°73'235	30	10°26765	9°94444	7	38
23	9°67'703	23	9°73'265	30	10°26735	9°94438	7	37
24	9°67'726	24	9°73'295	31	10°26705	9°94431	7	36
25	9°67'750	23	9°73'326	30	10°26674	9°94424	7	35
26	9°67'773	23	9°73'356	30	10°26644	9°94417	7	34
27	9°67'796	24	9°73'386	30	10°26614	9°94410	6	33
28	9°67'820	23	9°73'416	30	10°26584	9°94404	7	32
29	9°67'843	23	9°73'446	30	10°26554	9°94397	7	31
30	9°67'866		9°73'476		10°26524	9°94390	7	30
	Cosine.		Cotang.		Tangent.	Sine.		

## [61 degrees.]

'	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	D.	'
30	9°67'866	24	9°73'476	30	10°26524	9°94384	7	29
31	9°67'890	23	9°73'507	29	10°26493	9°94378	7	28
32	9°67'913	23	9°73'537	30	10°26463	9°94371	7	27
33	9°67'936	23	9°73'567	30	10°26433	9°94365	7	26
34	9°67'959	23	9°73'597	30	10°26403	9°94358	7	25
35	9°67'982	24	9°73'627	30	10°26373	9°94352	6	24
36	9°68'006	23	9°73'657	30	10°26343	9°94346	7	23
37	9°68'029	23	9°73'687	30	10°26313	9°94340	7	22
38	9°68'052	23	9°73'717	30	10°26283	9°94334	7	21
39	9°68'075	23	9°73'747	30	10°26253	9°94328	7	20
40	9°68'098	23	9°73'777	30	10°26223	9°94321	7	19
41	9°68'121	23	9°73'807	30	10°26193	9°94314	7	18
42	9°68'144	23	9°73'837	30	10°26163	9°94307	7	17
43	9°68'167	23	9°73'867	30	10°26133	9°94300	7	16
44	9°68'190	23	9°73'897	30	10°26103	9°94293	7	15
45	9°68'213	24	9°73'927	30	10°26073	9°94286	7	14
46	9°68'237	23	9°73'957	30	10°26043	9°94279	6	13
47	9°68'260	23	9°73'987	30	10°26013	9°94273	7	12
48	9°68'283	22	9°74'017	29	10°25983	9°94266	7	11
49	9°68'305	23	9°74'047	30	10°25953	9°94259	7	10
50	9°68'328	23	9°74'077	30	10°25923	9°94252	7	9
51	9°68'351	23	9°74'107	30	10°25893	9°94245	7	8
52	9°68'374	23	9°74'137	29	10°25863	9°94238	7	7
53	9°68'397	23	9°74'166	30	10°25833	9°94231	7	6
54	9°68'420	23	9°74'196	30	10°25804	9°94224	7	5
55	9°68'443	23	9°74'226	30	10°25774	9°94217	7	4
56	9°68'466	23	9°74'256	30	10°25744	9°94210	7	3
57	9°68'489	23	9°74'286	30	10°25714	9°94203	7	2
58	9°68'512	23	9°74'316	29	10°25684	9°94196	7	1
59	9°68'535	23	9°74'345	30	10°25655	9°94189	7	0
60	9°68'557		9°74'375		10°25625	9°94182		
	Cosine.		Cotang.		Tangent.	Sine.		

## [61 degrees.]



[29 degrees.]

°	Sines.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Coines.	D.	°
30	9.69334	9.75264	22	10.24716	9.93970	7	30		
31	9.69456	9.75294	23	10.24706	9.93961	8	29		
32	9.69579	9.75323	23	10.24677	9.93953	8	28		
33	9.69701	9.75353	23	10.24647	9.93948	7	27		
34	9.69823	9.75382	22	10.24618	9.93941	7	26		
35	9.69945	9.75411	22	10.24589	9.93934	7	25		
36	9.69168	9.75441	22	10.24559	9.93927	7	24		
37	9.69390	9.75470	22	10.24530	9.93920	8	23		
38	9.69612	9.75500	22	10.24500	9.93912	8	22		
39	9.69834	9.75529	22	10.24471	9.93905	7	21		
40	9.69456	9.75558	23	10.24442	9.93898	7	20		
41	9.69479	9.75588	23	10.24412	9.93891	7	19		
42	9.69501	9.75617	22	10.24383	9.93884	8	18		
43	9.69523	9.75647	22	10.24353	9.93876	7	17		
44	9.69545	9.75676	22	10.24324	9.93869	7	16		
45	9.69567	9.75705	22	10.24295	9.93862	7	15		
46	9.69589	9.75735	22	10.24265	9.93855	8	14		
47	9.69611	9.75764	22	10.24236	9.93847	7	13		
48	9.69633	9.75793	22	10.24207	9.93840	7	12		
49	9.69655	9.75822	22	10.24178	9.93833	7	11		
50	9.69677	9.75852	22	10.24148	9.93826	7	10		
51	9.69699	9.75881	22	10.24119	9.93819	8	9		
52	9.69721	9.75910	22	10.24090	9.93811	7	8		
53	9.69743	9.75939	22	10.24061	9.93804	7	7		
54	9.69765	9.75969	22	10.24031	9.93797	8	6		
55	9.69787	9.75998	22	10.24002	9.93789	7	5		
56	9.69809	9.76027	22	10.23973	9.93782	7	4		
57	9.69831	9.76056	22	10.23944	9.93775	7	3		
58	9.69853	9.76086	22	10.23914	9.93768	7	2		
59	9.69875	9.76115	22	10.23885	9.93760	8	1		
60	9.69897	9.76144	22	10.23856	9.93753	7	0		

[60 degrees.]

°	Sines.	Tangent.	Diff.	Cotang.	Coines.	D.	°
0	9.68557	9.74375	30	10.25625	9.94182	7	60
1	9.68580	9.74405	23	10.25595	9.94175	7	59
2	9.68603	9.74435	23	10.25565	9.94168	7	58
3	9.68625	9.74465	23	10.25535	9.94161	7	57
4	9.68648	9.74495	22	10.25505	9.94154	7	56
5	9.68671	9.74524	22	10.25476	9.94147	7	55
6	9.68694	9.74554	22	10.25446	9.94140	7	54
7	9.68716	9.74583	22	10.25417	9.94133	7	53
8	9.68739	9.74613	22	10.25387	9.94126	7	52
9	9.68762	9.74643	22	10.25357	9.94119	7	51
10	9.68784	9.74673	22	10.25328	9.94112	7	50
11	9.68807	9.74702	22	10.25298	9.94105	7	49
12	9.68829	9.74732	22	10.25268	9.94098	8	48
13	9.68852	9.74762	22	10.25238	9.94090	7	47
14	9.68875	9.74791	22	10.25209	9.94083	7	46
15	9.68897	9.74821	22	10.25179	9.94076	7	45
16	9.68920	9.74851	22	10.25149	9.94069	7	44
17	9.68942	9.74880	22	10.25120	9.94062	7	43
18	9.68965	9.74910	22	10.25090	9.94055	7	42
19	9.68987	9.74939	22	10.25061	9.94048	7	41
20	9.69010	9.74969	22	10.25031	9.94041	7	40
21	9.69032	9.74998	22	10.25002	9.94034	7	39
22	9.69055	9.75028	22	10.24972	9.94027	7	38
23	9.69077	9.75058	22	10.24942	9.94020	8	37
24	9.69100	9.75087	22	10.24913	9.94013	7	36
25	9.69122	9.75117	22	10.24883	9.94005	7	35
26	9.69144	9.75146	22	10.24854	9.93998	7	34
27	9.69167	9.75176	22	10.24824	9.93991	7	33
28	9.69189	9.75205	22	10.24795	9.93984	7	32
29	9.69212	9.75235	22	10.24765	9.93977	7	31
30	9.69234	9.75264	22	10.24736	9.93970	7	30

[60 degrees.]

[30 degrees.]

	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cosine.	D.
0	9.69897	22	9.76144	29	10.23856	9.93753	60	
1	9.69919	22	9.76173	29	10.23847	9.93746	7	
2	9.69941	22	9.76202	29	10.23798	9.93738	58	
3	9.69963	22	9.76231	29	10.23769	9.93731	7	
4	9.69984	22	9.76261	30	10.23740	9.93724	56	
5	9.70006	22	9.76290	29	10.23710	9.93717	55	
6	9.70028	22	9.76319	29	10.23681	9.93710	8	
7	9.70050	22	9.76348	29	10.23652	9.93702	54	
8	9.70072	21	9.76377	29	10.23623	9.93695	7	
9	9.70093	22	9.76406	29	10.23594	9.93687	51	
10	9.70115	22	9.76435	29	10.23565	9.93680	7	
11	9.70137	22	9.76464	29	10.23536	9.93673	49	
12	9.70159	21	9.76493	29	10.23507	9.93665	7	
13	9.70180	22	9.76522	29	10.23478	9.93658	48	
14	9.70202	22	9.76551	29	10.23449	9.93650	46	
15	9.70224	21	9.76580	29	10.23420	9.93643	7	
16	9.70245	22	9.76609	30	10.23391	9.93636	45	
17	9.70267	21	9.76639	29	10.23361	9.93628	44	
18	9.70288	22	9.76668	28	10.23332	9.93621	43	
19	9.70310	22	9.76697	28	10.23303	9.93614	7	
20	9.70332	21	9.76725	29	10.23275	9.93606	42	
21	9.70353	22	9.76754	29	10.23246	9.93599	7	
22	9.70375	22	9.76783	29	10.23217	9.93591	39	
23	9.70396	21	9.76812	29	10.23188	9.93584	38	
24	9.70418	21	9.76841	29	10.23159	9.93577	37	
25	9.70439	22	9.76870	29	10.23130	9.93569	8	
26	9.70461	21	9.76899	29	10.23101	9.93562	35	
27	9.70482	22	9.76928	29	10.23072	9.93554	34	
28	9.70504	21	9.76957	29	10.23043	9.93547	8	
29	9.70525	22	9.76986	29	10.23014	9.93539	33	
30	9.70547		9.77015		10.22985	9.93532	32	
			Cotang.		Tangent.	Sine.		

[59 degrees.]

	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cosine.	D.
30	9.70547	21	9.77015	29	10.22985	9.93532	7	
31	9.70568	21	9.77044	29	10.22956	9.93525	30	
32	9.70590	21	9.77073	28	10.22927	9.93517	29	
33	9.70611	21	9.77101	28	10.22899	9.93510	7	
34	9.70633	22	9.77130	29	10.22870	9.93502	27	
35	9.70654	21	9.77159	29	10.22841	9.93495	26	
36	9.70675	22	9.77188	29	10.22812	9.93487	25	
37	9.70697	22	9.77217	29	10.22783	9.93480	8	
38	9.70718	21	9.77246	28	10.22754	9.93472	7	
39	9.70739	21	9.77274	29	10.22726	9.93465	21	
40	9.70761	21	9.77303	29	10.22697	9.93457	8	
41	9.70782	21	9.77332	29	10.22668	9.93450	19	
42	9.70803	21	9.77361	29	10.22639	9.93442	7	
43	9.70824	22	9.77390	28	10.22610	9.93435	18	
44	9.70846	21	9.77418	29	10.22582	9.93427	16	
45	9.70867	21	9.77447	29	10.22553	9.93420	15	
46	9.70888	21	9.77476	29	10.22524	9.93412	14	
47	9.70909	22	9.77505	28	10.22495	9.93405	13	
48	9.70931	21	9.77533	29	10.22467	9.93397	12	
49	9.70952	21	9.77562	29	10.22438	9.93390	11	
50	9.70973	21	9.77591	28	10.22409	9.93382	10	
51	9.70994	21	9.77619	28	10.22381	9.93375	9	
52	9.71015	21	9.77648	29	10.22352	9.93367	8	
53	9.71036	22	9.77677	29	10.22323	9.93360	7	
54	9.71058	22	9.77706	28	10.22294	9.93352	6	
55	9.71079	21	9.77735	29	10.22266	9.93344	5	
56	9.71100	21	9.77763	28	10.22237	9.93337	4	
57	9.71121	21	9.77791	28	10.22209	9.93329	3	
58	9.71142	21	9.77820	29	10.22180	9.93322	2	
59	9.71163	21	9.77849	28	10.22151	9.93314	1	
60	9.71184		9.77877		10.22122	9.93307	0	
			Cotang.		Tangent.	Sine.		

[30 degrees.]



[31 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cosine.	D.
30	9.71809	20	9.78732	28	10.21268	9.93077	8	30
31	9.71830	21	9.78760	29	10.21240	9.93069	8	29
32	9.71850	20	9.78789	28	10.21211	9.93061	8	28
33	9.71870	21	9.78817	28	10.21183	9.93053	7	27
34	9.71891	20	9.78845	29	10.21155	9.93046	8	26
35	9.71911	21	9.78874	28	10.21126	9.93038	8	25
36	9.71932	20	9.78902	28	10.21098	9.93030	8	24
37	9.71952	21	9.78930	29	10.21070	9.93022	8	23
38	9.71973	21	9.78959	28	10.21041	9.93014	8	22
39	9.71994	20	9.78987	28	10.21013	9.93007	7	21
40	9.72014	20	9.79015	28	10.20985	9.92999	8	20
41	9.72034	21	9.79043	29	10.20957	9.92991	8	19
42	9.72055	20	9.79072	28	10.20928	9.92983	7	18
43	9.72075	21	9.79100	28	10.20900	9.92976	8	17
44	9.72096	20	9.79128	28	10.20872	9.92968	8	16
45	9.72116	21	9.79156	29	10.20844	9.92960	8	15
46	9.72137	20	9.79185	28	10.20815	9.92952	8	14
47	9.72157	20	9.79213	28	10.20787	9.92944	8	13
48	9.72177	21	9.79241	28	10.20759	9.92936	7	12
49	9.72198	20	9.79269	28	10.20731	9.92929	8	11
50	9.72218	20	9.79297	29	10.20703	9.92921	8	10
51	9.72238	21	9.79326	28	10.20674	9.92913	8	9
52	9.72259	20	9.79354	28	10.20646	9.92905	8	8
53	9.72279	20	9.79382	28	10.20618	9.92897	8	7
54	9.72299	21	9.79410	28	10.20590	9.92889	8	6
55	9.72320	20	9.79438	28	10.20562	9.92881	7	5
56	9.72340	20	9.79466	29	10.20534	9.92874	7	4
57	9.72360	21	9.79495	28	10.20505	9.92866	8	3
58	9.72381	20	9.79523	28	10.20477	9.92858	8	2
59	9.72401	20	9.79551	28	10.20449	9.92850	8	1
60	9.72421	20	9.79579	28	10.20421	9.92842	8	0

[58 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cosine.	D.
0	9.71184	21	9.77877	29	10.22123	9.93207	8	60
1	9.71205	21	9.77906	29	10.22094	9.93209	8	59
2	9.71226	21	9.77935	28	10.22065	9.93201	8	58
3	9.71247	21	9.77963	29	10.22037	9.93184	7	57
4	9.71268	21	9.77992	28	10.22008	9.93176	8	56
5	9.71289	21	9.78020	29	10.21980	9.93169	7	55
6	9.71310	21	9.78049	28	10.21951	9.93161	8	54
7	9.71331	21	9.78077	29	10.21923	9.93153	8	53
8	9.71352	21	9.78106	29	10.21894	9.93146	7	52
9	9.71373	21	9.78135	28	10.21865	9.93138	8	51
10	9.71393	21	9.78163	29	10.21837	9.93130	8	50
11	9.71414	21	9.78192	28	10.21808	9.93123	7	49
12	9.71435	21	9.78220	29	10.21780	9.93115	8	48
13	9.71456	21	9.78249	28	10.21751	9.93107	7	47
14	9.71477	21	9.78277	29	10.21723	9.93100	8	46
15	9.71498	21	9.78306	28	10.21694	9.93192	8	45
16	9.71519	20	9.78334	29	10.21666	9.93184	7	44
17	9.71539	20	9.78363	28	10.21637	9.93177	8	43
18	9.71560	21	9.78391	28	10.21609	9.93169	8	42
19	9.71581	21	9.78419	29	10.21581	9.93161	8	41
20	9.71602	20	9.78448	28	10.21554	9.93154	7	40
21	9.71622	21	9.78476	28	10.21524	9.93146	8	39
22	9.71643	21	9.78505	28	10.21495	9.93138	8	38
23	9.71664	21	9.78533	29	10.21467	9.93131	7	37
24	9.71685	20	9.78562	28	10.21438	9.93123	8	36
25	9.71705	21	9.78590	28	10.21410	9.93115	8	35
26	9.71726	21	9.78618	29	10.21382	9.93108	7	34
27	9.71747	20	9.78647	28	10.21353	9.93100	8	33
28	9.71767	21	9.78675	29	10.21325	9.93092	8	32
29	9.71788	21	9.78704	28	10.21296	9.93084	8	31
30	9.71809	21	9.78732	28	10.21268	9.93077	7	30

[58 degrees.]



[32 degrees.]

°	Sine.	Tangent.	Diff.	Cotang.	Cosine.	D.	°
0	9.7421	9.79579	20	10.20431	9.92842	60	
1	9.7441	9.79607	28	10.20393	9.92834	59	
2	9.7461	9.79635	28	10.20365	9.92826	58	
3	9.7482	9.79663	28	10.20337	9.92818	57	
4	9.7502	9.79691	28	10.20309	9.92810	56	
5	9.7522	9.79719	28	10.20281	9.92803	55	
6	9.7542	9.79747	29	10.20253	9.92795	54	
7	9.7562	9.79776	29	10.20224	9.92787	53	
8	9.7582	9.79804	28	10.20196	9.92779	52	
9	9.7602	9.79832	28	10.20168	9.92771	51	
10	9.7622	9.79860	28	10.20140	9.92763	50	
11	9.7643	9.79888	28	10.20112	9.92755	49	
12	9.7663	9.79916	28	10.20084	9.92747	48	
13	9.7683	9.79944	28	10.20056	9.92739	47	
14	9.7703	9.79972	28	10.20028	9.92731	46	
15	9.7723	9.80000	28	10.20000	9.92723	45	
16	9.7743	9.80028	28	10.19972	9.92715	44	
17	9.7763	9.80056	28	10.19944	9.92707	43	
18	9.7783	9.80084	28	10.19916	9.92699	42	
19	9.7783	9.80112	28	10.19888	9.92691	41	
20	9.7783	9.80140	28	10.19860	9.92683	40	
21	9.7783	9.80168	28	10.19832	9.92675	39	
22	9.7783	9.80195	28	10.19805	9.92667	38	
23	9.7783	9.80223	28	10.19777	9.92659	37	
24	9.77902	9.80251	28	10.19749	9.92651	36	
25	9.77922	9.80279	28	10.19721	9.92643	35	
26	9.77942	9.80307	28	10.19693	9.92635	34	
27	9.77962	9.80335	28	10.19665	9.92627	33	
28	9.77982	9.80363	28	10.19637	9.92619	32	
29	9.77902	9.80391	28	10.19609	9.92611	31	
30	9.77922	9.80419	28	10.19581	9.92603	30	

[37 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	D.	°
30	9.73022	19	9.80419	28	10.19581	9.92603	30	
31	9.73041	20	9.80447	27	10.19553	9.92595	29	
32	9.73061	20	9.80474	27	10.19526	9.92587	28	
33	9.73081	20	9.80502	28	10.19498	9.92579	27	
34	9.73101	20	9.80530	28	10.19470	9.92571	26	
35	9.73121	19	9.80558	28	10.19442	9.92563	25	
36	9.73140	20	9.80586	28	10.19414	9.92555	24	
37	9.73160	20	9.80614	28	10.19386	9.92546	23	
38	9.73180	20	9.80642	27	10.19358	9.92538	22	
39	9.73200	19	9.80669	28	10.19331	9.92530	21	
40	9.73219	20	9.80697	28	10.19303	9.92522	20	
41	9.73239	20	9.80725	28	10.19275	9.92514	19	
42	9.73259	19	9.80753	28	10.19247	9.92506	18	
43	9.73278	20	9.80781	27	10.19219	9.92498	17	
44	9.73298	20	9.80808	28	10.19192	9.92490	16	
45	9.73318	19	9.80836	28	10.19164	9.92482	15	
46	9.73337	20	9.80864	28	10.19136	9.92473	14	
47	9.73357	20	9.80892	27	10.19108	9.92465	13	
48	9.73377	19	9.80919	28	10.19081	9.92457	12	
49	9.73396	20	9.80947	28	10.19053	9.92449	11	
50	9.73416	19	9.80975	28	10.19025	9.92441	10	
51	9.73435	20	9.81003	27	10.18997	9.92433	9	
52	9.73455	19	9.81030	28	10.18970	9.92425	8	
53	9.73474	20	9.81058	28	10.18942	9.92417	7	
54	9.73494	19	9.81086	27	10.18914	9.92408	6	
55	9.73513	20	9.81113	28	10.18887	9.92400	5	
56	9.73533	19	9.81141	28	10.18859	9.92392	4	
57	9.73552	20	9.81169	27	10.18831	9.92384	3	
58	9.73572	19	9.81196	28	10.18804	9.92376	2	
59	9.73591	20	9.81224	28	10.18776	9.92367	1	
60	9.73611	19	9.81252	28	10.18748	9.92359	0	

[57 degrees.]

[33 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Secant.	Diff.	Co-sec.	°
30	9.74189	19	9.82078	28	10.17792	28	9.92111	9
31	9.74208	19	9.82106	27	10.17894	28	9.92102	8
32	9.74227	19	9.82133	28	10.17867	27	9.92094	8
33	9.74246	19	9.82161	27	10.17839	27	9.92086	7
34	9.74265	19	9.82188	27	10.17812	27	9.92077	6
35	9.74284	19	9.82215	28	10.17785	27	9.92069	5
36	9.74303	19	9.82243	27	10.17757	27	9.92060	4
37	9.74322	19	9.82270	28	10.17730	28	9.92052	3
38	9.74341	19	9.82298	27	10.17702	28	9.92044	2
39	9.74360	19	9.82325	27	10.17675	27	9.92035	1
40	9.74379	19	9.82352	28	10.17648	27	9.92027	8
41	9.74398	19	9.82380	27	10.17620	27	9.92018	8
42	9.74417	19	9.82407	28	10.17593	27	9.92010	8
43	9.74436	19	9.82435	27	10.17565	27	9.92002	7
44	9.74455	19	9.82462	27	10.17538	27	9.91993	6
45	9.74474	19	9.82489	28	10.17511	27	9.91985	5
46	9.74493	19	9.82517	27	10.17483	27	9.91976	4
47	9.74512	19	9.82544	27	10.17456	27	9.91968	3
48	9.74531	18	9.82571	28	10.17429	28	9.91959	2
49	9.74549	19	9.82599	27	10.17401	27	9.91951	1
50	9.74568	19	9.82626	27	10.17374	27	9.91942	8
51	9.74587	19	9.82653	28	10.17347	27	9.91934	8
52	9.74606	19	9.82681	27	10.17319	27	9.91925	7
53	9.74625	19	9.82708	27	10.17292	27	9.91917	6
54	9.74644	18	9.82735	27	10.17265	27	9.91908	5
55	9.74662	18	9.82762	28	10.17238	28	9.91900	4
56	9.74681	19	9.82790	27	10.17210	27	9.91891	3
57	9.74700	19	9.82817	27	10.17183	27	9.91883	2
58	9.74719	18	9.82844	27	10.17156	27	9.91874	1
59	9.74737	19	9.82871	28	10.17129	27	9.91866	8
60	9.74756	19	9.82899	27	10.17101	28	9.91857	0

[56 degrees.]

[33 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Secant.	Diff.	Co-sec.	°
0	9.71611	19	9.81252	27	10.18748	28	9.92359	60
1	9.71630	20	9.81279	28	10.18721	28	9.92351	59
2	9.71650	19	9.81307	28	10.18693	28	9.92343	58
3	9.71669	19	9.81335	27	10.18665	28	9.92335	57
4	9.71688	20	9.81362	28	10.18638	28	9.92326	56
5	9.71708	19	9.81390	28	10.18610	28	9.92318	55
6	9.71727	20	9.81418	27	10.18582	28	9.92310	54
7	9.71747	19	9.81445	27	10.18555	28	9.92302	53
8	9.71766	19	9.81473	27	10.18527	28	9.92293	52
9	9.71785	20	9.81500	28	10.18500	28	9.92285	51
10	9.71805	19	9.81528	28	10.18472	28	9.92277	50
11	9.71824	19	9.81556	27	10.18444	28	9.92269	49
12	9.71843	20	9.81583	28	10.18417	28	9.92260	48
13	9.71863	19	9.81611	27	10.18389	28	9.92252	47
14	9.71882	19	9.81638	28	10.18362	28	9.92244	46
15	9.71901	20	9.81666	27	10.18334	28	9.92235	45
16	9.71921	19	9.81693	28	10.18307	28	9.92227	44
17	9.71940	19	9.81721	27	10.18279	28	9.92219	43
18	9.71959	20	9.81748	28	10.18252	28	9.92211	42
19	9.71978	19	9.81776	27	10.18224	28	9.92202	41
20	9.71997	20	9.81803	28	10.18197	28	9.92194	40
21	9.72016	19	9.81831	27	10.18169	28	9.92186	39
22	9.72035	20	9.81858	28	10.18142	28	9.92177	38
23	9.72055	19	9.81886	27	10.18114	28	9.92169	37
24	9.72074	19	9.81913	28	10.18087	28	9.92161	36
25	9.72093	20	9.81941	27	10.18059	28	9.92152	35
26	9.72113	19	9.81968	28	10.18032	28	9.92144	34
27	9.72132	19	9.81996	27	10.18004	28	9.92136	33
28	9.72151	20	9.82023	28	10.17977	28	9.92127	32
29	9.72170	19	9.82051	27	10.17949	28	9.92119	31
30	9.72189	20	9.82078	28	10.17922	28	9.92111	30

[56 degrees.]



[34 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Colang.	Diff.	Colang.	Diff.	D.	'
30	0	9'75313	18	9'85713	18	10°16'287	18	10°16'287	18	30	0
30	1	9'75331	19	9'85740	19	10°16'266	19	10°16'266	19	29	1
30	2	9'75350	18	9'85768	18	10°16'241	18	10°16'241	18	28	2
30	3	9'75368	18	9'85795	18	10°16'205	17	10°16'205	17	27	3
30	4	9'75386	18	9'85822	18	10°16'178	17	10°16'178	17	26	4
30	5	9'75405	18	9'85849	17	10°16'151	17	10°16'151	17	25	5
30	6	9'75423	18	9'85876	17	10°16'124	17	10°16'124	17	24	6
30	7	9'75441	18	9'85903	17	10°16'097	17	10°16'097	17	23	7
30	8	9'75459	18	9'85930	17	10°16'070	17	10°16'070	17	22	8
30	9	9'75478	18	9'85957	17	10°16'043	17	10°16'043	17	21	9
30	10	9'75496	18	9'85984	17	10°16'016	16	10°16'016	16	20	10
30	11	9'75514	19	9'86011	17	10°15'989	16	10°15'989	16	19	11
30	12	9'75533	18	9'86038	17	10°15'962	16	10°15'962	16	18	12
30	13	9'75551	18	9'86065	17	10°15'935	16	10°15'935	16	17	13
30	14	9'75569	18	9'86092	17	10°15'908	15	10°15'908	15	16	14
30	15	9'75587	18	9'86119	17	10°15'881	15	10°15'881	15	15	15
30	16	9'75605	19	9'86146	17	10°15'854	15	10°15'854	15	14	16
30	17	9'75624	18	9'86173	17	10°15'827	14	10°15'827	14	13	17
30	18	9'75642	18	9'86200	17	10°15'800	14	10°15'800	14	12	18
30	19	9'75660	18	9'86227	17	10°15'773	14	10°15'773	14	11	19
30	20	9'75678	18	9'86254	16	10°15'746	13	10°15'746	13	10	20
30	21	9'75696	18	9'86280	16	10°15'720	13	10°15'720	13	9	21
30	22	9'75714	19	9'86307	17	10°15'693	12	10°15'693	12	8	22
30	23	9'75733	18	9'86334	17	10°15'666	12	10°15'666	12	7	23
30	24	9'75751	18	9'86361	17	10°15'639	11	10°15'639	11	6	24
30	25	9'75769	18	9'86388	17	10°15'612	11	10°15'612	11	5	25
30	26	9'75787	18	9'86415	17	10°15'585	10	10°15'585	10	4	26
30	27	9'75805	18	9'86442	17	10°15'558	10	10°15'558	10	3	27
30	28	9'75823	18	9'86469	17	10°15'531	9	10°15'531	9	2	28
30	29	9'75841	18	9'86496	17	10°15'504	9	10°15'504	9	1	29
30	30	9'75859	18	9'86523	17	10°15'477	8	10°15'477	8	0	30

[55 degrees.]

°	'	Sine.	Diff.	Tangent.	Diff.	Colang.	Diff.	Colang.	Diff.	D.	'
60	0	9'74756	19	9'82599	27	10°17'101	27	10°17'101	27	60	0
60	1	9'74775	19	9'82626	27	10°17'074	27	10°17'074	27	59	1
60	2	9'74794	18	9'82653	27	10°17'047	27	10°17'047	27	58	2
60	3	9'74812	18	9'82680	28	10°17'020	27	10°17'020	27	57	3
60	4	9'74831	19	9'82708	27	10°16'992	27	10°16'992	27	56	4
60	5	9'74850	19	9'82735	27	10°16'965	27	10°16'965	27	55	5
60	6	9'74868	18	9'82762	27	10°16'938	27	10°16'938	27	54	6
60	7	9'74887	19	9'82789	28	10°16'911	27	10°16'911	27	53	7
60	8	9'74906	18	9'82817	27	10°16'883	27	10°16'883	27	52	8
60	9	9'74924	19	9'82844	27	10°16'856	27	10°16'856	27	51	9
60	10	9'74943	18	9'82871	27	10°16'829	27	10°16'829	27	50	10
60	11	9'74961	19	9'82898	27	10°16'802	27	10°16'802	27	49	11
60	12	9'74980	19	9'82925	27	10°16'775	27	10°16'775	27	48	12
60	13	9'74999	18	9'82952	28	10°16'748	27	10°16'748	27	47	13
60	14	9'75017	19	9'82980	27	10°16'720	27	10°16'720	27	46	14
60	15	9'75036	18	9'83007	27	10°16'693	27	10°16'693	27	45	15
60	16	9'75054	19	9'83034	27	10°16'666	27	10°16'666	27	44	16
60	17	9'75073	18	9'83061	27	10°16'639	27	10°16'639	27	43	17
60	18	9'75091	19	9'83088	27	10°16'612	27	10°16'612	27	42	18
60	19	9'75110	18	9'83115	27	10°16'585	27	10°16'585	27	41	19
60	20	9'75128	19	9'83142	28	10°16'558	27	10°16'558	27	40	20
60	21	9'75147	18	9'83169	27	10°16'530	27	10°16'530	27	39	21
60	22	9'75165	19	9'83197	27	10°16'503	27	10°16'503	27	38	22
60	23	9'75184	18	9'83224	27	10°16'476	27	10°16'476	27	37	23
60	24	9'75202	19	9'83251	27	10°16'449	27	10°16'449	27	36	24
60	25	9'75221	18	9'83278	27	10°16'422	27	10°16'422	27	35	25
60	26	9'75239	19	9'83305	27	10°16'395	27	10°16'395	27	34	26
60	27	9'75258	18	9'83332	27	10°16'368	27	10°16'368	27	33	27
60	28	9'75276	18	9'83359	27	10°16'341	27	10°16'341	27	32	28
60	29	9'75294	19	9'83386	27	10°16'314	27	10°16'314	27	31	29
60	30	9'75313	19	9'83413	27	10°16'287	27	10°16'287	27	30	30

[55 degrees.]



[35 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Diff.	Secant.	Diff.
0	9.75359	18	9.85327	27	10.14673	27	10.14673	27	9.91069	9
1	9.75377	18	9.85354	26	10.14646	26	10.14646	26	9.91051	9
2	9.75395	18	9.85380	27	10.14620	27	10.14620	27	9.91034	9
3	9.75413	18	9.85407	27	10.14593	27	10.14593	27	9.91018	9
4	9.75431	18	9.85434	26	10.14566	26	10.14566	26	9.91003	9
5	9.75449	18	9.85460	27	10.14540	27	10.14540	27	9.91013	9
6	9.75467	18	9.85487	27	10.14513	27	10.14513	27	9.91014	9
7	9.75485	18	9.85514	26	10.14486	26	10.14486	26	9.91005	9
8	9.75503	18	9.85540	27	10.14460	27	10.14460	27	9.90996	9
9	9.75521	18	9.85567	27	10.14433	27	10.14433	27	9.90987	9
10	9.75539	18	9.85594	26	10.14406	26	10.14406	26	9.90978	9
11	9.75557	18	9.85620	27	10.14380	27	10.14380	27	9.90969	9
12	9.75575	18	9.85647	27	10.14353	27	10.14353	27	9.90960	9
13	9.75593	18	9.85674	26	10.14326	26	10.14326	26	9.90951	9
14	9.75611	18	9.85700	27	10.14300	27	10.14300	27	9.90942	9
15	9.75629	18	9.85727	27	10.14273	27	10.14273	27	9.90933	9
16	9.75646	18	9.85754	26	10.14246	26	10.14246	26	9.90924	9
17	9.75664	18	9.85780	27	10.14220	27	10.14220	27	9.90915	9
18	9.75682	18	9.85807	27	10.14193	27	10.14193	27	9.90906	10
19	9.75699	18	9.85834	26	10.14166	26	10.14166	26	9.90896	9
20	9.75718	18	9.85860	27	10.14140	27	10.14140	27	9.90887	9
21	9.75736	18	9.85887	27	10.14113	27	10.14113	27	9.90878	9
22	9.75754	18	9.85913	26	10.14087	26	10.14087	26	9.90869	9
23	9.75771	18	9.85940	27	10.14060	27	10.14060	27	9.90860	9
24	9.75789	18	9.85967	26	10.14033	26	10.14033	26	9.90851	9
25	9.75807	18	9.85993	27	10.14007	27	10.14007	27	9.90842	10
26	9.75824	18	9.86020	26	10.13980	26	10.13980	26	9.90832	9
27	9.75842	18	9.86046	27	10.13954	27	10.13954	27	9.90823	9
28	9.75860	18	9.86073	26	10.13927	26	10.13927	26	9.90814	9
29	9.75878	18	9.86100	27	10.13900	27	10.13900	27	9.90805	9
30	9.75895	17	9.86126	26	10.13874	26	10.13874	26	9.90796	9

[54 degrees.]

[35 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Diff.	Secant.	Diff.
0	9.75859	18	9.84533	27	10.15477	27	10.15477	27	9.91336	8
1	9.75877	18	9.84560	26	10.15450	26	10.15450	26	9.91318	9
2	9.75895	18	9.84587	27	10.15424	27	10.15424	27	9.91301	9
3	9.75913	18	9.84613	27	10.15397	27	10.15397	27	9.91284	9
4	9.75931	18	9.84640	26	10.15370	26	10.15370	26	9.91267	9
5	9.75949	18	9.84667	27	10.15343	27	10.15343	27	9.91250	9
6	9.75967	18	9.84694	27	10.15316	27	10.15316	27	9.91233	9
7	9.75985	18	9.84721	26	10.15289	26	10.15289	26	9.91216	9
8	9.76003	18	9.84748	27	10.15262	27	10.15262	27	9.91199	9
9	9.76021	18	9.84774	27	10.15235	27	10.15235	27	9.91182	9
10	9.76039	18	9.84801	26	10.15208	26	10.15208	26	9.91165	9
11	9.76057	18	9.84828	27	10.15181	27	10.15181	27	9.91148	9
12	9.76075	18	9.84855	27	10.15154	27	10.15154	27	9.91131	9
13	9.76093	18	9.84882	26	10.15127	26	10.15127	26	9.91114	9
14	9.76111	18	9.84909	27	10.15100	27	10.15100	27	9.91097	9
15	9.76129	18	9.84935	27	10.15073	27	10.15073	27	9.91080	9
16	9.76146	18	9.84962	26	10.15046	26	10.15046	26	9.91063	9
17	9.76164	18	9.84989	27	10.15019	27	10.15019	27	9.91046	9
18	9.76182	18	9.85016	27	10.14992	27	10.14992	27	9.91029	9
19	9.76200	18	9.85043	26	10.14965	26	10.14965	26	9.91012	9
20	9.76218	18	9.85069	27	10.14938	27	10.14938	27	9.90995	9
21	9.76236	18	9.85096	27	10.14911	27	10.14911	27	9.90978	9
22	9.76253	18	9.85123	26	10.14884	26	10.14884	26	9.90961	9
23	9.76271	18	9.85149	27	10.14857	27	10.14857	27	9.90944	9
24	9.76289	18	9.85176	26	10.14830	26	10.14830	26	9.90927	9
25	9.76307	18	9.85203	27	10.14803	27	10.14803	27	9.90910	9
26	9.76324	18	9.85230	26	10.14776	26	10.14776	26	9.90893	9
27	9.76342	18	9.85257	27	10.14749	27	10.14749	27	9.90876	9
28	9.76360	18	9.85283	26	10.14722	26	10.14722	26	9.90859	9
29	9.76378	17	9.85310	27	10.14695	27	10.14695	27	9.90842	9
30	9.76395	17	9.85337	26	10.14668	26	10.14668	26	9.90825	9

[54 degrees.]

[36 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Codine.	Diff.	°
0	9.775924	17	9.86126	87	10.13874	9.90796	60	30
1	9.776939	18	9.86153	26	10.13847	9.90787	59	29
2	9.776957	17	9.86179	26	10.13821	9.90777	10	58
3	9.776974	17	9.86206	26	10.13794	9.90768	9	57
4	9.776991	18	9.86232	27	10.13768	9.90759	9	56
5	9.777009	17	9.86259	26	10.13741	9.90750	9	55
6	9.777026	17	9.86285	27	10.13715	9.90741	10	54
7	9.777043	18	9.86312	26	10.13688	9.90731	9	53
8	9.777061	17	9.86338	27	10.13662	9.90722	9	52
9	9.777078	17	9.86365	27	10.13635	9.90713	9	51
10	9.777095	17	9.86392	26	10.13608	9.90704	10	50
11	9.777112	18	9.86418	27	10.13582	9.90694	9	49
12	9.777130	17	9.86445	26	10.13555	9.90685	9	48
13	9.777147	17	9.86471	27	10.13529	9.90676	9	47
14	9.777164	17	9.86498	26	10.13502	9.90667	10	46
15	9.777181	18	9.86524	27	10.13476	9.90657	9	45
16	9.777199	17	9.86551	26	10.13449	9.90648	9	44
17	9.777216	17	9.86577	26	10.13423	9.90639	9	43
18	9.777233	17	9.86603	27	10.13397	9.90630	10	42
19	9.777250	18	9.86630	26	10.13370	9.90620	9	41
20	9.777268	17	9.86656	27	10.13344	9.90611	9	40
21	9.777285	17	9.86683	26	10.13317	9.90602	10	39
22	9.777302	17	9.86709	27	10.13291	9.90592	38	38
23	9.777319	17	9.86736	26	10.13264	9.90583	9	37
24	9.777336	17	9.86762	27	10.13238	9.90574	9	36
25	9.777353	17	9.86789	26	10.13211	9.90565	10	35
26	9.777370	17	9.86815	27	10.13185	9.90555	10	34
27	9.777387	18	9.86842	26	10.13158	9.90546	9	33
28	9.777405	17	9.86868	26	10.13132	9.90537	10	32
29	9.777422	17	9.86894	27	10.13106	9.90527	10	31
30	9.777439	17	9.86921	27	10.13079	9.90518	9	30
°	Codine.	Cotang.		Tangent.	Sine.	°		

[53 degrees.]

[36 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Codine.	Diff.	°
30	9.77439	17	9.86021	26	10.13079	9.90318	9	30
31	9.77456	17	9.86047	27	10.13053	9.90309	9	29
32	9.77473	17	9.86074	26	10.13026	9.90299	10	28
33	9.77490	17	9.87000	26	10.13000	9.90290	9	27
34	9.77507	17	9.87027	26	10.12973	9.90280	9	26
35	9.77524	17	9.87053	26	10.12947	9.90271	9	25
36	9.77541	17	9.87079	27	10.12921	9.90262	9	24
37	9.77558	17	9.87106	26	10.12894	9.90252	10	23
38	9.77575	17	9.87132	26	10.12868	9.90243	9	22
39	9.77592	17	9.87158	27	10.12842	9.90234	9	21
40	9.77609	17	9.87185	26	10.12815	9.90224	10	20
41	9.77626	17	9.87211	27	10.12789	9.90215	9	19
42	9.77643	17	9.87238	26	10.12762	9.90205	9	18
43	9.77660	17	9.87264	26	10.12736	9.90196	10	17
44	9.77677	17	9.87290	27	10.12710	9.90186	9	16
45	9.77694	17	9.87317	26	10.12683	9.90177	9	15
46	9.77711	17	9.87343	26	10.12657	9.90168	10	14
47	9.77728	16	9.87369	27	10.12631	9.90158	9	13
48	9.77744	17	9.87396	26	10.12604	9.90149	10	12
49	9.77761	17	9.87422	26	10.12578	9.90139	9	11
50	9.77778	17	9.87448	27	10.12552	9.90130	10	10
51	9.77795	17	9.87475	26	10.12525	9.90120	9	9
52	9.77812	17	9.87501	26	10.12499	9.90111	10	7
53	9.77829	17	9.87527	27	10.12473	9.90101	9	6
54	9.77846	16	9.87554	26	10.12446	9.90092	10	5
55	9.77862	17	9.87580	26	10.12420	9.90082	10	4
56	9.77879	17	9.87606	27	10.12394	9.90073	10	3
57	9.77896	17	9.87633	26	10.12367	9.90063	9	2
58	9.77913	17	9.87659	26	10.12341	9.90054	10	1
59	9.77930	16	9.87685	26	10.12315	9.90044	9	0
60	9.77946	16	9.87711	27	10.12289	9.90035	9	0
°	Codine.	Cotang.		Tangent.	Sine.	°		

[53 degrees.]



[37 degrees.]

°	Sines.	Tangent.	Diff.	Cotang.	Diff.	Cosine.	Diff.
30	9.78445	9.88498	16	10.11502	9.89947	10	30
31	9.78461	9.88524	17	10.11476	9.89937	10	29
32	9.78478	9.88550	17	10.11450	9.89927	10	28
33	9.78494	9.88577	16	10.11423	9.89918	9	27
34	9.78510	9.88603	16	10.11397	9.89908	10	26
35	9.78527	9.88629	17	10.11371	9.89898	10	25
36	9.78543	9.88655	16	10.11345	9.89888	9	24
37	9.78560	9.88681	16	10.11319	9.89879	10	23
38	9.78576	9.88707	16	10.11293	9.89869	10	22
39	9.78592	9.88733	17	10.11267	9.89859	10	21
40	9.78609	9.88759	17	10.11241	9.89849	9	19
41	9.78625	9.88786	16	10.11214	9.89840	10	18
42	9.78642	9.88812	16	10.11188	9.89830	10	17
43	9.78658	9.88838	16	10.11162	9.89820	10	16
44	9.78674	9.88864	16	10.11136	9.89810	10	15
45	9.78691	9.88890	17	10.11110	9.89801	10	14
46	9.78707	9.88916	16	10.11084	9.89791	10	13
47	9.78723	9.88942	16	10.11058	9.89781	10	12
48	9.78739	9.88968	16	10.11032	9.89771	10	11
49	9.78756	9.88994	16	10.11006	9.89761	9	10
50	9.78772	9.89020	16	10.10980	9.89752	10	9
51	9.78788	9.89046	17	10.10954	9.89742	10	8
52	9.78805	9.89072	16	10.10928	9.89732	10	7
53	9.78821	9.89099	16	10.10902	9.89722	10	6
54	9.78837	9.89125	16	10.10875	9.89712	10	5
55	9.78853	9.89151	16	10.10849	9.89702	9	4
56	9.78869	9.89177	16	10.10823	9.89693	10	3
57	9.78886	9.89203	16	10.10797	9.89683	10	2
58	9.78902	9.89229	16	10.10771	9.89673	10	1
59	9.78918	9.89255	16	10.10745	9.89663	10	0
60	9.78934	9.89281	16	10.10719	9.89653	10	0

[52 degrees.]

[37 degrees.]

°	Sines.	Tangent.	Diff.	Cotang.	Diff.	Cosine.	Diff.
0	9.77046	9.87711	27	10.12289	9.90235	60	60
1	9.77063	9.87738	26	10.12262	9.90235	59	59
2	9.77080	9.87764	26	10.12236	9.90216	58	58
3	9.77097	9.87790	27	10.12210	9.90206	57	57
4	9.77113	9.87817	26	10.12183	9.90197	56	56
5	9.77130	9.87843	26	10.12157	9.90187	55	55
6	9.77147	9.87869	27	10.12131	9.90178	54	54
7	9.77163	9.87895	27	10.12105	9.90168	53	53
8	9.77180	9.87922	26	10.12078	9.90159	52	52
9	9.77197	9.87948	26	10.12052	9.90149	51	51
10	9.77213	9.87974	26	10.12026	9.90139	50	50
11	9.77230	9.88000	26	10.12000	9.90130	49	49
12	9.77247	9.88027	26	10.11973	9.90120	48	48
13	9.77263	9.88053	26	10.11947	9.90111	47	47
14	9.77280	9.88079	26	10.11921	9.90101	46	46
15	9.77297	9.88105	26	10.11895	9.90091	45	45
16	9.77313	9.88131	27	10.11869	9.90082	44	44
17	9.77330	9.88158	26	10.11842	9.90072	43	43
18	9.77346	9.88184	26	10.11816	9.90063	42	42
19	9.77363	9.88210	26	10.11790	9.90053	41	41
20	9.77380	9.88236	26	10.11764	9.90043	40	40
21	9.77396	9.88262	27	10.11738	9.90034	39	39
22	9.77413	9.88289	26	10.11711	9.90024	38	38
23	9.77429	9.88315	26	10.11685	9.90014	37	37
24	9.77446	9.88341	26	10.11659	9.90005	36	36
25	9.77462	9.88367	26	10.11633	9.99995	35	35
26	9.77479	9.88393	27	10.11607	9.99985	34	34
27	9.77495	9.88420	26	10.11580	9.99976	33	33
28	9.77512	9.88446	26	10.11554	9.99966	32	32
29	9.77528	9.88472	26	10.11528	9.99956	31	31
30	9.77545	9.88498	27	10.11502	9.99947	30	30

[52 degrees.]



[38 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Diff.	°
30	9.79415	16	9.90061	25	10.09914	9.89354	10	30	
31	9.79447	16	9.90086	26	10.09939	9.89344	10	29	
32	9.79481	16	9.90112	26	10.09964	9.89334	10	28	
33	9.79515	15	9.90138	26	10.09989	9.89324	10	27	
34	9.79548	16	9.90164	26	10.09986	9.89314	10	26	
35	9.79581	16	9.90190	26	10.09981	9.89304	10	25	
36	9.79615	16	9.90216	26	10.09976	9.89294	10	24	
37	9.79648	16	9.90242	26	10.09971	9.89284	10	23	
38	9.79681	16	9.90268	26	10.09966	9.89274	10	22	
39	9.79715	15	9.90294	26	10.09961	9.89264	10	21	
40	9.79748	16	9.90320	26	10.09956	9.89254	10	20	
41	9.79781	16	9.90346	25	10.09951	9.89244	11	19	
42	9.79815	16	9.90371	26	10.09946	9.89233	10	18	
43	9.79848	15	9.90397	26	10.09941	9.89223	10	17	
44	9.79881	16	9.90423	26	10.09936	9.89213	10	16	
45	9.79915	16	9.90449	26	10.09931	9.89203	10	15	
46	9.79948	16	9.90475	26	10.09926	9.89193	10	14	
47	9.79981	15	9.90501	26	10.09921	9.89183	10	13	
48	9.79999	16	9.90527	26	10.09916	9.89173	11	12	
49	9.80015	16	9.90553	25	10.09911	9.89162	10	11	
50	9.80031	15	9.90578	26	10.09906	9.89152	10	10	
51	9.80046	16	9.90604	26	10.09901	9.89142	10	9	
52	9.80061	16	9.90630	26	10.09896	9.89132	10	8	
53	9.80076	15	9.90656	26	10.09891	9.89122	10	7	
54	9.80091	16	9.90682	26	10.09886	9.89112	11	6	
55	9.80106	16	9.90708	26	10.09881	9.89101	10	5	
56	9.80121	15	9.90734	25	10.09876	9.89091	10	4	
57	9.80136	16	9.90759	26	10.09871	9.89081	10	3	
58	9.80151	16	9.90785	26	10.09866	9.89071	11	2	
59	9.80166	15	9.90811	26	10.09861	9.89060	10	1	
60	9.80181	15	9.90837	26	10.09856	9.89050	10	0	

[51 degrees.]

[38 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Diff.	°
60	9.86653	10	10.10719	9.86643	10	59			
59	9.86638	10	10.10694	9.86628	10	58			
58	9.86623	9	10.10669	9.86613	9	57			
57	9.86608	10	10.10644	9.86598	10	56			
56	9.86593	10	10.10619	9.86583	10	55			
55	9.86578	10	10.10594	9.86568	10	54			
54	9.86563	10	10.10569	9.86553	10	53			
53	9.86548	10	10.10544	9.86538	10	52			
52	9.86533	10	10.10519	9.86523	10	51			
51	9.86518	10	10.10494	9.86508	10	50			
50	9.86503	10	10.10469	9.86493	10	49			
49	9.86488	10	10.10444	9.86478	10	48			
48	9.86473	10	10.10419	9.86463	10	47			
47	9.86458	10	10.10394	9.86448	10	46			
46	9.86443	10	10.10369	9.86433	10	45			
45	9.86428	9	10.10344	9.86418	9	44			
44	9.86413	10	10.10319	9.86403	10	43			
43	9.86398	10	10.10294	9.86388	10	42			
42	9.86383	10	10.10269	9.86373	10	41			
41	9.86368	10	10.10244	9.86358	10	40			
40	9.86353	10	10.10219	9.86343	10	39			
39	9.86338	10	10.10194	9.86328	10	38			
38	9.86323	10	10.10169	9.86313	10	37			
37	9.86308	10	10.10144	9.86298	10	36			
36	9.86293	10	10.10119	9.86283	10	35			
35	9.86278	10	10.10094	9.86268	10	34			
34	9.86263	10	10.10069	9.86253	10	33			
33	9.86248	10	10.10044	9.86238	10	32			
32	9.86233	10	10.10019	9.86223	10	31			
31	9.86218	10	10.09994	9.86208	10	30			
30	9.86203	10	10.09969	9.86193	10	29			
29	9.86188	10	10.09944	9.86178	10	28			
28	9.86173	10	10.09919	9.86163	10	27			
27	9.86158	10	10.09894	9.86148	10	26			
26	9.86143	10	10.09869	9.86133	10	25			
25	9.86128	10	10.09844	9.86118	10	24			
24	9.86113	10	10.09819	9.86103	10	23			
23	9.86098	10	10.09794	9.86088	10	22			
22	9.86083	10	10.09769	9.86073	10	21			
21	9.86068	10	10.09744	9.86058	10	20			
20	9.86053	10	10.09719	9.86043	10	19			
19	9.86038	10	10.09694	9.86028	10	18			
18	9.86023	10	10.09669	9.86013	10	17			
17	9.86008	10	10.09644	9.86003	10	16			
16	9.85993	10	10.09619	9.85988	10	15			
15	9.85978	10	10.09594	9.85973	10	14			
14	9.85963	10	10.09569	9.85958	10	13			
13	9.85948	10	10.09544	9.85943	10	12			
12	9.85933	10	10.09519	9.85928	10	11			
11	9.85918	10	10.09494	9.85913	10	10			
10	9.85903	10	10.09469	9.85898	10	9			
9	9.85888	10	10.09444	9.85883	10	8			
8	9.85873	10	10.09419	9.85868	10	7			
7	9.85858	10	10.09394	9.85853	10	6			
6	9.85843	10	10.09369	9.85838	10	5			
5	9.85828	10	10.09344	9.85823	10	4			
4	9.85813	10	10.09319	9.85808	10	3			
3	9.85798	10	10.09294	9.85793	10	2			
2	9.85783	10	10.09269	9.85778	10	1			
1	9.85768	10	10.09244	9.85763	10	0			

[51 degrees.]

[39 degrees.]

Sine.	Tangent.	Cotang.	Co-sine.	Diff.	Sine.	Tangent.	Cotang.	Co-sine.	Diff.
30	9.80311	15	9.91610	26	10.08190	9.88741	11	30	
31	9.80366	16	9.91636	26	10.08304	9.88730	10	29	
32	9.80382	15	9.91662	26	10.08338	9.88720	10	28	
33	9.80397	15	9.91688	25	10.08311	9.88709	10	27	
34	9.80412	16	9.91713	26	10.08287	9.88699	10	26	
35	9.80428	15	9.91739	26	10.08261	9.88688	11	25	
36	9.80443	15	9.91765	26	10.08235	9.88678	10	24	
37	9.80458	15	9.91791	25	10.08209	9.88668	10	23	
38	9.80473	16	9.91816	26	10.08184	9.88657	10	22	
39	9.80489	15	9.91842	26	10.08158	9.88647	11	21	
40	9.80504	15	9.91868	25	10.08132	9.88636	10	20	
41	9.80519	15	9.91893	26	10.08107	9.88626	10	19	
42	9.80534	16	9.91919	26	10.08081	9.88615	10	18	
43	9.80550	15	9.91945	26	10.08055	9.88605	11	17	
44	9.80565	15	9.91971	25	10.08029	9.88594	10	16	
45	9.80580	15	9.91996	26	10.08004	9.88584	11	15	
46	9.80595	15	9.92022	26	10.07978	9.88573	10	14	
47	9.80610	16	9.92048	25	10.07952	9.88563	10	13	
48	9.80625	15	9.92073	26	10.07927	9.88552	11	12	
49	9.80641	15	9.92099	26	10.07901	9.88542	10	11	
50	9.80656	15	9.92125	25	10.07875	9.88531	10	10	
51	9.80671	15	9.92150	25	10.07850	9.88521	11	9	
52	9.80686	15	9.92176	26	10.07824	9.88510	11	8	
53	9.80701	15	9.92202	25	10.07798	9.88499	10	7	
54	9.80716	15	9.92227	25	10.07773	9.88489	11	6	
55	9.80731	15	9.92253	26	10.07747	9.88478	10	5	
56	9.80746	16	9.92279	25	10.07721	9.88468	11	4	
57	9.80762	15	9.92304	26	10.07696	9.88457	10	3	
58	9.80777	15	9.92330	26	10.07670	9.88447	11	2	
59	9.80792	15	9.92356	25	10.07644	9.88436	11	1	
60	9.80807	15	9.92381	25	10.07619	9.88425	11	0	

[50 degrees.]

[39 degrees.]

Sine.	Tangent.	Cotang.	Co-sine.	Diff.	Sine.	Tangent.	Cotang.	Co-sine.	Diff.
0	9.79887	16	9.90837	26	10.09163	9.89050	10	60	
1	9.79901	15	9.90861	26	10.09137	9.89040	10	59	
2	9.79918	16	9.90889	25	10.09111	9.89030	10	58	
3	9.79934	15	9.90914	26	10.09086	9.89020	11	57	
4	9.79950	16	9.90940	26	10.09060	9.89009	10	56	
5	9.79965	15	9.90966	26	10.09034	9.88999	10	55	
6	9.79981	15	9.90992	26	10.09008	9.88989	11	54	
7	9.79996	16	9.91018	25	10.08982	9.88978	10	53	
8	9.80012	15	9.91043	26	10.08957	9.88968	10	52	
9	9.80027	15	9.91069	26	10.08931	9.88958	10	51	
10	9.80043	15	9.91095	26	10.08905	9.88948	11	50	
11	9.80058	16	9.91121	26	10.08879	9.88937	10	49	
12	9.80074	15	9.91147	25	10.08853	9.88927	10	48	
13	9.80089	16	9.91172	26	10.08828	9.88917	11	47	
14	9.80105	15	9.91198	26	10.08802	9.88906	10	46	
15	9.80120	16	9.91224	26	10.08776	9.88896	10	45	
16	9.80136	15	9.91250	26	10.08750	9.88886	10	44	
17	9.80151	15	9.91276	25	10.08724	9.88875	10	43	
18	9.80166	16	9.91301	26	10.08699	9.88865	10	42	
19	9.80182	15	9.91327	26	10.08673	9.88855	11	41	
20	9.80197	16	9.91353	26	10.08647	9.88844	10	40	
21	9.80213	15	9.91379	25	10.08621	9.88834	10	39	
22	9.80228	16	9.91404	26	10.08596	9.88824	11	38	
23	9.80244	15	9.91430	26	10.08570	9.88813	10	37	
24	9.80259	15	9.91456	26	10.08544	9.88803	10	36	
25	9.80274	16	9.91482	25	10.08518	9.88793	11	35	
26	9.80290	15	9.91507	26	10.08493	9.88782	10	34	
27	9.80305	15	9.91533	26	10.08467	9.88772	11	33	
28	9.80320	16	9.91559	26	10.08441	9.88761	10	32	
29	9.80336	15	9.91585	25	10.08415	9.88751	10	31	
30	9.80351	15	9.91610	26	10.08390	9.88741	10	30	

[50 degrees.]



[40 degrees.]

Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	Diff.
0	9'8087	9'92381	26	10'07619	9'88425	10
1	9'80824	9'92407	26	10'07593	9'88415	10
2	9'80837	9'92433	25	10'07567	9'88404	11
3	9'80852	9'92458	25	10'07542	9'88394	10
4	9'80867	9'92484	26	10'07516	9'88383	11
5	9'80882	9'92510	25	10'07490	9'88372	11
6	9'80897	9'92535	26	10'07465	9'88362	10
7	9'80912	9'92561	26	10'07439	9'88351	11
8	9'80927	9'92587	25	10'07413	9'88340	11
9	9'80942	9'92612	26	10'07388	9'88330	10
10	9'80957	9'92638	25	10'07362	9'88319	11
11	9'80972	9'92663	26	10'07337	9'88308	11
12	9'80987	9'92689	26	10'07311	9'88298	10
13	9'81002	9'92715	25	10'07285	9'88287	11
14	9'81017	9'92740	26	10'07260	9'88276	11
15	9'81032	9'92766	26	10'07234	9'88266	10
16	9'81047	9'92792	25	10'07208	9'88255	11
17	9'81061	9'92817	26	10'07183	9'88244	11
18	9'81076	9'92843	25	10'07157	9'88234	11
19	9'81091	9'92868	26	10'07132	9'88223	11
20	9'81106	9'92894	26	10'07106	9'88212	11
21	9'81121	9'92920	25	10'07080	9'88201	10
22	9'81136	9'92945	26	10'07055	9'88191	11
23	9'81151	9'92971	25	10'07029	9'88180	11
24	9'81166	9'92996	26	10'07004	9'88169	11
25	9'81180	9'93022	26	10'06978	9'88158	11
26	9'81195	9'93048	25	10'06952	9'88148	11
27	9'81210	9'93073	26	10'06927	9'88137	11
28	9'81225	9'93099	25	10'06901	9'88126	11
29	9'81240	9'93124	26	10'06876	9'88115	10
30	9'81254	9'93150	26	10'06850	9'88105	10
	Cosine.	Cotang.	Tangent.	Sine.		

[49 degrees.]

Sine.	Diff.	Tangent.	Diff.	Cotang.	Cosine.	Diff.
10	9'81254	9'93150	25	10'06850	9'88105	11
11	9'81269	9'93175	26	10'06825	9'88094	10
12	9'81284	9'93201	26	10'06799	9'88083	11
13	9'81299	9'93227	25	10'06773	9'88072	11
14	9'81314	9'93252	26	10'06748	9'88061	10
15	9'81328	9'93278	26	10'06722	9'88051	11
16	9'81343	9'93303	25	10'06697	9'88040	11
17	9'81358	9'93329	25	10'06671	9'88029	11
18	9'81372	9'93354	26	10'06646	9'88018	11
19	9'81387	9'93380	26	10'06620	9'88007	11
20	9'81402	9'93406	25	10'06594	9'87996	11
21	9'81417	9'93431	26	10'06569	9'87985	10
22	9'81431	9'93457	25	10'06543	9'87975	11
23	9'81446	9'93482	26	10'06518	9'87964	11
24	9'81461	9'93508	26	10'06492	9'87953	11
25	9'81475	9'93533	26	10'06467	9'87942	11
26	9'81490	9'93559	25	10'06441	9'87931	11
27	9'81505	9'93584	26	10'06416	9'87920	11
28	9'81519	9'93610	26	10'06390	9'87909	11
29	9'81534	9'93636	25	10'06364	9'87898	11
30	9'81549	9'93661	26	10'06339	9'87887	10
31	9'81563	9'93687	25	10'06313	9'87877	11
32	9'81578	9'93712	26	10'06288	9'87866	11
33	9'81592	9'93738	25	10'06262	9'87855	11
34	9'81607	9'93763	26	10'06237	9'87844	11
35	9'81622	9'93789	25	10'06211	9'87833	11
36	9'81636	9'93814	26	10'06186	9'87822	11
37	9'81651	9'93840	25	10'06160	9'87811	11
38	9'81665	9'93865	26	10'06135	9'87800	11
39	9'81680	9'93891	25	10'06109	9'87789	11
40	9'81694	9'93916	26	10'06084	9'87778	11
	Cosine.	Cotang.	Tangent.	Sine.		

[49 degrees.]



[41 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Diff.	Secant.	Diff.
30	0.81126	15	9.94681	25	10.05319	25	9.87436	12	30	
31	0.82141	14	9.94706	26	10.05294	26	9.87434	11	29	
32	0.82155	14	9.94732	25	10.05268	25	9.87423	11	28	
33	0.82169	14	9.94757	26	10.05243	26	9.87412	11	27	
34	0.82184	14	9.94783	25	10.05217	25	9.87402	11	26	
35	0.82198	14	9.94808	26	10.05192	26	9.87390	11	25	
36	0.82212	14	9.94834	26	10.05166	26	9.87378	11	24	
37	0.82226	14	9.94859	25	10.05141	25	9.87367	11	23	
38	0.82240	14	9.94884	26	10.05116	26	9.87356	11	22	
39	0.82255	14	9.94910	25	10.05090	25	9.87345	11	21	
40	0.82269	14	9.94935	26	10.05065	26	9.87334	11	20	
41	0.82283	14	9.94961	25	10.05039	25	9.87322	11	19	
42	0.82297	14	9.94986	26	10.05014	26	9.87311	11	18	
43	0.82311	14	9.95012	25	10.04988	25	9.87300	11	17	
44	0.82326	14	9.95037	25	10.04963	25	9.87288	11	16	
45	0.82340	14	9.95062	26	10.04938	26	9.87277	11	15	
46	0.82354	14	9.95088	25	10.04912	25	9.87266	11	14	
47	0.82368	14	9.95113	26	10.04887	26	9.87255	11	13	
48	0.82382	14	9.95139	25	10.04861	25	9.87243	11	12	
49	0.82396	14	9.95164	26	10.04836	26	9.87232	11	11	
50	0.82410	14	9.95190	25	10.04810	25	9.87221	11	10	
51	0.82424	14	9.95215	26	10.04785	26	9.87209	11	9	
52	0.82439	14	9.95240	25	10.04760	25	9.87198	11	8	
53	0.82453	14	9.95266	26	10.04734	26	9.87187	11	7	
54	0.82467	14	9.95291	25	10.04709	25	9.87175	11	6	
55	0.82481	14	9.95317	26	10.04683	26	9.87164	11	5	
56	0.82495	14	9.95342	25	10.04658	25	9.87153	11	4	
57	0.82509	14	9.95368	26	10.04632	26	9.87141	11	3	
58	0.82523	14	9.95393	25	10.04607	25	9.87130	11	2	
59	0.82537	14	9.95418	26	10.04582	26	9.87119	11	1	
60	0.82551	14	9.95444	25	10.04556	25	9.87107	11	0	

[48 degrees.]

[41 degrees.]

°	Sine.	Diff.	Tangent.	Diff.	Cotang.	Diff.	Cotang.	Diff.	Secant.	Diff.
0	0.81694	15	9.93916	26	10.06084	26	9.87778	11	59	60
1	0.81709	14	9.93942	25	10.06058	25	9.87767	11	58	
2	0.81723	14	9.93967	25	10.06033	25	9.87756	11	57	
3	0.81738	14	9.93993	26	10.06007	26	9.87745	11	56	
4	0.81752	14	9.94018	25	10.05982	25	9.87734	11	55	
5	0.81767	14	9.94044	25	10.05956	25	9.87723	11	54	
6	0.81781	14	9.94069	26	10.05931	26	9.87712	11	53	
7	0.81796	14	9.94095	25	10.05905	25	9.87701	11	52	
8	0.81810	14	9.94120	26	10.05880	26	9.87690	11	51	
9	0.81825	14	9.94146	25	10.05854	25	9.87679	11	50	
10	0.81839	14	9.94171	26	10.05829	26	9.87668	11	49	
11	0.81854	14	9.94197	25	10.05803	25	9.87657	11	48	
12	0.81868	14	9.94222	26	10.05778	26	9.87646	11	47	
13	0.81882	14	9.94248	25	10.05752	25	9.87635	11	46	
14	0.81897	14	9.94273	26	10.05727	26	9.87624	11	45	
15	0.81911	14	9.94299	25	10.05701	25	9.87613	11	44	
16	0.81926	14	9.94324	26	10.05676	26	9.87601	11	43	
17	0.81940	14	9.94350	25	10.05650	25	9.87590	11	42	
18	0.81955	14	9.94375	26	10.05625	26	9.87579	11	41	
19	0.81969	14	9.94401	25	10.05599	25	9.87568	11	40	
20	0.81983	14	9.94426	26	10.05574	26	9.87557	11	39	
21	0.81998	14	9.94452	25	10.05548	25	9.87546	11	38	
22	0.82012	14	9.94477	26	10.05523	26	9.87535	11	37	
23	0.82026	14	9.94503	25	10.05497	25	9.87524	11	36	
24	0.82041	14	9.94528	26	10.05472	26	9.87513	11	35	
25	0.82055	14	9.94554	25	10.05446	25	9.87501	11	34	
26	0.82069	14	9.94579	26	10.05421	26	9.87490	11	33	
27	0.82084	14	9.94604	25	10.05396	25	9.87479	11	32	
28	0.82098	14	9.94630	26	10.05370	26	9.87468	11	31	
29	0.82112	14	9.94655	25	10.05345	25	9.87457	11	30	
30	0.82126	14	9.94681	26	10.05319	26	9.87446	11	29	

[48 degrees.]

[42 degrees.]

'	Sine.	Diff.	Tangent.	Co-tang.	Diff.	Co-sine.	Diff.
30	9.82668	14	9.96205	10.03795	26	9.86763	30
31	9.82682	15	9.96231	10.03769	25	9.86752	29
32	9.82696	14	9.96256	10.03744	25	9.86740	28
33	9.82710	14	9.96281	10.03718	25	9.86728	27
34	9.82724	13	9.96307	10.03693	26	9.86717	26
35	9.82737	14	9.96332	10.03668	25	9.86705	25
36	9.82751	14	9.96357	10.03643	25	9.86694	24
37	9.82765	13	9.96382	10.03617	26	9.86682	23
38	9.82778	14	9.96408	10.03592	25	9.86670	22
39	9.82792	14	9.96433	10.03567	25	9.86659	21
40	9.82806	14	9.96459	10.03541	25	9.86647	20
41	9.82819	13	9.96484	10.03516	26	9.86635	19
42	9.82833	14	9.96510	10.03490	25	9.86624	18
43	9.82847	14	9.96535	10.03465	25	9.86612	17
44	9.82861	13	9.96560	10.03440	26	9.86600	16
45	9.82874	14	9.96586	10.03414	25	9.86589	15
46	9.82888	14	9.96611	10.03389	25	9.86577	14
47	9.82902	13	9.96636	10.03364	26	9.86565	13
48	9.82915	14	9.96662	10.03338	26	9.86554	12
49	9.82929	14	9.96687	10.03313	25	9.86542	11
50	9.82942	13	9.96712	10.03288	26	9.86530	10
51	9.82956	14	9.96738	10.03262	26	9.86518	9
52	9.82970	14	9.96763	10.03237	25	9.86507	8
53	9.82983	13	9.96788	10.03212	25	9.86495	7
54	9.82997	14	9.96814	10.03186	26	9.86483	6
55	9.83010	13	9.96839	10.03161	25	9.86472	5
56	9.83024	14	9.96864	10.03136	26	9.86460	4
57	9.83038	14	9.96890	10.03110	26	9.86448	3
58	9.83051	13	9.96915	10.03085	25	9.86436	2
59	9.83065	14	9.96940	10.03060	25	9.86425	1
60	9.83078	13	9.96966	10.03034	26	9.86413	0

[47 degrees.]

'	Sine.	Diff.	Tangent.	Co-tang.	Co-sine.	Diff.
0	9.82551	14	9.95444	10.04556	9.87107	11
1	9.82565	14	9.95469	10.04531	9.87096	60
2	9.82579	14	9.95495	10.04505	9.87085	59
3	9.82593	14	9.95520	10.04480	9.87073	58
4	9.82607	14	9.95545	10.04455	9.87062	57
5	9.82621	14	9.95571	10.04429	9.87050	56
6	9.82635	14	9.95596	10.04404	9.87039	55
7	9.82649	14	9.95622	10.04378	9.87028	54
8	9.82663	14	9.95647	10.04353	9.87016	53
9	9.82677	14	9.95672	10.04328	9.87005	52
10	9.82691	14	9.95698	10.04302	9.86993	51
11	9.82705	14	9.95723	10.04277	9.86982	50
12	9.82719	14	9.95748	10.04252	9.86970	49
13	9.82733	14	9.95774	10.04226	9.86959	48
14	9.82747	14	9.95799	10.04201	9.86947	47
15	9.82761	14	9.95825	10.04175	9.86936	46
16	9.82775	13	9.95850	10.04150	9.86924	45
17	9.82788	14	9.95875	10.04125	9.86913	44
18	9.82802	14	9.95901	10.04099	9.86902	43
19	9.82816	14	9.95926	10.04074	9.86890	42
20	9.82830	14	9.95952	10.04048	9.86879	41
21	9.82844	14	9.95977	10.04023	9.86867	40
22	9.82858	14	9.96002	10.03998	9.86855	39
23	9.82872	14	9.96028	10.03972	9.86844	38
24	9.82885	13	9.96053	10.03947	9.86832	37
25	9.82899	14	9.96078	10.03922	9.86821	36
26	9.82913	14	9.96102	10.03896	9.86810	35
27	9.82927	14	9.96129	10.03871	9.86798	34
28	9.82941	14	9.96155	10.03845	9.86786	33
29	9.82955	13	9.96180	10.03820	9.86775	32
30	9.82968	13	9.96205	10.03795	9.86763	31

[47 degrees.]



[43 degrees.]

°	'	Sines	Diff.	Tangents.	Diff.	Cotang.	Diff.	Comme.	Diff.
30	0	9.83781	14	9.97725	25	10.02275	9.86056	12	30
31	0	9.83795	13	9.97750	26	10.02250	9.86044	12	29
32	0	9.83808	13	9.97776	25	10.02224	9.86032	12	28
33	0	9.83821	13	9.97801	25	10.02199	9.86020	12	27
34	0	9.83834	13	9.97826	25	10.02174	9.86008	12	26
35	0	9.83848	13	9.97851	26	10.02149	9.85996	12	25
36	0	9.83861	13	9.97877	25	10.02123	9.85984	12	24
37	0	9.83874	13	9.97902	25	10.02098	9.85972	12	23
38	0	9.83887	14	9.97927	26	10.02073	9.85960	12	22
39	0	9.83901	13	9.97953	25	10.02047	9.85948	12	21
40	0	9.83914	13	9.97978	25	10.02022	9.85936	12	20
41	0	9.83927	13	9.98003	26	10.01997	9.85924	12	19
42	0	9.83940	14	9.98029	25	10.01971	9.85912	12	18
43	0	9.83954	13	9.98054	25	10.01946	9.85900	12	17
44	0	9.83967	13	9.98079	25	10.01921	9.85888	12	16
45	0	9.83980	13	9.98104	26	10.01896	9.85876	12	15
46	0	9.83993	13	9.98130	26	10.01870	9.85864	12	14
47	0	9.84006	14	9.98155	25	10.01845	9.85851	12	13
48	0	9.84020	13	9.98180	26	10.01820	9.85839	12	12
49	0	9.84033	13	9.98206	25	10.01794	9.85827	12	11
50	0	9.84046	13	9.98231	25	10.01769	9.85815	12	10
51	0	9.84059	13	9.98256	25	10.01744	9.85803	12	9
52	0	9.84072	13	9.98281	26	10.01719	9.85791	12	8
53	0	9.84085	13	9.98307	25	10.01693	9.85779	12	7
54	0	9.84098	14	9.98332	26	10.01668	9.85766	12	6
55	0	9.84112	13	9.98357	25	10.01643	9.85754	12	5
56	0	9.84125	13	9.98383	25	10.01617	9.85742	12	4
57	0	9.84138	13	9.98408	25	10.01592	9.85730	12	3
58	0	9.84151	13	9.98433	26	10.01567	9.85718	12	2
59	0	9.84164	13	9.98458	26	10.01542	9.85706	12	1
60	0	9.84177	13	9.98484	26	10.01516	9.85693	12	0

[46 degrees.]

[43 degrees.]

°	'	Sines	Diff.	Tangents.	Diff.	Cotang.	Diff.	Comme.	Diff.
0	0	9.83378	14	9.96666	25	10.03034	9.86413	12	59
1	0	9.83392	13	9.96691	25	10.03009	9.86401	12	58
2	0	9.83405	14	9.96716	26	10.02984	9.86389	12	57
3	0	9.83419	13	9.96742	25	10.02958	9.86377	12	56
4	0	9.83432	14	9.96767	26	10.02933	9.86366	12	55
5	0	9.83446	13	9.96792	26	10.02908	9.86354	12	54
6	0	9.83459	14	9.96818	25	10.02882	9.86342	12	53
7	0	9.83473	13	9.96843	25	10.02857	9.86330	12	52
8	0	9.83486	14	9.96868	25	10.02832	9.86318	12	51
9	0	9.83500	13	9.96893	26	10.02807	9.86306	12	50
10	0	9.83513	14	9.96919	25	10.02781	9.86295	12	49
11	0	9.83527	13	9.96944	25	10.02756	9.86283	12	48
12	0	9.83540	14	9.96969	26	10.02731	9.86271	12	47
13	0	9.83554	13	9.96995	25	10.02705	9.86259	12	46
14	0	9.83567	14	9.97020	25	10.02680	9.86247	12	45
15	0	9.83581	13	9.97045	26	10.02655	9.86235	12	44
16	0	9.83594	14	9.97071	25	10.02630	9.86223	12	43
17	0	9.83608	13	9.97096	25	10.02604	9.86211	12	42
18	0	9.83621	14	9.97121	26	10.02579	9.86200	12	41
19	0	9.83634	13	9.97147	25	10.02553	9.86188	12	40
20	0	9.83648	14	9.97172	25	10.02528	9.86176	12	39
21	0	9.83661	13	9.97197	26	10.02503	9.86164	12	38
22	0	9.83674	14	9.97223	25	10.02477	9.86152	12	37
23	0	9.83688	13	9.97248	25	10.02452	9.86140	12	36
24	0	9.83701	14	9.97273	26	10.02427	9.86128	12	35
25	0	9.83715	13	9.97298	25	10.02402	9.86116	12	34
26	0	9.83728	14	9.97324	25	10.02376	9.86104	12	33
27	0	9.83741	13	9.97349	26	10.02351	9.86092	12	32
28	0	9.83755	14	9.97374	25	10.02326	9.86080	12	31
29	0	9.83768	13	9.97399	26	10.02300	9.86068	12	30
30	0	9.83781	13	9.97425	25	10.02275	9.86056	12	29

[46 degrees.]



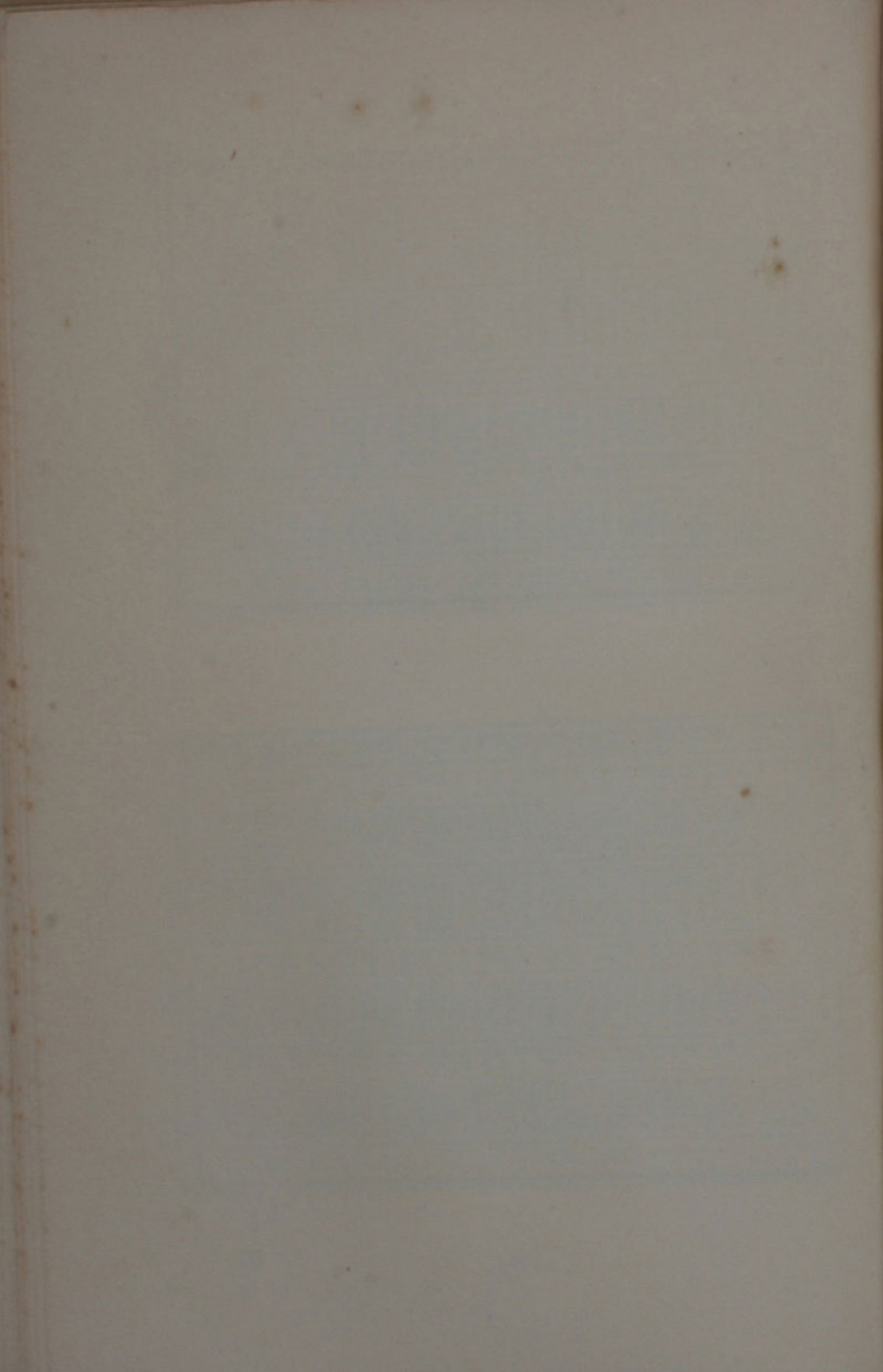
[44 degrees.]

°	Sine.	Diff.	Tangent.	Cotang.	Cosine.	Diff.	°
30	9'84566	13	9'90242	10'00758	9'85124	12	30
31	9'84579	13	9'90267	10'00733	9'85112	12	29
32	9'84592	13	9'90293	10'00707	9'85099	12	28
33	9'84605	13	9'90318	10'00682	9'85087	12	27
34	9'84618	12	9'90343	10'00657	9'85074	12	26
35	9'84630	13	9'90368	10'00632	9'85062	12	25
36	9'84643	13	9'90394	10'00606	9'85050	12	24
37	9'84656	13	9'90419	10'00581	9'85037	12	23
38	9'84669	13	9'90444	10'00556	9'85025	12	22
39	9'84682	12	9'90469	10'00531	9'85012	12	21
40	9'84694	13	9'90495	10'00505	9'85000	12	20
41	9'84707	13	9'90520	10'00480	9'85018	12	19
42	9'84720	13	9'90545	10'00455	9'85075	12	18
43	9'84733	12	9'90570	10'00430	9'85062	12	17
44	9'84745	13	9'90596	10'00404	9'85050	12	16
45	9'84758	13	9'90621	10'00379	9'85037	12	15
46	9'84771	13	9'90646	10'00354	9'85025	12	14
47	9'84784	12	9'90672	10'00328	9'85012	12	13
48	9'84796	13	9'90697	10'00303	9'85000	12	12
49	9'84809	13	9'90722	10'00278	9'85087	12	11
50	9'84822	13	9'90747	10'00253	9'85074	12	10
51	9'84835	12	9'90773	10'00227	9'85062	12	9
52	9'84847	13	9'90798	10'00202	9'85049	12	8
53	9'84860	13	9'90823	10'00177	9'85037	12	7
54	9'84873	12	9'90848	10'00152	9'85024	12	6
55	9'84885	13	9'90874	10'00126	9'85012	12	5
56	9'84898	13	9'90899	10'00101	9'85000	12	4
57	9'84911	12	9'90924	10'00076	9'84986	12	3
58	9'84923	13	9'90949	10'00051	9'84974	12	2
59	9'84936	13	9'90975	10'00025	9'84962	12	1
60	9'84949		9'90999	10'00000	9'84949		0

[45 degrees.]

°	Sine.	Diff.	Tangent.	Cotang.	Cosine.	Diff.	°
0	9'84977	13	9'98454	10'01516	9'85693	12	60
1	9'84990	13	9'98479	10'01491	9'85681	12	59
2	9'85003	13	9'98504	10'01466	9'85669	12	58
3	9'85016	13	9'98529	10'01440	9'85657	12	57
4	9'85029	13	9'98554	10'01415	9'85645	12	56
5	9'85042	13	9'98579	10'01390	9'85632	12	55
6	9'85055	14	9'98604	10'01365	9'85620	12	54
7	9'85068	13	9'98629	10'01339	9'85608	12	53
8	9'85082	13	9'98654	10'01314	9'85596	12	52
9	9'85095	13	9'98679	10'01289	9'85583	12	51
10	9'85108	13	9'98704	10'01263	9'85571	12	50
11	9'85121	13	9'98729	10'01238	9'85559	12	49
12	9'85134	13	9'98754	10'01213	9'85547	12	48
13	9'85147	13	9'98779	10'01188	9'85534	12	47
14	9'85160	13	9'98804	10'01162	9'85522	12	46
15	9'85173	12	9'98829	10'01137	9'85510	12	45
16	9'85186	13	9'98854	10'01112	9'85497	12	44
17	9'85199	13	9'98879	10'01087	9'85485	12	43
18	9'85211	13	9'98904	10'01061	9'85473	12	42
19	9'85224	13	9'98929	10'01036	9'85460	12	41
20	9'85237	13	9'98954	10'01011	9'85448	12	40
21	9'85250	13	9'99015	10'00985	9'85436	12	39
22	9'85263	13	9'99040	10'00960	9'85423	12	38
23	9'85276	13	9'99065	10'00935	9'85411	12	37
24	9'85289	13	9'99090	10'00910	9'85399	12	36
25	9'85302	13	9'99116	10'00884	9'85386	12	35
26	9'85315	13	9'99141	10'00859	9'85374	12	34
27	9'85328	12	9'99166	10'00834	9'85361	12	33
28	9'85340	13	9'99191	10'00809	9'85349	12	32
29	9'85353	13	9'99217	10'00783	9'85337	12	31
30	9'85366	13	9'99242	10'00758	9'85324	12	30

[45 degrees.]



TABLES OF RIGHT ASCENSION,  
DECLINATION, AND ASCENSIONAL  
DIFFERENCE





ARIES AND LIBRA			ASCENSIONAL DIFFERENCE							
Deg.	Declin.		Rt. Ascen.		London		Birming'm		Liverpool	
°	°	'	°	'	°	'	°	'	°	'
0	0	0	0	0	0	0	0	0	0	0
1	0	24	0	55	0	30	0	31	0	32
2	0	48	1	50	1	0	1	2	1	4
3	1	12	2	45	1	30	1	33	1	37
4	1	36	3	40	2	0	2	4	2	9
5	1	59	4	35	2	30	2	35	2	41
6	2	23	5	30	3	0	3	6	3	13
7	2	47	6	26	3	30	3	37	3	45
8	3	10	7	21	4	0	4	8	4	17
9	3	34	8	16	4	30	4	39	4	49
10	3	58	9	11	5	0	5	10	5	21
11	4	21	10	7	5	30	5	41	5	53
12	4	45	11	2	6	0	6	12	6	25
13	5	8	11	58	6	30	6	43	6	57
14	5	31	12	53	7	0	7	14	7	29
15	5	55	13	49	7	29	7	45	8	1
16	6	18	14	44	7	59	8	16	8	33
17	6	41	15	40	8	29	8	46	9	5
18	7	4	16	36	8	58	9	17	9	37
19	7	27	17	32	9	28	9	48	10	8
20	7	49	18	28	9	57	10	18	10	40
21	8	12	19	24	10	27	10	49	11	12
22	8	34	20	20	10	56	11	19	11	43
23	8	57	21	17	11	26	11	49	12	15
24	9	19	22	13	11	55	12	20	12	46
25	9	41	23	10	12	24	12	50	13	17
26	10	3	24	6	12	53	13	20	13	49
27	10	24	25	3	13	22	13	50	14	20
28	10	46	26	0	13	51	14	20	14	51
29	11	7	26	57	14	20	14	50	15	22
30	11	29	27	55	14	48	15	19	15	53

☞ For the R.A. of Libra add 180° to the same degree of Aries. The Declin. and Asc. Diff. are the same for both.

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

For R.A. of Scorpio add 180° to the same degree of Taurus. The Declin. and Asc. Diff. are the same for both.



GEMINI & SAGITTARIUS ASCENSIONAL DIFFERENCE

Deg.	Declin.		Rt. Ascen.		London		Birming'm		Liverpool	
	°	'	°	'	°	'	°	'	°	'
0	20	10	57	49	27	31	28	33	29	39
1	20	22	58	52	27	52	28	54	30	1
2	20	35	59	54	28	12	29	15	30	23
3	20	46	60	57	28	31	29	35	30	44
4	20	57	62	0	28	49	29	54	31	4
5	21	8	63	3	29	8	30	18	31	24
6	21	19	64	7	29	25	30	32	31	43
7	21	29	65	10	29	42	30	50	32	2
8	21	39	66	14	29	59	31	7	32	20
9	21	49	67	18	30	15	31	23	32	37
10	21	58	68	22	30	30	31	40	32	54
11	22	6	69	26	30	45	31	55	33	10
12	22	14	70	30	30	58	32	9	33	26
13	22	22	71	34	31	11	32	23	33	40
14	22	29	72	39	31	24	32	37	33	54
15	22	36	73	43	31	36	32	49	34	7
16	22	43	74	48	31	48	33	1	34	20
17	22	49	75	52	31	58	33	12	34	31
18	22	55	76	57	32	8	33	22	34	42
19	23	0	78	2	32	17	33	32	34	52
20	23	4	79	7	32	25	33	41	35	1
21	23	9	80	12	32	33	33	49	35	10
22	23	18	81	17	32	40	33	56	35	17
23	23	16	82	22	32	46	34	2	35	24
24	23	19	83	28	32	51	34	7	35	30
25	23	21	84	33	32	55	34	12	35	35
26	23	23	85	38	32	59	34	16	35	39
27	23	25	86	44	33	2	34	19	35	42
28	23	26	87	49	33	4	34	21	35	44
29	23	27	88	55	33	5	34	22	35	45
30	23	27	90	0	33	6	34	23	35	46

☞ For the R.A. of Sagittarius add 180° to the same degree of Gemini. The Declin. and Asc. Diff. are the same for both.

CANCER AND CAPRICORNUS				ASCENSIONAL DIFFERENCE						
Deg.	Declin.		Rt. Ascen.		London		Birming'm		Liverpool	
°	°	'	°	'	°	'	°	'	°	'
0	23	27	90	0	33	6	34	23	35	46
1	23	27	91	5	33	5	34	22	35	45
2	23	26	92	11	33	4	34	21	35	44
3	23	25	93	16	33	2	34	19	35	42
4	23	23	94	22	32	59	34	16	35	39
5	23	21	95	27	32	55	34	12	35	35
6	23	19	96	32	32	51	34	7	35	30
7	23	16	97	38	32	46	34	2	35	24
8	23	13	98	43	32	40	33	56	35	17
9	23	9	99	48	32	33	33	49	35	10
10	23	4	100	53	32	25	33	41	35	1
11	23	0	101	58	32	17	33	32	34	52
12	22	55	103	3	32	8	33	22	34	42
13	22	49	104	8	31	58	33	12	34	31
14	22	43	105	12	31	48	33	1	34	20
15	22	36	106	17	31	36	32	49	34	7
16	22	29	107	21	31	24	32	37	33	54
17	22	22	108	26	31	11	32	23	33	40
18	22	14	109	30	30	58	32	9	33	26
19	22	6	110	34	30	45	31	55	33	10
20	21	58	111	38	30	30	31	40	32	54
21	21	49	112	42	30	15	31	23	32	37
22	21	39	113	46	29	59	31	7	32	20
23	21	29	114	50	29	42	30	50	32	2
24	21	19	115	53	29	25	30	32	31	43
25	21	8	116	57	29	8	30	18	31	24
26	20	57	118	0	28	49	29	54	31	4
27	20	46	119	3	28	31	29	35	30	44
28	20	35	120	6	28	12	29	15	30	23
29	20	22	121	8	27	52	28	54	30	1
30	20	10	122	11	27	31	28	33	29	39

☞ For the R.A. of Capricornus add 180° to the same degree of Cancer. The Declin. and Asc. Diff. are the same for both.

LEO AND AQUARIUS			ASCENSIONAL DIFFERENCE							
Deg.	Declin.		Rt. Ascen.		London		Birming'm		Liverpool	
°	′	″	°	′	°	′	°	′	°	′
0	20	10	122	11	27	31	28	33	29	39
1	19	57	123	13	27	11	28	11	29	16
2	19	43	124	16	26	49	27	49	28	53
3	19	30	125	18	26	28	27	27	28	29
4	19	16	126	20	26	6	27	4	28	5
5	19	-1	127	21	25	43	26	40	27	41
6	18	47	128	23	25	21	26	16	27	16
7	18	32	129	24	24	57	25	52	26	51
8	18	17	130	25	24	34	25	28	26	25
9	18	1	131	26	24	10	25	3	25	59
10	17	45	132	27	23	46	24	37	25	33
11	17	29	133	27	23	21	24	12	25	6
12	17	12	134	28	22	56	23	46	24	39
13	16	55	135	28	22	31	23	20	24	12
14	16	38	136	28	22	5	22	53	23	44
15	16	21	137	28	21	40	22	26	23	16
16	16	3	138	28	21	14	21	59	22	48
17	15	45	139	27	20	47	21	32	22	20
18	15	27	140	27	20	21	21	5	21	51
19	15	8	141	26	19	54	20	37	21	22
20	14	49	142	25	19	27	20	9	20	53
21	14	30	143	23	19	0	19	41	20	24
22	14	11	144	22	18	33	19	12	19	54
23	13	51	145	21	18	5	18	44	19	25
24	13	32	146	19	17	38	18	15	18	55
25	13	12	147	17	17	10	17	46	18	25
26	12	51	148	15	16	42	17	17	17	55
27	12	31	149	13	16	14	16	48	17	24
28	12	10	150	11	15	45	16	19	16	54
29	11	50	151	8	15	17	15	49	16	23
30	11	29	152	5	14	48	15	19	15	53

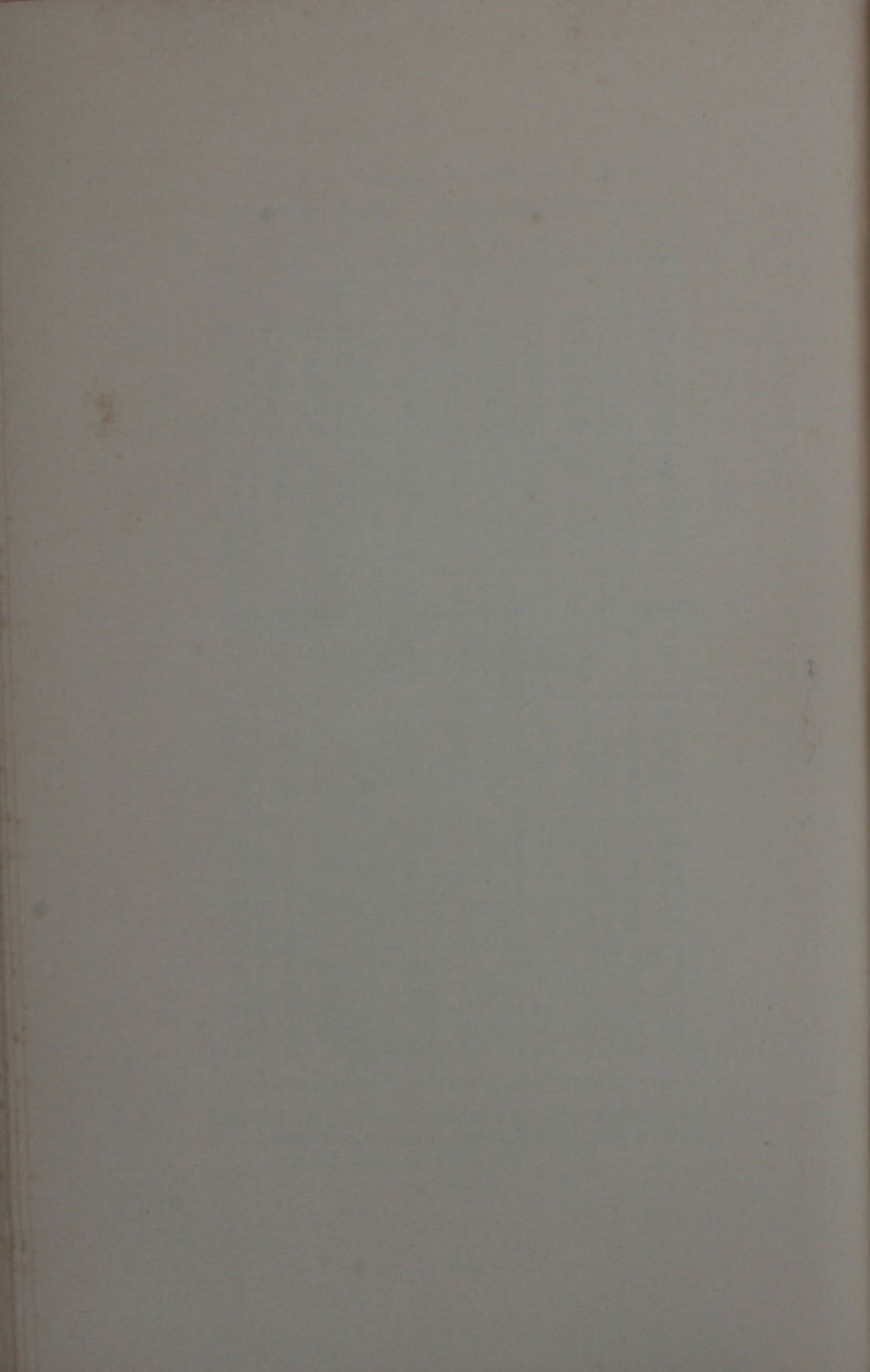
For the R.A. of Aquarius add 180° to the same degree of Leo. The Declin. and Asc. Diff. are the same for both.



VIRGO AND PISCES			ASCENSIONAL DIFFERENCE		
Deg.	Declin.	Rt. Ascen.	London	Birming'm	Liverpool
o	o	o	o	o	o
0	11 29	152 5	14 48	15 19	15 53
1	11 7	153 8	14 20	14 50	15 22
2	10 46	154 0	13 51	14 20	14 51
3	10 24	154 57	13 22	13 50	14 20
4	10 3	155 54	12 53	13 20	13 49
5	9 41	156 50	12 24	12 50	13 17
6	9 19	157 47	11 55	12 20	12 46
7	8 57	158 43	11 26	11 49	12 15
8	8 34	159 40	10 56	11 19	11 43
9	8 12	160 36	10 27	10 49	11 12
10	7 49	161 32	9 57	10 18	10 40
11	7 27	162 28	9 28	9 48	10 8
12	7 4	163 24	8 58	9 17	9 37
13	6 41	164 20	8 29	8 46	9 5
14	6 18	165 16	7 59	8 16	8 33
15	5 55	166 11	7 29	7 45	8 1
16	5 31	167 7	7 0	7 14	7 29
17	5 8	168 2	6 30	6 43	6 57
18	4 45	168 58	6 0	6 12	6 25
19	4 21	169 53	5 30	5 41	5 53
20	3 58	170 49	5 0	5 10	5 21
21	3 34	171 44	4 30	4 39	4 49
22	3 10	172 39	4 0	4 8	4 17
23	2 47	173 34	3 30	3 37	3 45
24	2 23	174 30	3 0	3 6	3 13
25	1 59	175 25	2 30	2 35	2 41
26	1 36	176 20	2 0	2 4	2 9
27	1 12	177 15	1 30	1 33	1 37
28	0 48	178 10	1 0	1 2	1 4
29	0 24	179 5	0 30	0 31	0 32
30	0 0	180 0	0 0	0 0	0 0

☞ For the R.A. of Pisces add 180° to the same degree of Virgo. The Declin. and Asc. Diff. are the same for both.

TERNARY PROPORTIONAL  
LOGARITHMS





TERNARY PROPORTIONAL LOGARITHMS

	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°
0	Infinite	2'2527	1'9524	1'77815	1'65321	1'55630	1'47712	1'41017	1'35218	1'30103
1	4'0334	2'24809	1'95064	1'77575	1'65141	1'55486	1'47592	1'40914	1'35128	1'30023
2	3'7339	2'24103	1'94706	1'77335	1'64901	1'55342	1'47472	1'40811	1'35038	1'29942
3	3'55630	2'23408	1'94352	1'77097	1'64782	1'55198	1'47352	1'40708	1'34948	1'29862
4	3'43136	2'22724	1'94000	1'76861	1'64603	1'55055	1'47232	1'40606	1'34858	1'29782
5	3'33445	2'22051	1'93651	1'76625	1'64426	1'54912	1'47113	1'40503	1'34768	1'29703
6	3'25527	2'21388	1'93305	1'76391	1'64249	1'54770	1'46994	1'40404	1'34679	1'29623
7	3'18833	2'20735	1'92962	1'76158	1'64073	1'54629	1'46876	1'40300	1'34589	1'29544
8	3'13033	2'20091	1'92621	1'75927	1'63907	1'54487	1'46758	1'40198	1'34500	1'29464
9	3'07918	2'19457	1'92283	1'75696	1'63722	1'54347	1'46640	1'40097	1'34411	1'29385
10	3'0334	2'18833	1'91948	1'75467	1'63548	1'54206	1'46522	1'39996	1'34323	1'29306
11	2'99203	2'18217	1'91615	1'75239	1'63375	1'54066	1'46404	1'39895	1'34234	1'29227
12	2'95424	2'17609	1'91285	1'75012	1'63202	1'53927	1'46288	1'39794	1'34146	1'29148
13	2'91948	2'17010	1'90957	1'74787	1'63030	1'53788	1'46171	1'39694	1'34058	1'29070
14	2'88730	2'16419	1'90632	1'74562	1'62859	1'53649	1'46055	1'39593	1'33970	1'28991
15	2'85733	2'15836	1'90309	1'74339	1'62688	1'53511	1'45938	1'39493	1'33882	1'28913
16	2'82930	2'15261	1'89988	1'74117	1'62518	1'53374	1'45824	1'39394	1'33794	1'28835
17	2'80297	2'14693	1'89670	1'73896	1'62349	1'53236	1'45708	1'39294	1'33707	1'28757
18	2'77815	2'14133	1'89354	1'73676	1'62180	1'53100	1'45593	1'39195	1'33619	1'28679
19	2'75467	2'13580	1'89041	1'73457	1'62012	1'52963	1'45478	1'39096	1'33532	1'28601
20	2'73239	2'13033	1'88730	1'73239	1'61845	1'52827	1'45364	1'38997	1'33445	1'28524
21	2'71120	2'12494	1'88420	1'73023	1'61678	1'52692	1'45250	1'38899	1'33359	1'28446
22	2'69100	2'11961	1'88114	1'72807	1'61512	1'52557	1'45136	1'38800	1'33272	1'28369
23	2'67170	2'11435	1'87809	1'72593	1'61347	1'52422	1'45022	1'38702	1'33186	1'28292
24	2'65321	2'10914	1'87506	1'72379	1'61182	1'52288	1'44909	1'38604	1'33099	1'28215
25	2'63548	2'10400	1'87206	1'72167	1'61018	1'52154	1'44796	1'38506	1'33013	1'28138
26	2'61845	2'09893	1'86907	1'71956	1'60854	1'52021	1'44684	1'38409	1'32927	1'28061
27	2'60206	2'09390	1'86611	1'71745	1'60691	1'51888	1'44571	1'38312	1'32842	1'27984
28	2'58627	2'08894	1'86316	1'71536	1'60529	1'51753	1'44459	1'38215	1'32756	1'27908
29	2'57103	2'08403	1'86024	1'71328	1'60367	1'51623	1'44347	1'38118	1'32671	1'27831
30	2'55630	2'07918	1'85733	1'71120	1'60206	1'51491	1'44236	1'38021	1'32585	1'27755
31	2'54206	2'07438	1'85445	1'70914	1'60045	1'51360	1'44125	1'37925	1'32500	1'27679
32	2'52827	2'06964	1'85158	1'70709	1'59885	1'51229	1'44014	1'37829	1'32415	1'27603
33	2'51491	2'06494	1'84873	1'70504	1'59726	1'51098	1'43903	1'37733	1'32331	1'27527
34	2'50194	2'06030	1'84590	1'70301	1'59567	1'50967	1'43793	1'37637	1'32246	1'27451
35	2'48936	2'05570	1'84309	1'70099	1'59409	1'50838	1'43683	1'37541	1'32162	1'27376
36	2'47712	2'05115	1'84030	1'69897	1'59251	1'50708	1'43573	1'37446	1'32077	1'27300
37	2'46524	2'04665	1'83752	1'69696	1'59094	1'50579	1'43463	1'37351	1'31993	1'27225
38	2'45364	2'04220	1'83477	1'69497	1'58938	1'50451	1'43354	1'37256	1'31909	1'27150
39	2'44236	2'03779	1'83203	1'69298	1'58782	1'50322	1'43245	1'37161	1'31826	1'27075
40	2'43136	2'03344	1'82930	1'69100	1'58627	1'50194	1'43136	1'37067	1'31742	1'27000
41	2'42064	2'02910	1'82660	1'68903	1'58472	1'50067	1'43028	1'36972	1'31659	1'26925
42	2'41017	2'02482	1'82391	1'68707	1'58317	1'49940	1'42920	1'36878	1'31575	1'26850
43	2'39996	2'02060	1'82124	1'68512	1'58164	1'49813	1'42812	1'36784	1'31492	1'26776
44	2'38997	2'01639	1'81858	1'68318	1'58011	1'49687	1'42704	1'36691	1'31409	1'26701
45	2'38021	2'01223	1'81594	1'68124	1'57858	1'49560	1'42597	1'36597	1'31326	1'26627
46	2'37067	2'00812	1'81332	1'67932	1'57706	1'49435	1'42490	1'36504	1'31244	1'26553
47	2'36133	2'00404	1'81071	1'67740	1'57554	1'49309	1'42383	1'36411	1'31161	1'26479
48	2'35218	2'00000	1'80811	1'67549	1'57403	1'49184	1'42276	1'36318	1'31079	1'26405
49	2'34323	1'99600	1'80554	1'67359	1'57253	1'49060	1'42170	1'36225	1'30997	1'26331
50	2'33445	1'99203	1'80299	1'67170	1'57103	1'48936	1'42064	1'36133	1'30915	1'26257
51	2'32585	1'98810	1'80043	1'66981	1'56953	1'48812	1'41958	1'36040	1'30833	1'26184
52	2'31742	1'98421	1'79790	1'66794	1'56804	1'48688	1'41851	1'35948	1'30751	1'26110
53	2'30915	1'98035	1'79538	1'66607	1'56656	1'48565	1'41747	1'35856	1'30670	1'26037
54	2'30103	1'97652	1'79287	1'66421	1'56508	1'48442	1'41642	1'35765	1'30588	1'25964
55	2'29306	1'97273	1'79039	1'66236	1'56360	1'48320	1'41538	1'35673	1'30507	1'25891
56	2'28524	1'96897	1'78791	1'66051	1'56213	1'48197	1'41433	1'35582	1'30426	1'25818
57	2'27755	1'96524	1'78545	1'65868	1'56067	1'48076	1'41329	1'35491	1'30345	1'25745
58	2'27000	1'96154	1'78300	1'65685	1'55921	1'47954	1'41225	1'35400	1'30264	1'25672
59	2'26257	1'95788	1'78057	1'65503	1'55775	1'47833	1'41121	1'35309	1'30183	1'25600
60	2'25527	1'95424	1'77815	1'65321	1'55630	1'47712	1'41017	1'35218	1'30103	1'25527

TERNARY PROPORTIONAL LOGARITHMS

	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°
0	1'25527	1'21388	1'17609	1'14133	1'10914	1'07918	1'05115	1'02482	1'00000	0'97652
1	1'25453	1'21322	1'17549	1'14077	1'10863	1'07870	1'05070	1'02440	0'99960	0'97614
2	1'25383	1'21257	1'17489	1'14022	1'10811	1'07822	1'05025	1'02397	0'99920	0'97576
3	1'25311	1'21191	1'17429	1'13966	1'10760	1'07774	1'04980	1'02355	0'99880	0'97538
4	1'25239	1'21126	1'17369	1'13911	1'10708	1'07726	1'04935	1'02312	0'99839	0'97500
5	1'25167	1'21060	1'17309	1'13855	1'10657	1'07678	1'04890	1'02270	0'99799	0'97462
6	1'25095	1'20995	1'17249	1'13800	1'10605	1'07630	1'04845	1'02228	0'99759	0'97424
7	1'25024	1'20930	1'17189	1'13745	1'10554	1'07582	1'04800	1'02185	0'99719	0'97386
8	1'24952	1'20865	1'17129	1'13690	1'10503	1'07534	1'04755	1'02143	0'99679	0'97348
9	1'24881	1'20800	1'17070	1'13635	1'10452	1'07486	1'04710	1'02101	0'99640	0'97310
10	1'24809	1'20735	1'17010	1'13580	1'10400	1'07438	1'04665	1'02059	0'99600	0'97273
11	1'24738	1'20670	1'16951	1'13525	1'10349	1'07391	1'04620	1'02017	0'99560	0'97235
12	1'24667	1'20605	1'16891	1'13470	1'10298	1'07343	1'04576	1'01974	0'99520	0'97197
13	1'24596	1'20541	1'16832	1'13415	1'10247	1'07295	1'04531	1'01932	0'99480	0'97159
14	1'24525	1'20476	1'16773	1'13360	1'10197	1'07248	1'04486	1'01890	0'99441	0'97122
15	1'24455	1'20412	1'16714	1'13306	1'10146	1'07200	1'04442	1'01848	0'99401	0'97084
16	1'24384	1'20348	1'16655	1'13251	1'10095	1'07153	1'04397	1'01806	0'99361	0'97047
17	1'24314	1'20284	1'16596	1'13197	1'10044	1'07105	1'04353	1'01764	0'99322	0'97009
18	1'24244	1'20219	1'16537	1'13142	1'09994	1'07058	1'04308	1'01723	0'99282	0'96972
19	1'24173	1'20155	1'16478	1'13088	1'09943	1'07011	1'04264	1'01681	0'99243	0'96934
20	1'24103	1'20091	1'16419	1'13033	1'09892	1'06964	1'04220	1'01639	0'99203	0'96897
21	1'24033	1'20028	1'16361	1'12979	1'09842	1'06916	1'04175	1'01597	0'99164	0'96859
22	1'23963	1'19964	1'16302	1'12925	1'09792	1'06869	1'04131	1'01556	0'99124	0'96822
23	1'23894	1'19900	1'16243	1'12871	1'09744	1'06822	1'04087	1'01514	0'99085	0'96784
24	1'23824	1'19837	1'16185	1'12817	1'09691	1'06775	1'04043	1'01472	0'99045	0'96747
25	1'23754	1'19773	1'16127	1'12763	1'09641	1'06728	1'03999	1'01431	0'99006	0'96710
26	1'23685	1'19710	1'16068	1'12709	1'09591	1'06681	1'03955	1'01389	0'98967	0'96673
27	1'23616	1'19647	1'16010	1'12655	1'09540	1'06634	1'03911	1'01348	0'98928	0'96635
28	1'23546	1'19584	1'15952	1'12601	1'09490	1'06588	1'03867	1'01306	0'98888	0'96598
29	1'23477	1'19520	1'15894	1'12548	1'09440	1'06541	1'03823	1'01265	0'98849	0'96561
30	1'23408	1'19457	1'15836	1'12494	1'09390	1'06494	1'03779	1'01223	0'98810	0'96524
31	1'23339	1'19395	1'15778	1'12440	1'09341	1'06447	1'03735	1'01182	0'98771	0'96487
32	1'23271	1'19332	1'15721	1'12387	1'09291	1'06401	1'03691	1'01141	0'98732	0'96450
33	1'23202	1'19269	1'15663	1'12333	1'09241	1'06354	1'03647	1'01100	0'98693	0'96413
34	1'23133	1'19206	1'15605	1'12280	1'09191	1'06308	1'03604	1'01058	0'98654	0'96376
35	1'23065	1'19144	1'15548	1'12227	1'09142	1'06261	1'03560	1'01017	0'98615	0'96339
36	1'22997	1'19081	1'15490	1'12173	1'09092	1'06215	1'03516	1'00976	0'98576	0'96302
37	1'22928	1'19019	1'15433	1'12120	1'09042	1'06168	1'03473	1'00935	0'98537	0'96265
38	1'22860	1'18957	1'15375	1'12067	1'08993	1'06122	1'03429	1'00894	0'98498	0'96228
39	1'22792	1'18895	1'15318	1'12014	1'08943	1'06076	1'03386	1'00853	0'98459	0'96191
40	1'22724	1'18833	1'15261	1'11961	1'08894	1'06030	1'03342	1'00812	0'98421	0'96154
41	1'22657	1'18771	1'15204	1'11908	1'08845	1'05983	1'03299	1'00771	0'98382	0'96117
42	1'22589	1'18709	1'15147	1'11855	1'08796	1'05937	1'03256	1'00730	0'98343	0'96081
43	1'22521	1'18647	1'15090	1'11802	1'08746	1'05891	1'03212	1'00689	0'98304	0'96044
44	1'22454	1'18585	1'15033	1'11750	1'08697	1'05845	1'03169	1'00648	0'98266	0'96007
45	1'22386	1'18523	1'14976	1'11697	1'08648	1'05799	1'03126	1'00607	0'98227	0'95971
46	1'22319	1'18462	1'14919	1'11644	1'08599	1'05753	1'03083	1'00567	0'98189	0'95934
47	1'22252	1'18400	1'14863	1'11592	1'08550	1'05707	1'03039	1'00526	0'98150	0'95897
48	1'22185	1'18339	1'14806	1'11539	1'08501	1'05662	1'02996	1'00485	0'98111	0'95861
49	1'22118	1'18278	1'14750	1'11487	1'08452	1'05616	1'02953	1'00445	0'98073	0'95824
50	1'22051	1'18217	1'14693	1'11435	1'08403	1'05570	1'02910	1'00404	0'98035	0'95788
51	1'21984	1'18155	1'14637	1'11382	1'08355	1'05524	1'02867	1'00363	0'97996	0'95751
52	1'21918	1'18094	1'14581	1'11330	1'08306	1'05479	1'02824	1'00323	0'97958	0'95715
53	1'21851	1'18033	1'14524	1'11278	1'08257	1'05433	1'02781	1'00282	0'97919	0'95678
54	1'21785	1'17973	1'14468	1'11226	1'08209	1'05388	1'02739	1'00242	0'97881	0'95642
55	1'21718	1'17912	1'14412	1'11174	1'08160	1'05342	1'02696	1'00202	0'97843	0'95606
56	1'21652	1'17851	1'14356	1'11122	1'08112	1'05297	1'02653	1'00161	0'97805	0'95569
57	1'21586	1'17790	1'14300	1'11070	1'08063	1'05251	1'02610	1'00121	0'97766	0'95533
58	1'21520	1'17730	1'14244	1'11018	1'08015	1'05206	1'02568	1'00081	0'97728	0'95497
59	1'21454	1'17669	1'14189	1'10966	1'07966	1'05161	1'02525	1'00040	0'97690	0'95460
60	1'21388	1'17609	1'14133	1'10914	1'07918	1'05115	1'02482	1'00000	0'97652	0'95424



TERNARY PROPORTIONAL LOGARITHMS

	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°
0	95424	93305	91285	89354	87506	85733	84030	82391	80811	79287
1	95388	93271	91252	89323	87476	85704	84002	82364	80786	79262
2	95352	93236	91219	89292	87446	85675	83974	82337	80760	79238
3	95316	93202	91186	89260	87416	85646	83946	82311	80734	79213
4	95280	93168	91154	89229	87386	85618	83919	82284	80708	79188
5	95244	93133	91121	89197	87356	85589	83891	82257	80682	79163
6	95208	93099	91088	89166	87326	85560	83863	82230	80657	79138
7	95172	93065	91055	89135	87296	85531	83835	82204	80631	79113
8	95136	93030	91023	89103	87266	85502	83808	82177	80605	79088
9	95100	92996	90990	89072	87236	85473	83780	82150	80579	79063
10	95064	92962	90957	89041	87206	85445	83752	82124	80554	79039
11	95028	92928	90925	89010	87176	85416	83725	82097	80528	79014
12	94992	92894	90892	88978	87146	85387	83697	82070	80502	78989
13	94956	92860	90859	88947	87116	85358	83670	82044	80477	78964
14	94921	92825	90827	88916	87086	85330	83642	82017	80451	78939
15	94885	92791	90794	88885	87056	85301	83614	81991	80425	78915
16	94849	92757	90762	88854	87026	85272	83587	81964	80400	78890
17	94813	92723	90729	88823	86996	85244	83559	81938	80374	78865
18	94778	92689	90697	88792	86967	85215	83532	81911	80349	78840
19	94742	92655	90664	88761	86937	85187	83504	81884	80323	78816
20	94706	92621	90632	88730	86907	85158	83477	81858	80297	78791
21	94671	92587	90599	88699	86877	85129	83449	81832	80272	78766
22	94635	92554	90567	88668	86848	85101	83422	81805	80246	78742
23	94600	92520	90535	88637	86818	85072	83394	81779	80221	78717
24	94564	92486	90502	88606	86789	85044	83367	81752	80195	78693
25	94529	92452	90470	88575	86759	85015	83339	81726	80170	78668
26	94493	92418	90438	88544	86729	84987	83312	81699	80144	78643
27	94458	92385	90406	88513	86699	84958	83285	81673	80119	78619
28	94423	92351	90373	88482	86670	84930	83257	81647	80094	78594
29	94387	92317	90341	88451	86640	84902	83230	81620	80068	78570
30	94352	92283	90309	88420	86611	84873	83203	81594	80043	78545
31	94317	92250	90277	88390	86581	84845	83175	81568	80017	78521
32	94281	92216	90245	88359	86552	84816	83148	81541	79992	78496
33	94246	92183	90213	88328	86522	84788	83121	81515	79967	78472
34	94211	92149	90181	88297	86493	84760	83094	81489	79941	78447
35	94176	92115	90148	88267	86463	84732	83066	81463	79916	78423
36	94141	92082	90116	88236	86434	84703	83039	81436	79891	78398
37	94105	92048	90084	88205	86404	84675	83012	81410	79865	78374
38	94070	92015	90052	88175	86375	84647	82985	81384	79840	78349
39	94035	91981	90020	88144	86346	84619	82958	81358	79815	78325
40	94000	91948	89988	88114	86316	84590	82930	81332	79790	78300
41	93965	91915	89957	88083	86287	84562	82903	81305	79764	78276
42	93930	91881	89925	88052	86258	84534	82876	81279	79739	78252
43	93895	91848	89893	88022	86228	84506	82849	81253	79714	78227
44	93860	91815	89861	87991	86199	84478	82822	81227	79689	78203
45	93825	91781	89829	87961	86170	84450	82795	81201	79663	78179
46	93791	91748	89797	87930	86140	84421	82768	81175	79638	78154
47	93756	91715	89766	87900	86111	84393	82741	81149	79613	78130
48	93721	91682	89734	87870	86082	84365	82714	81123	79588	78106
49	93686	91648	89702	87839	86053	84337	82687	81097	79563	78081
50	93651	91615	89670	87809	86024	84309	82660	81071	79538	78057
51	93617	91582	89639	87778	85995	84281	82633	81045	79513	78033
52	93582	91549	89607	87748	85965	84253	82606	81019	79488	78009
53	93547	91516	89575	87718	85936	84225	82579	80993	79463	77984
54	93513	91483	89544	87687	85907	84197	82552	80967	79437	77960
55	93478	91450	89512	87657	85878	84169	82525	80941	79412	77936
56	93443	91417	89481	87627	85849	84141	82498	80915	79387	77912
57	93409	91384	89449	87597	85820	84114	82471	80889	79362	77888
58	93374	91351	89417	87566	85791	84086	82445	80863	79337	77864
59	93340	91318	89386	87536	85762	84058	82418	80837	79312	77840
60	93305	91285	89354	87506	85733	84030	82391	80811	79287	77815



### TERNARY PROPORTIONAL LOGARITHMS

	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°
0	77815	76391	75012	73676	72379	71120	69897	68707	67549	66421
1	77791	76368	74990	73654	72358	71100	69877	68688	67530	66402
2	77767	76344	74967	73632	72337	71079	69857	68668	67511	66384
3	77743	76321	74944	73610	72316	71058	69837	68648	67492	66359
4	77719	76298	74922	73588	72294	71038	69817	68629	67473	66337
5	77695	76274	74899	73566	72273	71017	69797	68609	67454	66328
6	77671	76251	74877	73544	72252	70997	69777	68590	67435	66310
7	77647	76228	74854	73523	72231	70976	69756	68570	67416	66291
8	77623	76205	74832	73501	72209	70955	69736	68551	67397	66273
9	77599	76181	74809	73479	72188	70935	69716	68531	67378	66254
10	77575	76158	74787	73457	72167	70914	69696	68512	67359	66236
11	77551	76135	74764	73435	72146	70894	69676	68492	67340	66217
12	77527	76112	74742	73413	72125	70873	69656	68473	67321	66199
13	77503	76089	74719	73392	72103	70852	69636	68454	67302	66180
14	77479	76065	74697	73370	72082	70832	69616	68434	67283	66162
15	77455	76042	74674	73348	72061	70811	69596	68415	67264	66143
16	77431	76019	74652	73326	72040	70791	69576	68395	67245	66125
17	77407	75996	74629	73305	72019	70770	69557	68376	67226	66106
18	77383	75973	74607	73283	71998	70750	69537	68356	67207	66088
19	77359	75950	74585	73261	71977	70729	69517	68337	67188	66070
20	77335	75927	74562	73239	71956	70709	69497	68318	67170	66051
21	77311	75903	74540	73218	71935	70688	69477	68298	67151	66033
22	77288	75880	74517	73196	71914	70668	69457	68279	67132	66014
23	77264	75857	74495	73174	71892	70647	69437	68259	67113	65996
24	77240	75834	74473	73153	71871	70627	69417	68240	67094	65978
25	77216	75811	74450	73131	71850	70606	69397	68221	67075	65959
26	77192	75788	74428	73109	71829	70586	69377	68201	67056	65941
27	77169	75765	74406	73088	71808	70566	69358	68182	67038	65923
28	77145	75742	74383	73066	71787	70545	69338	68163	67019	65904
29	77121	75719	74361	73044	71766	70525	69318	68143	67000	65886
30	77097	75696	74339	73023	71745	70504	69298	68124	66981	65868
31	77074	75673	74317	73001	71724	70484	69278	68105	66962	65849
32	77050	75650	74294	72980	71703	70464	69258	68086	66944	65831
33	77026	75627	74272	72958	71682	70443	69239	68066	66925	65813
34	77002	75604	74250	72936	71662	70423	69219	68047	66906	65794
35	76979	75581	74228	72915	71641	70403	69199	68028	66887	65776
36	76955	75559	74205	72893	71620	70382	69179	68008	66869	65758
37	76931	75536	74183	72872	71599	70362	69159	67989	66850	65739
38	76908	75513	74161	72850	71578	70342	69140	67970	66831	65721
39	76884	75490	74139	72829	71557	70321	69120	67951	66812	65703
40	76861	75467	74117	72807	71536	70301	69100	67932	66794	65685
41	76837	75444	74095	72786	71515	70281	69080	67912	66775	65666
42	76813	75421	74072	72764	71494	70260	69061	67893	66756	65648
43	76790	75398	74050	72743	71473	70240	69041	67874	66737	65630
44	76766	75376	74028	72721	71453	70220	69021	67855	66719	65612
45	76743	75353	74006	72700	71432	70200	69002	67836	66700	65594
46	76719	75330	73984	72678	71411	70179	68982	67816	66681	65575
47	76696	75307	73962	72657	71390	70159	68962	67797	66663	65557
48	76672	75285	73940	72636	71369	70139	68942	67778	66644	65539
49	76649	75262	73918	72614	71349	70119	68923	67759	66625	65521
50	76625	75239	73896	72593	71328	70099	68903	67740	66607	65503
51	76602	75216	73874	72571	71307	70078	68884	67721	66588	65484
52	76578	75194	73852	72550	71286	70058	68864	67702	66570	65466
53	76555	75171	73830	72529	71265	70038	68844	67682	66551	65448
54	76531	75148	73808	72507	71245	70018	68824	67663	66532	65430
55	76508	75126	73786	72486	71224	69998	68805	67644	66514	65412
56	76485	75103	73764	72465	71203	69977	68785	67625	66495	65394
57	76461	75080	73742	72444	71182	69957	68766	67606	66477	65376
58	76438	75058	73720	72422	71162	69937	68746	67587	66458	65357
59	76414	75035	73698	72401	71141	69917	68727	67568	66439	65339
60	76391	75012	73676	72379	71120	69897	68707	67549	66421	65321

## TERNARY PROPORTIONAL LOGARITHMS

	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°
0	65321	64249	63202	62180	61182	60206	59251	58317	57403	56508
1	65303	64231	63185	62164	61166	60190	59236	58302	57388	56493
2	65285	64214	63168	62147	61149	60174	59220	58287	57373	56478
3	65267	64196	63151	62130	61133	60158	59204	58271	57358	56463
4	65249	64178	63133	62113	61116	60142	59189	58256	57343	56449
5	65231	64161	63116	62096	61100	60126	59173	58241	57328	56434
6	65213	64143	63099	62080	61083	60110	59157	58225	57313	56419
7	65195	64125	63082	62063	61067	60094	59141	58210	57298	56404
8	65177	64108	63065	62046	61051	60078	59126	58194	57283	56390
9	65159	64090	63047	62029	61034	60061	59110	58179	57268	56375
10	65141	64073	63030	62012	61018	60045	59094	58164	57253	56360
11	65123	64055	63013	61996	61001	60029	59079	58143	57238	56345
12	65105	64038	62996	61979	60985	60013	59063	58133	57223	56331
13	65087	64020	62979	61962	60969	59997	59047	58118	57208	56316
14	65069	64002	62962	61945	60952	59981	59032	58102	57193	56301
15	65051	63985	62945	61929	60936	59965	59016	58087	57178	56287
16	65033	63967	62927	61912	60920	59949	59000	58072	57163	56272
17	65015	63950	62910	61895	60903	59933	58985	58056	57148	56257
18	64997	63932	62893	61878	60887	59917	58969	58041	57133	56243
19	64979	63915	62876	61862	60871	59901	58954	58026	57118	56228
20	64961	63897	62859	61845	60854	59885	58938	58011	57103	56213
21	64943	63880	62842	61828	60838	59870	58922	57995	57088	56199
22	64925	63862	62825	61812	60822	59854	58907	57980	57073	56184
23	64907	63845	62808	61795	60805	59838	58891	57965	57058	56169
24	64889	63827	62791	61778	60789	59822	58875	57949	57043	56155
25	64871	63810	62774	61762	60773	59806	58860	57934	57028	56140
26	64853	63792	62757	61745	60756	59790	58844	57919	57013	56125
27	64835	63775	62739	61728	60740	59774	58829	57904	56998	56111
28	64818	63757	62722	61712	60724	59758	58813	57888	56983	56096
29	64800	63740	62705	61695	60708	59742	58798	57873	56968	56081
30	64782	63722	62688	61678	60691	59726	58782	57858	56953	56067
31	64764	63705	62671	61662	60675	59710	58766	57843	56938	56052
32	64746	63688	62654	61645	60659	59694	58751	57827	56923	56037
33	64728	63670	62637	61628	60642	59678	58735	57812	56908	56023
34	64710	63653	62620	61612	60626	59663	58720	57797	56893	56008
35	64692	63635	62603	61595	60610	59647	58704	57782	56879	55994
36	64675	63618	62586	61579	60594	59631	58689	57767	56864	55979
37	64657	63601	62569	61562	60578	59615	58673	57751	56849	55964
38	64639	63583	62552	61545	60561	59599	58658	57736	56834	55950
39	64621	63566	62535	61529	60545	59583	58642	57721	56819	55935
40	64603	63548	62518	61512	60529	59567	58627	57706	56804	55921
41	64586	63531	62501	61496	60513	59551	58611	57691	56789	55906
42	64568	63514	62484	61479	60496	59536	58596	57675	56774	55892
43	64550	63496	62468	61463	60480	59520	58580	57660	56759	55877
44	64532	63479	62451	61446	60464	59504	58565	57645	56745	55862
45	64514	63462	62434	61429	60448	59488	58549	57630	56730	55848
46	64497	63444	62417	61413	60432	59472	58534	57615	56715	55833
47	64479	63427	62400	61396	60416	59457	58518	57600	56700	55819
48	64461	63410	62383	61380	60399	59441	58503	57584	56685	55804
49	64443	63392	62366	61363	60383	59425	58487	57569	56670	55790
50	64426	63375	62349	61347	60367	59409	58472	57554	56655	55775
51	64408	63358	62332	61330	60351	59393	58456	57539	56641	55761
52	64390	63340	62315	61314	60335	59378	58441	57524	56626	55746
53	64373	63323	62298	61297	60319	59362	58425	57509	56611	55732
54	64355	63306	62282	61281	60303	59346	58410	57494	56596	55717
55	64337	63289	62265	61264	60286	59330	58395	57479	56582	55703
56	64320	63271	62248	61248	60270	59314	58379	57463	56567	55688
57	64302	63254	62231	61231	60254	59299	58364	57448	56552	55674
58	64284	63237	62214	61215	60238	59283	58348	57433	56537	55659
59	64267	63220	62197	61198	60222	59267	58333	57418	56522	55645
60	64249	63202	62180	61182	60206	59251	58317	57403	56508	55630



TERNARY PROPORTIONAL LOGARITHMS

	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°
1										
0	55630	54770	53927	53100	52288	51491	50708	49940	49184	48442
1	55616	54756	53913	53086	52274	51478	50696	49927	49172	48430
2	55601	54742	53899	53072	52261	51465	50683	49914	49159	48418
3	55587	54728	53885	53059	52248	51452	50670	49902	49147	48405
4	55572	54714	53871	53045	52234	51438	50657	49889	49135	48393
5	55558	54699	53857	53031	52221	51425	50644	49876	49122	48381
6	55543	54685	53843	53018	52208	51412	50631	49864	49110	48369
7	55529	54671	53830	53004	52194	51399	50618	49851	49097	48356
8	55515	54657	53816	52991	52181	51386	50605	49838	49085	48344
9	55500	54643	53802	52977	52167	51373	50592	49826	49072	48332
10	55486	54629	53788	52963	52154	51360	50579	49813	49060	48320
11	55471	54614	53774	52950	52141	51346	50566	49800	49047	48307
12	55457	54600	53760	52936	52127	51333	50554	49788	49035	48295
13	55442	54586	53746	52922	52114	51320	50541	49775	49023	48283
14	55428	54572	53732	52909	52101	51307	50528	49762	49010	48271
15	55414	54558	53719	52895	52087	51294	50515	49750	48998	48259
16	55399	54544	53705	52882	52074	51281	50502	49737	48985	48246
17	55385	54530	53691	52868	52061	51268	50489	49724	48973	48234
18	55370	54516	53677	52855	52047	51255	50476	49712	48960	48222
19	55356	54501	53663	52841	52034	51242	50464	49699	48948	48210
20	55342	54487	53649	52827	52021	51229	50451	49687	48936	48197
21	55327	54473	53636	52814	52007	51215	50438	49674	48923	48185
22	55313	54459	53622	52800	51994	51202	50425	49661	48911	48173
23	55299	54445	53608	52787	51981	51189	50412	49649	48898	48161
24	55284	54431	53594	52773	51967	51176	50399	49636	48886	48149
25	55270	54417	53580	52760	51954	51163	50387	49623	48874	48136
26	55255	54403	53567	52746	51941	51150	50374	49611	48861	48124
27	55241	54389	53553	52732	51927	51137	50361	49598	48849	48112
28	55227	54375	53539	52719	51914	51124	50348	49586	48836	48100
29	55212	54361	53525	52705	51901	51111	50335	49573	48824	48088
30	55198	54347	53511	52692	51888	51098	50322	49560	48812	48076
31	55184	54332	53498	52678	51874	51085	50310	49548	48799	48063
32	55169	54318	53484	52665	51861	51072	50297	49535	48787	48051
33	55155	54304	53470	52651	51848	51059	50284	49523	48775	48039
34	55141	54290	53456	52638	51835	51046	50271	49510	48762	48027
35	55127	54276	53442	52624	51821	51033	50258	49498	48750	48015
36	55112	54262	53429	52611	51808	51020	50246	49485	48737	48003
37	55098	54248	53415	52597	51795	51007	50233	49472	48725	47990
38	55084	54234	53401	52584	51781	50994	50220	49460	48713	47978
39	55069	54220	53387	52570	51768	50981	50207	49447	48700	47966
40	55055	54206	53374	52557	51755	50968	50194	49435	48688	47954
41	55041	54192	53360	52543	51742	50955	50182	49422	48676	47942
42	55026	54178	53346	52530	51729	50942	50169	49410	48663	47930
43	55012	54164	53332	52516	51715	50929	50156	49397	48651	47918
44	54998	54150	53319	52503	51702	50916	50143	49385	48639	47906
45	54984	54136	53305	52489	51689	50903	50131	49372	48626	47893
46	54969	54122	53291	52476	51676	50890	50118	49360	48614	47881
47	54955	54108	53277	52462	51662	50877	50105	49347	48602	47869
48	54941	54094	53264	52449	51649	50864	50092	49334	48590	47857
49	54927	54080	53250	52436	51636	50851	50080	49322	48577	47845
50	54912	54066	53236	52422	51623	50838	50067	49309	48565	47833
51	54898	54052	53223	52409	51610	50825	50054	49297	48553	47821
52	54884	54038	53209	52395	51596	50812	50041	49284	48540	47809
53	54870	54024	53195	52382	51583	50799	50029	49272	48528	47797
54	54855	54011	53182	52368	51570	50786	50016	49259	48516	47785
55	54841	53997	53168	52355	51557	50773	50003	49247	48503	47772
56	54827	53983	53154	52342	51544	50760	49991	49234	48491	47760
57	54813	53969	53141	52328	51530	50747	49978	49222	48479	47748
58	54799	53955	53127	52315	51517	50734	49965	49210	48467	47736
59	54784	53941	53113	52301	51504	50721	49952	49197	48454	47724
60	54770	53927	53100	52288	51491	50708	49940	49184	48442	47712



TERNARY PROPORTIONAL LOGARITHMS

'	60°	61°	62°	63°	64°	65°	66°	67°	68°	69°	70°	71°
0	47712	46994	46288	45593	44909	44236	43573	42920	42276	41642	41017	40401
1	47700	46982	46276	45582	44898	44225	43562	42909	42266	41632	41007	40391
2	47688	46971	46265	45570	44887	44214	43551	42898	42255	41621	40997	40381
3	47676	46959	46253	45559	44875	44203	43540	42887	42244	41611	40986	40371
4	47664	46947	46241	45547	44864	44191	43529	42877	42234	41600	40976	40361
5	47652	46935	46230	45536	44853	44180	43518	42866	42223	41590	40966	40350
6	47640	46923	46218	45524	44841	44169	43507	42855	42213	41579	40955	40340
7	47628	46911	46206	45513	44830	44158	43496	42844	42202	41569	40945	40330
8	47616	46899	46195	45501	44819	44147	43485	42833	42191	41559	40935	40320
9	47604	46888	46183	45490	44808	44136	43474	42823	42181	41548	40924	40310
10	47592	46876	46171	45478	44796	44125	43463	42812	42170	41538	40914	40300
11	47580	46864	46160	45467	44785	44114	43452	42801	42159	41527	40904	40289
12	47568	46852	46148	45456	44774	44102	43441	42790	42149	41517	40894	40279
13	47556	46840	46137	45444	44762	44091	43431	42780	42138	41506	40883	40269
14	47544	46828	46125	45433	44751	44080	43420	42769	42128	41496	40873	40259
15	47532	46817	46113	45421	44740	44069	43409	42758	42117	41485	40863	40249
16	47520	46805	46102	45410	44729	44058	43398	42747	42106	41475	40852	40239
17	47508	46793	46090	45398	44717	44047	43387	42737	42096	41464	40842	40228
18	47496	46781	46078	45387	44706	44036	43376	42726	42085	41454	40832	40218
19	47484	46769	46067	45375	44695	44025	43365	42715	42075	41443	40821	40208
20	47472	46758	46055	45364	44684	44014	43354	42704	42064	41433	40811	40198
21	47460	46746	46044	45353	44672	44003	43343	42693	42053	41423	40801	40188
22	47448	46734	46032	45341	44661	43992	43332	42683	42043	41412	40791	40178
23	47436	46722	46020	45330	44650	43981	43321	42672	42032	41402	40780	40168
24	47424	46710	46009	45318	44639	43969	43310	42661	42022	41391	40770	40157
25	47412	46699	45997	45307	44627	43958	43300	42651	42011	41381	40760	40147
26	47400	46687	45986	45295	44616	43947	43289	42640	42000	41370	40749	40137
27	47388	46675	45974	45284	44605	43936	43278	42629	41990	41360	40739	40127
28	47376	46663	45962	45273	44594	43925	43267	42618	41979	41350	40729	40117
29	47364	46652	45951	45261	44583	43914	43256	42608	41969	41339	40719	40107
30	47352	46640	45939	45250	44571	43903	43245	42597	41958	41329	40708	40097
31	47340	46628	45928	45238	44560	43892	43234	42586	41948	41318	40698	40087
32	47328	46616	45916	45227	44549	43881	43223	42575	41937	41308	40688	40076
33	47316	46604	45905	45216	44538	43870	43212	42565	41927	41298	40678	40066
34	47304	46593	45893	45204	44526	43859	43202	42554	41916	41287	40667	40056
35	47292	46581	45881	45193	44515	43848	43191	42543	41905	41277	40657	40046
36	47280	46569	45870	45182	44504	43837	43180	42533	41895	41266	40647	40036
37	47268	46557	45858	45170	44493	43826	43169	42522	41884	41256	40637	40026
38	47256	46546	45847	45159	44482	43815	43158	42511	41874	41246	40626	40016
39	47244	46534	45835	45147	44470	43804	43147	42500	41863	41235	40616	40006
40	47232	46522	45824	45136	44459	43793	43136	42490	41853	41225	40606	39996
41	47220	46510	45812	45125	44448	43782	43126	42479	41842	41214	40596	39985
42	47208	46499	45800	45113	44437	43771	43115	42468	41832	41204	40585	39975
43	47196	46487	45789	45102	44426	43760	43104	42458	41821	41194	40575	39965
44	47185	46475	45777	45091	44414	43749	43093	42447	41811	41183	40565	39955
45	47173	46464	45766	45079	44403	43738	43082	42436	41800	41173	40555	39945
46	47161	46452	45754	45068	44392	43727	43071	42426	41789	41162	40544	39935
47	47149	46440	45743	45057	44381	43716	43060	42415	41779	41152	40534	39925
48	47137	46428	45731	45045	44370	43705	43050	42404	41768	41142	40524	39915
49	47125	46417	45720	45034	44359	43694	43039	42394	41758	41131	40514	39905
50	47113	46405	45708	45022	44347	43683	43028	42383	41747	41121	40503	39895
51	47101	46393	45697	45011	44336	43672	43017	42372	41737	41111	40493	39885
52	47089	46382	45685	45000	44325	43661	43006	42362	41726	41100	40483	39874
53	47077	46370	45674	44988	44314	43650	42995	42351	41716	41090	40473	39864
54	47066	46358	45662	44977	44303	43639	42985	42340	41705	41080	40463	39854
55	47054	46346	45651	44966	44292	43628	42974	42330	41695	41069	40452	39844
56	47042	46335	45639	44955	44280	43617	42963	42319	41684	41059	40442	39834
57	47030	46323	45628	44943	44269	43606	42952	42308	41674	41048	40432	39824
58	47018	46311	45616	44932	44258	43595	42941	42297	41663	41038	40422	39814
59	47006	46300	45605	44921	44247	43584	42931	42287	41653	41028	40412	39804
60	46994	46288	45593	44909	44236	43573	42920	42276	41642	41017	40401	39794

TERNARY PROPORTIONAL LOGARITHMS

	72°	73°	74°	75°	76°	77°	78°	79°	80°	81°	82°	83°
0	39794	39195	38604	38021	37446	36878	36318	35765	35218	34679	34146	33619
1	39784	39185	38594	38011	37436	36869	36309	35755	35209	34670	34137	33611
2	39774	39175	38585	38002	37427	36869	36299	35746	35200	34661	34128	33602
3	39764	39165	38575	37992	37417	36850	36280	35727	35181	34642	34109	33583
4	39754	39155	38565	37983	37408	36841	36271	35719	35173	34634	34102	33576
5	39744	39145	38555	37973	37398	36831	36262	35710	35164	34625	34093	33567
6	39734	39136	38545	37963	37389	36822	36253	35701	35155	34616	34084	33558
7	39724	39126	38536	37954	37379	36812	36244	35691	35145	34607	34075	33550
8	39714	39116	38526	37944	37370	36803	36234	35682	35139	34598	34066	33541
9	39704	39106	38516	37934	37360	36794	36225	35673	35128	34589	34058	33532
10	39694	39096	38506	37925	37351	36784	36216	35664	35119	34581	34049	33524
11	39684	39086	38497	37915	37341	36775	36207	35655	35110	34572	34040	33515
12	39674	39076	38487	37905	37332	36766	36197	35646	35101	34563	34031	33506
13	39664	39066	38477	37896	37322	36756	36188	35636	35092	34554	34022	33498
14	39653	39056	38467	37886	37312	36747	36179	35627	35083	34545	34014	33489
15	39643	39046	38458	37877	37303	36737	36170	35618	35074	34536	34005	33480
16	39633	39037	38448	37867	37294	36728	36160	35609	35065	34527	33996	33471
17	39623	39027	38438	37857	37284	36719	36150	35600	35056	34518	33987	33463
18	39613	39017	38428	37848	37275	36709	36141	35591	35047	34509	33978	33454
19	39603	39007	38419	37838	37265	36700	36132	35582	35038	34500	33970	33445
20	39593	38997	38409	37829	37256	36691	36123	35573	35029	34491	33961	33437
21	39583	38987	38399	37819	37246	36681	36114	35563	35020	34483	33952	33428
22	39573	38977	38389	37809	37237	36672	36105	35554	35011	34474	33943	33419
23	39563	38968	38380	37800	37227	36663	36096	35545	35002	34466	33935	33411
24	39553	38958	38370	37790	37218	36653	36086	35536	34993	34456	33926	33402
25	39543	38948	38360	37781	37208	36644	36077	35527	34984	34447	33917	33393
26	39533	38938	38351	37771	37199	36634	36068	35518	34975	34438	33908	33385
27	39523	38928	38341	37761	37189	36625	36059	35509	34966	34429	33899	33376
28	39513	38918	38331	37752	37180	36616	36050	35500	34957	34420	33891	33367
29	39503	38908	38321	37742	37171	36606	36040	35491	34948	34411	33882	33359
30	39493	38899	38312	37733	37161	36597	36031	35481	34939	34403	33873	33350
31	39483	38889	38302	37723	37152	36588	36022	35472	34930	34394	33864	33341
32	39473	38879	38292	37713	37142	36578	36013	35463	34921	34385	33856	33333
33	39464	38869	38282	37704	37133	36569	36003	35454	34912	34376	33847	33324
34	39454	38859	38273	37694	37123	36560	35994	35445	34903	34367	33838	33315
35	39444	38849	38263	37685	37114	36550	35985	35436	34894	34358	33829	33307
36	39434	38839	38253	37675	37104	36541	35976	35427	34885	34349	33820	33298
37	39424	38830	38244	37666	37095	36532	35967	35418	34876	34340	33812	33289
38	39414	38820	38234	37656	37085	36522	35957	35409	34867	34332	33803	33281
39	39404	38810	38224	37646	37076	36513	35948	35400	34858	34323	33794	33272
40	39394	38800	38215	37637	37067	36504	35939	35391	34849	34314	33785	33263
41	39384	38790	38205	37627	37057	36494	35930	35382	34840	34305	33777	33255
42	39374	38781	38195	37618	37048	36485	35921	35373	34831	34296	33768	33246
43	39364	38771	38186	37608	37038	36476	35912	35364	34822	34287	33759	33237
44	39354	38761	38176	37599	37029	36467	35903	35355	34813	34278	33750	33229
45	39344	38751	38166	37589	37019	36457	35894	35346	34804	34269	33741	33220
46	39334	38741	38156	37579	37010	36448	35885	35337	34795	34261	33732	33211
47	39324	38731	38147	37570	37001	36439	35876	35328	34786	34252	33723	33202
48	39314	38722	38137	37560	36991	36430	35867	35319	34777	34243	33714	33194
49	39304	38712	38127	37551	36982	36421	35858	35310	34768	34234	33705	33186
50	39294	38702	38118	37541	36972	36411	35849	35301	34759	34225	33696	33177
51	39284	38692	38108	37532	36963	36401	35840	35292	34750	34216	33687	33168
52	39274	38682	38098	37522	36953	36392	35831	35283	34741	34207	33678	33160
53	39264	38673	38089	37513	36944	36383	35822	35274	34732	34198	33669	33151
54	39254	38663	38079	37503	36935	36374	35813	35265	34723	34189	33660	33142
55	39245	38653	38069	37494	36925	36364	35804	35256	34714	34180	33651	33134
56	39235	38643	38060	37484	36916	36355	35795	35247	34705	34171	33642	33125
57	39225	38633	38050	37474	36906	36346	35786	35238	34696	34162	33633	33117
58	39215	38624	38040	37465	36897	36336	35777	35229	34687	34153	33624	33108
59	39205	38614	38031	37455	36888	36327	35768	35220	34678	34144	33615	33100
60	39195	38604	38021	37446	36879	36318	35760	35212	34670	34136	33606	33091



TERNARY PROPORTIONAL LOGARITHMS

	84°	85°	86°	87°	88°	89°	90°	91°	92°	93°	94°	95°
0	33099	32585	32077	31575	31079	30588	30103	29623	29148	28679	28214	27755
1	33091	32577	32069	31567	31071	30580	30095	29615	29141	28671	28207	27747
2	33082	32568	32061	31559	31063	30572	30087	29607	29133	28663	28199	27740
3	33073	32560	32052	31550	31054	30564	30079	29599	29125	28655	28191	27732
4	33065	32551	32044	31542	31046	30556	30071	29591	29117	28648	28184	27724
5	33056	32543	32035	31534	31038	30548	30063	29583	29109	28640	28176	27717
6	33048	32534	32027	31525	31030	30539	30055	29575	29101	28632	28168	27709
7	33039	32526	32019	31517	31021	30531	30047	29567	29093	28625	28161	27702
8	33030	32517	32010	31509	31013	30523	30039	29560	29086	28617	28153	27694
9	33022	32509	32002	31501	31005	30515	30031	29552	29078	28609	28145	27686
10	33013	32500	31993	31492	30997	30507	30023	29544	29070	28601	28138	27679
11	33005	32492	31985	31484	30989	30499	30015	29536	29062	28593	28130	27671
12	32996	32483	31977	31476	30980	30491	30007	29528	29054	28586	28122	27664
13	32987	32475	31968	31467	30972	30483	29999	29520	29046	28578	28114	27656
14	32979	32466	31960	31459	30964	30475	29991	29512	29038	28570	28107	27648
15	32970	32458	31951	31451	30956	30466	29983	29504	29031	28562	28099	27641
16	32962	32449	31943	31442	30948	30458	29975	29496	29023	28555	28091	27633
17	32953	32441	31935	31434	30939	30450	29967	29488	29015	28547	28084	27626
18	32944	32432	31926	31426	30931	30442	29958	29480	29007	28539	28076	27618
19	32936	32424	31918	31418	30923	30434	29950	29472	28999	28531	28068	27610
20	32927	32415	31909	31409	30915	30426	29942	29464	28991	28524	28061	27603
21	32919	32407	31901	31401	30907	30418	29934	29456	28984	28516	28053	27595
22	32910	32398	31893	31393	30898	30410	29926	29448	28976	28508	28045	27588
23	32902	32390	31884	31384	30890	30402	29918	29441	28968	28500	28038	27580
24	32893	32381	31876	31376	30882	30393	29910	29433	28960	28493	28030	27572
25	32884	32373	31867	31368	30874	30385	29902	29425	28952	28485	28022	27565
26	32876	32365	31859	31360	30866	30377	29894	29417	28944	28477	28015	27557
27	32867	32356	31851	31351	30857	30369	29886	29409	28937	28469	28007	27550
28	32859	32348	31842	31343	30849	30361	29878	29401	28929	28462	27999	27542
29	32850	32339	31834	31335	30841	30353	29870	29393	28921	28454	27992	27534
30	32842	32331	31826	31326	30833	30345	29862	29385	28913	28446	27984	27527
31	32833	32322	31817	31318	30825	30337	29854	29377	28905	28438	27976	27519
32	32824	32314	31809	31310	30817	30329	29846	29369	28897	28431	27969	27512
33	32816	32305	31801	31302	30808	30321	29838	29361	28890	28423	27961	27504
34	32807	32297	31792	31293	30800	30313	29830	29353	28882	28415	27953	27497
35	32799	32288	31784	31285	30792	30305	29822	29346	28874	28407	27946	27489
36	32790	32280	31775	31277	30784	30296	29814	29338	28866	28400	27938	27481
37	32782	32271	31767	31269	30776	30288	29806	29330	28858	28392	27930	27474
38	32773	32263	31759	31260	30768	30280	29798	29322	28851	28384	27923	27466
39	32765	32255	31750	31252	30760	30272	29790	29314	28843	28376	27915	27459
40	32756	32246	31742	31244	30751	30264	29782	29306	28835	28369	27908	27451
41	32747	32238	31734	31236	30743	30256	29775	29298	28827	28361	27900	27444
42	32739	32229	31725	31227	30735	30248	29767	29290	28819	28353	27892	27436
43	32730	32221	31717	31219	30727	30240	29759	29282	28811	28346	27885	27429
44	32722	32212	31709	31211	30719	30232	29751	29275	28804	28338	27877	27421
45	32713	32204	31700	31203	30710	30224	29743	29267	28796	28330	27869	27413
46	32705	32195	31692	31194	30702	30216	29735	29259	28788	28322	27862	27406
47	32696	32187	31684	31186	30694	30208	29727	29251	28780	28315	27854	27398
48	32688	32179	31675	31178	30686	30200	29719	29243	28772	28307	27846	27391
49	32679	32170	31667	31170	30678	30192	29711	29235	28765	28299	27839	27383
50	32671	32162	31659	31161	30670	30183	29703	29227	28757	28292	27831	27376
51	32662	32153	31650	31153	30662	30175	29695	29219	28749	28284	27824	27368
52	32654	32145	31642	31145	30653	30167	29687	29211	28741	28276	27818	27360
53	32645	32136	31634	31137	30645	30159	29679	29204	28733	28268	27810	27353
54	32636	32128	31625	31128	30637	30151	29671	29196	28726	28261	27801	27345
55	32628	32120	31617	31120	30629	30143	29663	29188	28718	28253	27793	27338
56	32619	32111	31609	31112	30621	30135	29655	29180	28710	28245	27785	27330
57	32611	32103	31600	31104	30613	30127	29647	29172	28702	28238	27778	27323
58	32602	32094	31592	31095	30605	30119	29639	29164	28695	28230	27770	27315
59	32594	32086	31584	31087	30596	30111	29631	29156	28687	28222	27763	27308
60	32585	32077	31575	31079	30588	30103	29623	29148	28679	28214	27755	27300



TERNARY PROPORTIONAL LOGARITHMS

	98°	97°	98°	99°	100°	101°	102°	103°	104°	105°	106°	107°
0	27300	26850	26405	25964	25527	25095	24667	24244	23824	23408	22997	22589
1	27203	26843	26397	25956	25520	25088	24660	24237	23817	23401	22990	22582
2	27285	26835	26390	25949	25513	25081	24653	24229	23810	23395	22983	22575
3	27278	26828	26382	25944	25508	25074	24646	24222	23803	23388	22976	22569
4	27270	26820	26375	25934	25498	25066	24639	24215	23796	23381	22969	22562
5	27262	26813	26368	25927	25491	25059	24632	24208	23789	23374	22963	22555
6	27255	26805	26360	25920	25484	25052	24625	24201	23782	23367	22956	22548
7	27247	26798	26353	25913	25477	25045	24618	24194	23775	23360	22949	22542
8	27240	26790	26346	25905	25469	25038	24610	24187	23768	23353	22942	22535
9	27232	26783	26338	25898	25462	25031	24603	24180	23761	23346	22935	22528
10	27225	26776	26331	25891	25455	25024	24596	24173	23754	23339	22928	22521
11	27217	26768	26323	25883	25448	25016	24589	24166	23747	23332	22922	22515
12	27210	26761	26316	25876	25440	25009	24582	24159	23740	23326	22915	22508
13	27202	26753	26309	25869	25433	25002	24575	24152	23734	23319	22908	22501
14	27195	26746	26301	25861	25426	24995	24568	24145	23727	23312	22901	22494
15	27187	26738	26294	25854	25419	24988	24561	24138	23720	23305	22894	22488
16	27180	26731	26287	25847	25412	24981	24554	24131	23713	23298	22888	22481
17	27172	26723	26279	25840	25404	24973	24547	24124	23706	23291	22881	22474
18	27165	26716	26272	25832	25397	24966	24540	24117	23699	23284	22874	22467
19	27157	26709	26265	25825	25390	24959	24533	24110	23692	23278	22867	22461
20	27150	26701	26257	25818	25383	24952	24526	24103	23685	23271	22860	22454
21	27142	26694	26250	25810	25376	24945	24518	24096	23678	23264	22854	22447
22	27135	26686	26242	25803	25368	24938	24511	24089	23671	23257	22847	22440
23	27127	26679	26235	25796	25361	24931	24504	24082	23664	23250	22840	22434
24	27120	26671	26228	25789	25354	24923	24497	24075	23657	23243	22833	22427
25	27112	26664	26220	25781	25347	24916	24490	24068	23650	23236	22826	22420
26	27105	26656	26213	25774	25339	24909	24483	24061	23643	23229	22819	22413
27	27097	26649	26206	25767	25332	24902	24476	24054	23636	23222	22813	22407
28	27090	26642	26198	25759	25325	24895	24469	24047	23629	23216	22806	22400
29	27082	26634	26191	25752	25318	24888	24462	24040	23623	23209	22799	22393
30	27075	26627	26184	25745	25311	24881	24455	24033	23616	23202	22792	22386
31	27067	26619	26176	25738	25303	24874	24448	24026	23609	23195	22785	22380
32	27060	26612	26169	25730	25296	24866	24441	24019	23602	23188	22779	22373
33	27052	26605	26162	25723	25289	24859	24434	24012	23595	23181	22772	22366
34	27045	26597	26154	25716	25282	24852	24427	24005	23588	23175	22765	22359
35	27037	26590	26147	25709	25275	24845	24420	23998	23581	23168	22758	22353
36	27030	26582	26140	25701	25267	24838	24413	23991	23574	23161	22752	22346
37	27022	26575	26132	25694	25260	24831	24405	23984	23567	23154	22745	22339
38	27015	26567	26125	25687	25253	24824	24398	23977	23560	23147	22738	22333
39	27007	26560	26118	25680	25246	24817	24391	23970	23553	23140	22731	22326
40	27000	26553	26110	25672	25239	24809	24384	23963	23546	23133	22724	22319
41	26992	26545	26103	25665	25231	24802	24377	23956	23539	23127	22718	22312
42	26985	26538	26096	25658	25224	24795	24370	23949	23533	23120	22711	22306
43	26977	26530	26088	25650	25217	24788	24363	23942	23526	23113	22704	22299
44	26970	26523	26081	25643	25210	24781	24356	23935	23519	23106	22697	22292
45	26962	26516	26074	25636	25203	24774	24349	23928	23512	23099	22690	22286
46	26955	26508	26066	25629	25196	24767	24342	23921	23505	23092	22684	22279
47	26947	26501	26059	25621	25188	24760	24335	23914	23498	23086	22677	22272
48	26940	26493	26052	25614	25181	24752	24328	23908	23491	23079	22670	22265
49	26932	26486	26044	25607	25174	24745	24321	23901	23484	23072	22663	22259
50	26925	26479	26037	25600	25167	24738	24314	23894	23477	23065	22657	22252
51	26917	26471	26030	25592	25160	24731	24307	23887	23470	23058	22650	22245
52	26910	26464	26022	25585	25152	24724	24300	23880	23464	23051	22643	22239
53	26902	26456	26015	25578	25145	24717	24293	23873	23457	23044	22636	22232
54	26895	26449	26008	25571	25138	24710	24286	23866	23450	23038	22629	22225
55	26887	26442	26000	25563	25131	24703	24279	23859	23443	23031	22623	22218
56	26880	26434	25993	25556	25124	24696	24272	23852	23436	23024	22616	22212
57	26872	26427	25986	25549	25117	24689	24265	23845	23429	23017	22609	22205
58	26865	26419	25978	25542	25109	24681	24258	23838	23422	23010	22602	22198
59	26858	26412	25971	25534	25102	24674	24251	23831	23415	23004	22595	22192
60	26850	26405	25964	25527	25095	24667	24244	23824	23408	22997	22589	22185

TERNARY PROPORTIONAL LOGARITHMS

	108°	109°	110°	111°	112°	113°	114°	115°	116°	117°	118°	119°
0	22185	21785	21388	20995	20605	20219	19837	19457	19081	18709	18339	17973
1	22178	21778	21381	20988	20599	20213	19830	19451	19075	18702	18333	17966
2	22171	21771	21375	20982	20593	20207	19824	19445	19069	18696	18327	17960
3	22165	21765	21368	20975	20586	20200	19818	19439	19063	18690	18321	17954
4	22158	21758	21362	20969	20580	20194	19811	19432	19056	18684	18315	17948
5	22151	21751	21355	20962	20573	20187	19805	19426	19050	18678	18308	17942
6	22145	21745	21349	20956	20567	20181	19799	19420	19044	18672	18302	17936
7	22138	21738	21342	20949	20560	20175	19792	19413	19038	18665	18296	17930
8	22131	21731	21335	20943	20554	20168	19786	19407	19032	18659	18290	17924
9	22125	21725	21329	20936	20547	20162	19780	19401	19025	18653	18284	17918
10	22118	21718	21322	20930	20541	20155	19773	19395	19019	18647	18278	17912
11	22111	21711	21316	20923	20534	20149	19767	19388	19013	18641	18272	17906
12	22105	21705	21309	20917	20528	20143	19761	19382	19007	18634	18266	17900
13	22098	21698	21303	20910	20522	20136	19754	19376	19000	18628	18259	17894
14	22091	21691	21296	20904	20515	20130	19748	19369	18994	18622	18253	17887
15	22084	21685	21289	20897	20509	20123	19742	19363	18988	18616	18247	17881
16	22078	21678	21283	20891	20502	20117	19735	19357	18982	18610	18241	17875
17	22071	21672	21276	20884	20496	20111	19729	19351	18976	18604	18235	17869
18	22064	21665	21270	20878	20489	20104	19723	19344	18969	18597	18229	17863
19	22058	21659	21263	20871	20483	20098	19716	19338	18963	18591	18223	17857
20	22051	21652	21257	20865	20476	20091	19710	19332	18957	18585	18217	17851
21	22044	21645	21250	20858	20470	20085	19704	19325	18951	18579	18210	17845
22	22038	21639	21243	20852	20464	20079	19697	19319	18944	18573	18204	17839
23	22031	21632	21237	20845	20457	20072	19691	19313	18938	18567	18198	17833
24	22024	21626	21230	20839	20451	20066	19685	19307	18932	18560	18192	17827
25	22018	21619	21224	20832	20444	20060	19678	19300	18926	18554	18186	17821
26	22011	21612	21217	20826	20438	20053	19672	19294	18920	18548	18180	17815
27	22004	21606	21211	20819	20431	20047	19666	19288	18913	18542	18174	17809
28	21998	21599	21204	20813	20425	20040	19659	19282	18907	18536	18168	17803
29	21991	21592	21198	20806	20418	20034	19653	19275	18901	18530	18162	17797
30	21984	21586	21191	20800	20412	20028	19647	19269	18895	18523	18155	17790
31	21978	21579	21184	20793	20406	20021	19640	19263	18888	18517	18149	17784
32	21971	21573	21178	20787	20399	20015	19634	19257	18882	18511	18143	17778
33	21964	21566	21171	20780	20393	20009	19628	19250	18876	18505	18137	17772
34	21958	21559	21165	20774	20380	20002	19621	19244	18870	18499	18131	17766
35	21951	21553	21158	20767	20380	19996	19615	19238	18864	18493	18125	17760
36	21944	21546	21152	20761	20373	19989	19609	19231	18857	18487	18119	17754
37	21938	21540	21145	20754	20367	19983	19602	19225	18851	18480	18113	17748
38	21931	21533	21139	20748	20361	19977	19596	19219	18845	18474	18107	17742
39	21924	21526	21132	20741	20354	19970	19590	19213	18839	18468	18100	17736
40	21918	21520	21126	20735	20348	19964	19584	19206	18833	18462	18094	17730
41	21911	21513	21119	20728	20341	19958	19577	19200	18826	18456	18088	17724
42	21904	21507	21112	20722	20335	19951	19571	19194	18820	18450	18082	17718
43	21898	21500	21106	20715	20328	19945	19565	19188	18814	18443	18076	17712
44	21891	21493	21099	20709	20322	19938	19558	19181	18808	18437	18070	17706
45	21884	21487	21093	20702	20316	19932	19552	19175	18802	18431	18064	17700
46	21878	21480	21086	20696	20309	19926	19546	19169	18795	18425	18058	17694
47	21871	21474	21080	20690	20303	19919	19539	19163	18789	18419	18052	17688
48	21864	21467	21073	20683	20296	19913	19533	19156	18783	18413	18046	17682
49	21858	21460	21067	20676	20290	19907	19527	19150	18777	18407	18040	17676
50	21851	21454	21060	20670	20284	19900	19520	19144	18771	18400	18033	17669
51	21844	21447	21054	20664	20277	19894	19514	19138	18764	18394	18027	17663
52	21838	21441	21047	20657	20271	19888	19508	19131	18758	18388	18021	17657
53	21831	21434	21041	20651	20264	19881	19502	19125	18752	18382	18015	17651
54	21824	21427	21034	20644	20258	19875	19495	19119	18746	18376	18009	17645
55	21818	21421	21028	20638	20251	19869	19489	19113	18740	18370	18003	17639
56	21811	21414	21021	20631	20245	19862	19483	19106	18733	18364	17997	17633
57	21805	21408	21015	20625	20239	19856	19476	19100	18727	18357	17991	17627
58	21798	21401	21008	20618	20232	19849	19470	19094	18721	18351	17985	17621
59	21791	21395	21001	20612	20226	19843	19464	19088	18715	18345	17979	17615
60	21785	21388	20995	20605	20219	19837	19457	19081	18709	18339	17973	17609



TERNARY PROPORTIONAL LOGARITHMS

	120°	121°	122°	123°	124°	125°	126°	127°	128°	129°	130°	131°
0	17609	17249	16891	16537	16185	15836	15490	15147	14806	14468	14133	13800
1	17603	17243	16885	16531	16179	15830	15484	15141	14801	14463	14127	13795
2	17597	17237	16879	16525	16173	15825	15479	15135	14795	14457	14121	13789
3	17591	17231	16873	16519	16168	15819	15473	15129	14789	14451	14115	13784
4	17585	17225	16868	16513	16162	15813	15467	15123	14784	14446	14111	13778
5	17579	17219	16862	16507	16156	15807	15461	15118	14778	14440	14105	13773
6	17573	17213	16856	16501	16150	15802	15456	15113	14772	14435	14100	13767
7	17567	17207	16850	16496	16144	15796	15450	15107	14767	14429	14094	13761
8	17561	17201	16844	16490	16138	15790	15444	15101	14761	14423	14088	13756
9	17555	17195	16838	16484	16133	15784	15439	15096	14755	14418	14083	13750
10	17549	17189	16832	16478	16127	15778	15433	15090	14750	14412	14077	13745
11	17543	17183	16826	16472	16121	15773	15427	15084	14744	14407	14072	13739
12	17537	17177	16820	16466	16115	15767	15421	15079	14738	14401	14066	13734
13	17531	17171	16814	16460	16109	15761	15416	15073	14733	14395	14061	13728
14	17525	17165	16808	16454	16103	15755	15410	15067	14727	14390	14055	13723
15	17519	17159	16802	16449	16098	15749	15404	15061	14722	14384	14049	13717
16	17513	17153	16796	16443	16092	15744	15398	15056	14716	14379	14044	13712
17	17507	17147	16791	16437	16086	15738	15393	15050	14710	14373	14038	13706
18	17501	17141	16785	16431	16080	15732	15387	15044	14705	14367	14033	13701
19	17495	17135	16779	16425	16074	15726	15381	15039	14699	14362	14027	13695
20	17489	17129	16773	16419	16068	15721	15375	15033	14693	14356	14022	13690
21	17483	17123	16767	16413	16063	15715	15370	15027	14688	14351	14016	13684
22	17477	17117	16761	16407	16057	15709	15364	15022	14682	14345	14011	13679
23	17471	17111	16755	16402	16051	15703	15358	15016	14676	14339	14005	13673
24	17465	17105	16749	16396	16045	15697	15353	15010	14671	14334	14000	13668
25	17459	17099	16743	16390	16039	15692	15347	15005	14665	14328	13994	13662
26	17453	17093	16737	16384	16034	15686	15341	14999	14659	14323	13988	13657
27	17447	17087	16731	16378	16028	15680	15335	14993	14654	14317	13983	13651
28	17441	17082	16725	16372	16022	15674	15330	14988	14648	14311	13977	13646
29	17435	17076	16720	16366	16016	15668	15324	14982	14643	14306	13972	13640
30	17429	17070	16714	16361	16010	15663	15318	14976	14637	14300	13966	13635
31	17423	17064	16708	16355	16005	15657	15312	14971	14631	14295	13961	13629
32	17417	17058	16702	16349	15999	15651	15307	14965	14626	14289	13955	13624
33	17411	17052	16696	16343	15993	15646	15301	14959	14620	14284	13950	13618
34	17405	17046	16690	16337	15987	15640	15295	14954	14614	14278	13944	13613
35	17399	17040	16684	16331	15981	15634	15290	14948	14609	14272	13938	13607
36	17393	17034	16678	16325	15975	15628	15284	14942	14603	14267	13933	13602
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